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CONTENTS	PAGE
Pal MOLNAR , Tibor MAROSI, Jozsef GAL, Antal VEHA <i>PATH TO BUSINESS EXCELLENCE: INNOVATION AND QUALITY</i>	5.
Otepká PAVOL, Ivan ĎUĎÁK , Slavka TÓTHOVÁ <i>USE OF WOOD ASH FOR FERTILIZING THE PLANTATION OF FAST-GROWING WOODY PLANTS – BASKET WILLOW (SALIX VIMINALIS L.)</i>	14.
Istvan PETER SZABO, Antal VEHA, Gabor SZABO <i>RESEARCH AND EDUCATION OF THE APPLICATION OF RENEWABLE RESOURCES AT THE FACULTY OF ENGINEERING UNIVERSITY OF SZEGED</i>	19.
Victoria PETROESC, Roland Iosif MORARU <i>INDUSTRIAL POLLUTION AND CONTROL MEASURES IN ROMANIAN FOUNDRIES</i>	26.
Adriana PUŢAN, HepuŢ TEODOR, PuŢan VASILLE <i>RESEARCH ON DESULPHURIZATION OF STEEL WITH CALCIUM ALUMINATE SYNTHETIC SLAG WITH ADDITION OF TITANIUM OXIDE</i>	36.
Vesna RAFAJLOVSKA, Snežana SINADINOVIĆ-FIŠER, Olga BOROTA, Marija SRBINOSKA <i>CHARACTERIZATION AND EXTRACTION OF MARIGOLD (Calendula officinalis L.) CULTIVATED IN THE REPUBLIC OF MACEDONIA</i>	45.
László SALLAI <i>COFERMENTATION OF ORGANIC WASTE OF THE PILOT FARM OF SZTE MGK</i>	50.
József SÁROSI, Roland ELEK <i>IMPORTING AND ANALYSING LIVE ELECTROENCEPHALOGRAPH DATA IN MATLAB/SIMULINK ENVIRONMENT</i>	57.
Sorina ŞERBAN, George SAVII <i>EDUCATIONAL SOFTWARE USED IN CHEMISTRY FOR DETERMINING CHEMICAL COMPOSITION/MOLECULAR WEIGHT CHEMICALS</i>	63.
Sándor SIPOS <i>THE NUTRITION SITUATION AND THE FOOD SAFETY CHALLENGES OF THE 21th. CENTURY</i>	69.
Péter SIPOS, Zoltán GYŐRI <i>EVALUATION OF FOOD ADDITIVES ON THE RHEOLOGIC PROPERTIES OF WINTER WHEAT FLOURS</i>	74.
Balázs P. SZABÓ <i>CONNECTIONS BETWEEN THE MECHANICAL PROPERTIES OF WHEAT</i>	80.
Viktória SZŰCS, Diána BÁNÁTI <i>RISK PERCEPTION OF FOOD ADDITIVES IN HUNGARY</i>	85.
Slavici TITUS, Mnerie DUMITRU <i>AGRI-FOOD BUSINESS OPTIMIZATION USING ARTIFICIAL INTELLIGENCE METHODS</i>	91.
P. TOMAN, J. GYEVIKI, A. VÉHA <i>POSITION CONTROL OF PNEUMATIC ACTUATORS WITH PLC</i>	97.

Éva TÓTH-KMOSKÓ <i>THE ROLE OF FOREIGN CAPITAL AND MULTINATIONAL COMPANIES AND THEIR EFFECT ON ECONOMY IN HUNGARY</i>	107.
Anikó TŰRKÖSSY <i>NEEDED ACTIONS IN BUSINESS LIFE ON PREVENTION OF MONEY LAUNDERING AND TERRORISM</i>	116.
János VARGA, Sándor KOCSUBÉ, Katalin SURI, Gyöngyi SZIGETI, Tibor BARTÓK, Beáta TÓTH <i>MYCOBIOTA AND FUMONISIN CONTAMINATION IN DRIED FRUITS OF DIFFERENT ORIGIN</i>	120.
László VARGA <i>NEWER INVESTIGATIONS ON THE APPLICATION OF PHYSICAL METHODS IN THE FOODSTUFFS' QUALIFICATION</i>	126.
Antal VEHA, Balázs P. SZABÓ, Ernő GYIMES <i>PERITEC TECHNOLOGY TO REDUCE FUSARIUM TOXIN CONTAMINATION IN THE MILLING TECHNOLOGY</i>	131.
Adriana VESELÁ, František KUZMA <i>MULTIFUNCTIONAL UTILIZATION OF AGRICULTURAL LAND FOR BIONERGY PRODUCTION IN CONTEXT OF ECONOMY'S FOOD SATISFACTION LEVEL</i>	137.

PATH TO BUSINESS EXCELLENCE: INNOVATION AND QUALITY

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ABSTRACT

In the competitive global market quality, costs and productivity are particularly important indicators for the corporate management. Quality is prioritised due to the reason that this is one of the major competitive advantages. Economic growth is only possible when innovations constantly surface, and that the market adopts. A company can hardly survive without innovations that produce profit. Anyone who undertakes the path to excellence should be in front, has to overtake others, must achieve a leap forward. To be in front means to be better, more effective, more efficient, more economic, more ecologically aware or more social and proactive than others. The direction and speed of change are important. One can only reach the top through major changes, through major innovations including evaluation phases and continuous improvement. The present situation is discussed in details as lesson learned in the past and as quality vision of the future.

1. INTRODUCTION

For quality managers and quality experts as well as for general managers who are involved in quality matters the question for the future of their job, their profession, their business, their company or the whole society concern the importance of quality for the future world. Quality is mostly prioritised in business management due to the reason that this is one of the major competitive advantages. However, the aspect of quality as a competitive advantage is changing especially after the economic crisis. To overcome the problems including the 2008 economic crisis and the global climate change and to built up social, economic and environmental responsibility in all areas, the need for not only creating breakthrough levels of productivity improvement but also assessing productivity from different perspectives has been understood clearly.

2. MATERIAL AND METHOD

On the competitive global market quality, costs and productivity are particularly important indicators for corporate management perspective to keep improving and maintaining quality, but also production volume, delivery performance, and productivity as well as costs. Economic growth is only possible when innovations periodically surface, and that the market adopts. A company can hardly survive without innovations that produce profit. Anyone who undertakes the path to excellence should be in front, has to overtake others, must achieve a leap forward. To be in front means to be better, more effective, more efficient, more economic, more ecologically aware or more social and proactive than others. The direction and speed of change are important. One can only reach the top thorough major changes, through major innovations.

The driving forces behind the management challenges for the new decade seem to be the followings:

- Globalization
- Worldwide competition
- Innovation as a key process
- Changing working conditions through communication technologies
- International networking
- Decreasing number of workers in production businesses
- Increasing number in new businesses
- New forms of work
- Changing public sector through privatisation and New Public Management, incl. quality management.

3. LESSONS LEARNED IN THE PAST

Total Quality and continuous improvement are synonymous. One of the best works on this topic is "Kaizen, the Key to Japan's Competitive Success" by Massaki /1/. He presented a model linking innovation to continuous improvement, stating that in the West too much emphasis is placed on innovation.

Improvement can be broken down between KAIZEN and innovation. KAIZEN signifies small improvements made in the status quo as a result of ongoing efforts. Innovation involves a drastic improvement in the status quo as a result of a large investment in new technology and/or equipment.

Lesson learned No. 1.: Traditional continuous improvement is considered to be too slow for the present competitive environment.

On the other side we can't continuously work on Business Process Redesign (BPA) or make innovations systems require a minimum stabilisation period. However, during that period we must continuously improve and use KAIZEN.

4. LESSONS LEARNED IN THE 90TH

Which was the dominating success factor of the tension triangle? It was the time. Winners were companies, which were faster in product, and service development, which could offer services quicker, whose delivery time was shorter. Winner was the quickest, not the best and not the cheapest. Time constraints produced quality improvements and cost reductions but the opposite happened much more seldom. Quality of products and services was a must: No defects, no failures, and expected benefits for the user.

Lesson learned No.2: A consistent quality level of products and service is absolutely necessary for the global business of European enterprises. This level must be sustainable and directed towards the expectations of the users.

The hierarchy of quality formed the basis for the EFQM model. It shows the dependence of the consistency and sustainability of product and service quality from the quality of the processes and the quality of the enterprise that means of the quality management system of the

enterprise. In the last decade quality management systems became a must for all type of organisations. They are often based on the models of ISO 9000 standard series.

Lesson learned No.3: The integration of quality management into Business Administration is essential for the global economy.

Through the introduction of quality management the economic weight of the quality discipline increased essentially compared with the former situation of quality control and quality assurance. Already, the still isolated partial management models of ISO 9000:1987 and: 1994 made a big progress. But the real breakthrough came with the integration of quality management into management theory and business administration. With the book "Integriertes Qualitätsmanagement – das St.Galler Konzept" of Seghezzi prepared the path /2/.

The success of the Japanese companies with Total Quality Control stimulated American leaders in the eighties and European leaders in the nineties to develop instruments for reaching excellence in global business. The reasons for founding the EFQM was the lack of innovative concepts of business schools which stimulated the CEO's of fourteen European large companies to give the signal for a European concept of TQM, later named Excellence. It fills a gap in general management and presents a generic management model suitable for the incorporation of all management duties. TQM is a Trojan horse through which new management concepts gain access to the economic environment.

The growth period of the nineties had its absolute peak in 2000 with highest rates of turnover, share values, profits and brightest forecasts. The year 2000 was the year of the economic party. What followed was the economic hangover in 2001.

5. BREAK IN 2001 AND THE NEXT STEPS

The whole economy suffered from a dramatic fall-down in 2001. Hit were especially high-tech branches like telecommunication. For survival companies had to reduce costs. In most cases this meant lay-off of personal and selling of peripheral businesses. In most cases those businesses were profitable. Laying-off personal in a ethical way became an innovative task. Most companies realize that cost reduction alone is not enough. They consider quantity management as a new success factor and include it in their tension diagram. It contains flexibility in quantity, decrease of volumes with low retention costs, outsourcing of peripheral activities, concentrating on key capabilities.

6. EXTENDED EFFORTS AFTER THE 2008 ECONOMIC CRISIS

The global economic crisis is having a broad impact across many sectors. Most notable is the crisis in financial institutions and markets as well as on both developed and developing economies. In addition commodity and service markets have been impacted and there are serious implications the crisis has for the global economy including the quality development and its participants. Opportunities for product and service need to be identified and taken advantage. Sustainable and quality oriented production methods, including those of suppliers, need to be developed. The companies must use their capital resource efficiently and tailor their products to meet changing consumer demand and seek out strategic alliances. Lastly, human capital will be at a premium and programs and strategies need to put in place that develop

human capitals as well as inform, educate, and provide overall quality oriented direction and trust.

7. INNOVATION – PATH TO EXCELLENCE

As a result of extensive research, it is undisputed that economic growth is only possible when innovations constantly surface, and that the market adopts. A company can hardly survive without innovations that produce profit.

We know three innovation strategies.

In the cost conscious firm, profit margins are low and rival competition is fierce. These firms are forced to cut costs to stay competitive, and there is a minimal focus on innovation.

A firm making product and service quality a high priority, the quality oriented firm, enjoys a competitive advantage – until rivals introduce a new product or service. Quality of the obsolete product or services then becomes a moot point.

The innovative firm is focused on developing new value added products and services. New products or services give the innovative firm a competitive advantage over its competitors. Quality and cost control programs then sustain this competitive advantage.

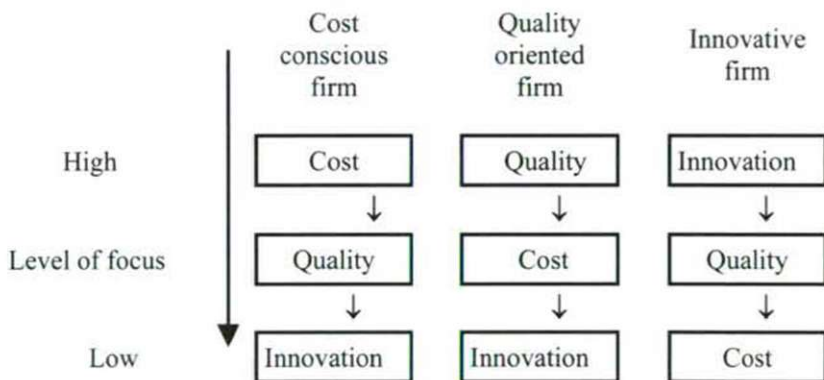


Fig. 1: Three Approaches to Innovation

8. INNOVATION IS A KEY SUCCESS FACTOR FOR BUSINESS EXCELLENCE

On the path to business excellence, models like the EFQM or the new ISO 9004 can be helpful, but are no guarantee of success. To select the right model, one must understand that there are, in fact, two kinds of models, i.e. the so-called 'better and better' models and the 'good enough' models. Only the first help supports changes in the direction of business excellence. The efforts must come from one's own inner drive, led by company management, and adopted by as many staff members as possible.

Intermediate goals such as the five steps proposed by the EFQM can support perseverance, and lead to new impulses. But it has to be understood by all that after achievement of an

intermediate goal, the journey has to continue, or one will be overtaken. One never reaches the final goal.

In order to avoid false expectations from the implementation of models, it should be understood that the 'good enough' model does serve another purpose. Models like ISO 9001 or 14001 set minimum standards. Companies that satisfy or exceed these requirements can be certified. Models of this kind form the basis for legal regulations or contractual agreements and create trust in the capability of certified organisations.

When the existing state of the innovation process is known, phased-in approach of the new quality tools can then be completed over time. A good place for introduction of the new tools might be at the interdepartmental meetings that occur during the innovation process.

Table 1: The Seven New Quality Tools and the Innovation

Degree of Complexity	New Tool	Useful Area
Low 1	Affinity diagram	Brainstorming, consensus
2	Relations diagram	Cause and effect
3	Tree	Logic based problem solving
4	Process decision program chart	Identifying best solution
5	Arrow	Resource planning
6	Matrix	Determining interrelated factors
High 7	Matrix data analysis	Quantitative analysis

9. SUCCESS FACTORS FOR INNOVATION

In view of the significance of innovations towards the achievement of excellence followings are the most important factors for successful innovations.

Success factor 1: People

In the case of all winners of the European and National Quality Award competitions, as well as in many other companies, people with their knowledge, know-how and creativity are the most important factor. However, it is also necessary, that they be committed to active changes. People must want changes and not persist in existing situations.

Success factor 2: Leadership

Creative people who welcome change are convinced of their ideas and are often individualists who do not care for work in project teams.

Thus leadership becomes all the more important as the second success factor. This does not refer only to motivation and guidance of staff, but also the selection of the best solution among several propositions. Equally important are timely decisions in the innovation process, which can only be made correctly in line with a correspondingly broad vision competence of management and operational expertise. In many companies selection and decision-making are protracted; this can be avoided by developing pressure.

Success factor 3: Culture of innovation

Concerning a company culture this is apparent through communication, transparency, failure tolerance, willingness to take risks and for ongoing learning, wanting to change, and an environment that calls forth enthusiasm, fun and happiness in the work.

Such a climate can be seriously damaged through unwillingness to take risks and petty implementation of risk management. Those who want to avoid risks must stand clear of innovations, as innovations without failures are not possible. Instead of avoiding risks, failures may be dominated by recognising and bypassing them, not repeating them, and learning from them.

Success factor 4: Company strategy

The strategy must establish guardrails between which the innovation process runs. If such guardrails are not in place, then the company with an applied culture of innovation may quickly fall into chaos. The strategy must also push desired changes for cultural development. It has to optimise the interplay between steps of large and small changes (Fig 2). Too many small steps, as is frequently the case in the implementation of the EFQM model, indeed obtain the commitment of the staff but fail to solve larger problems. Too many large steps at too fast a cadence lead to turbulence, chaos and inner resignation of the overtaxed staff.

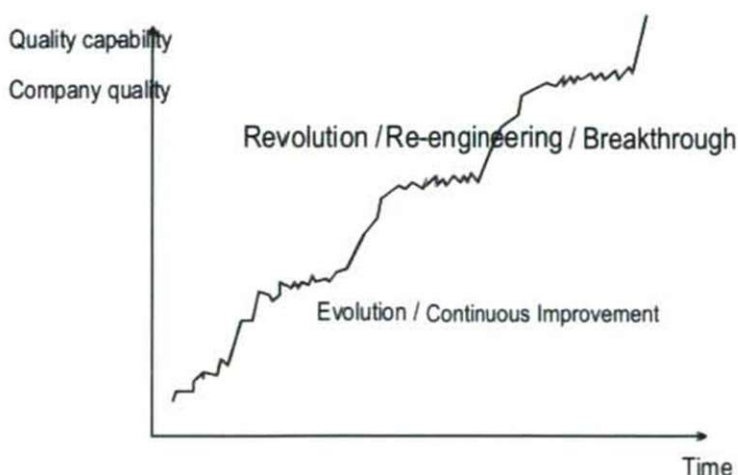


Fig. 2: Change through large jumps and small steps

Success factor 5: Organisation

As the final factor, organisation should be mentioned. Frequently, the false opinion prevails that innovation requires creativity above all. The truth is that every innovation process consists of interplay between creative and repetitive phases. In particular, at the beginning, in the creative part, concepts are outlined, ideas gathered and evaluated, various solutions developed and tested for their feasibility. The repetitive part covers the carrying out of examinations and tests, the conversion of solutions and their practical implementation. The significance and the cost of the creative work are usually over-valued. In my opinion, the ratio is 20 to 80 with the focal point in the repetitive part (20% inspiration, 80% transpiration).

The innovation process can take very different forms depending on the company size, branch, environment and complexity of the innovation process. The form adopted may go from a much personalised pragmatic management using check lists, up to the formation of a large project team.

It is also important in the formation of the organisation to pay attention to the use of sources of innovation. On the one hand, sources are ideas and inventions, on the other, technological possibilities, and finally the requirements of customers, partners and society. Sufficient sources are available to be tapped or developed through benchmarking and research.

10. RESULTS AND CONCLUSIONS

It is difficult to make a forecast, even after a thorough analysis of facts and drivers, but following answers are possible:

1) Quality management will be highly effective if it handles quality in relation with costs, quantity and time (Fig. 3) and if it is completely integrated in general management. That means to apply a concept of Integrated Quality Management.

2) Best practices in innovation

Innovation research so far has uncovered two types of best practice, one directed to effectiveness in “doing the right projects” and the other directed to efficiency in “doing the right projects right”. An overview of best practices as revealed by different studies is following:

- Clear product definition
- A structured R&D process
- Use of cross-functional project teams
- Use of integrated virtual development tools

3) What about models like ISO 9000, EFQM, Balanced Score Card, 6 Sigma etc.?

We have to differentiate. Models of the type, which support the managing of product, service and process quality, will flourish. This is the group of models where ISO 9001 and 6 Sigma belongs.

- What about certification of quality management systems? Certificates must be reliable. No ‘cheep’ certificates. The number of competing certifiers is increasing constantly. Certifying has become a business. Due to the competition between the certifying organizations the quality of certificates could decrease. This reduces the reliability of the certificates and destroys their real value. Certifiers can kill their own business.

- Certificates need recognition otherwise they lose any value. To avoid the destruction of certificates in an open market of certification it is necessary to have some formal regulation, generally named accreditation schemes.

4) What about Excellence Models? As already mentioned they were very successful in the last decade because of two reasons, the threat of the Japanese Quality Offensive and the gap of models from business schools. Both reasons are no longer valid. The Japanese companies have lost their dominating power. And the business schools and large consulting firms have regained their former position. They come up with new concepts in Strategic Management, with Balanced Score Cards etc.. So, excellence models are now under competition and pressure. To survive they need further development.

- For example the EFQM Excellence Model. It is a valuable instrument but expensive to apply. A study from 2002 and 2003 showed that for many companies, the results are lower than expected, the model is not integrated in general management and the Self Assessment by EFQM model is too complex.
- The integration of partial management systems into Integrated System the partial management systems are isolated with conflicts in the contents, with duplications of activities, using different terms. To improve their effectiveness and efficiency they should not remain as standalones. It is generally accepted that partial management systems should be coordinated and if possible incorporated into a generic system. In practice, the integration is restricted to quality, environment, OHS and risk management. Besides quality management these disciplines are highly regulated and bureaucratic. This is a disadvantage for quality systems.
- The new ISO 9004 is a model for an ongoing journey to improve quality management systems starting with the minimum level of ISO 9001. It is dedicated to the organization itself and not for the outside world. This model is the offer of ISO to the industry to build up effective and efficient quality management systems. For many companies this model would offer an appropriate path for continuous improvement of their system. Only a smaller amount of companies was interested in this tool for management improvement towards excellence.



Fig. 3: Forecast for Quality Management and Business Excellence

So, excellence models are models for general management. For those models, which have their origin in TQM, further development is necessary. We even foresee (Fig. 3) a separation between Integrated Quality Management on the one side and the excellence programmes on the side of General Management. Then, quality management can keep its economic weight as a young part of Business Administration whereas excellence concepts can gain even more value within general management.

Anyone who undertakes the path to excellence should be in front, has to overtake others, must achieve a leap forward. To be in front means to be better, more effective, more efficient, more economic, more ecologically aware or more social and proactive than others. The direction and speed of change are important. One can only reach the top through major changes, through major innovations. One has to recognise that never actually reaches the goal, but is always on the way to achieving it.

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USE OF WOOD ASH FOR FERTILIZING THE PLANTATION OF FAST-GROWING WOODY PLANTS – BASKET WILLOW (SALIX VIMINALIS L.)

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ABSTRACT

Energetic utilization of wood biomass obtained from fast-growing woody plants nowadays records more important capability. The article discusses the issue of research using wood ash as solid waste from the boiler while burning biomass and the intensification of short-rotation coppice basket willow – common osier (*Salix viminalis* L.) for energy use as a renewable energy source. Purpose of the article is to show the importance of basket willow (*Salix viminalis* L.) as short-rotation coppice with the emphasis of its production and remedial effects.

Key words: renewable energy resources (carriers), biomass, short-rotation trees, basket willow, common osier (*Salix viminalis* L.), wood ash

1. INTRODUCTION

The issue of renewable energy resources is still current, especially in times when oil crisis and negative consequences of global climate change are appearing in the human society. One of these sources is the biomass. It fulfills majority of benefits from all spectrum of renewable energy resources (Húska et al., 2000; Niňaj – Húska, 2005). In the spring of 1994, experiments to prove the possibility for cultivation of fast-growing varieties of basket willow – common osier (*Salix viminalis* L.) were carried out in Krivá research centre, located in the Orava region of the Slovak Republic. For this purpose, three varieties of willow bred at the Research Institute of Agriculture in Swale (Sweden), were used: ULV, ORM and RAPP (Habovštiak – Daniel, 2001). The same varieties are tested in the conditions of warm agro-climatic region in Dolná Malanta, Nitra, Slovakia. They have been grown here continuously since 1996. Experiments are established on Experimental Base of the Slovak University of Agriculture in Nitra, Slovak Republic (Otepka – Habán, 2006).

By the cultivation of fast growing coppice with short rotation period, the nutrients for growing plants are taking off intensively, reducing their storages in the soil. Partial compensation might be mineral multicomponent fertilization, for which wood ash with the content of wide spectrum of macro and microelements can fit well. Specific problem is that this type of solid waste generated in the boilers does not contain nitrogen, which had been released into the air after the biomass was burned. The project, supported by the Slovak Research and Development Agency is carried out by cooperation between Intech Slovakia, Ltd. and Slovak University of Agriculture in Nitra.

2. MATERIAL AND METHODS

Methodology of the experiment with wood species basket willow – common osier (*Salix viminalis* L.) has a long-term design (25 years). Stand was established by planting in the spring of 1996 (19th April). Planting material was originated from Swedish breeding (Swale); source was in Research Centre Krivá in the Orava region, the Slovak Republic (VÚTPaHP). Planted cuttings were done in length 0.20 m; thickness from 10 to 20 mm. Forecrop was *Amaranthus* sp. Soil preparation was done by plowing to the depth of 30 cm, dragging, harrowing. Planting method: manually by hand. Treatment during the vegetation period is aimed to regulation of harmful factors (weeds, pests and diseases) and to maintain the status and condition of the crop stand.

Total cultivation area is approximately 648 m²; area of individual plots (variants) is 108 m²; total number of tested plots is 6; identification of plots: ORM/A, ORM/B, ULV/A, ULV/B, RAPP/A RAPP/B. Cultivated varieties: ORM, ULV, RAPP. Design of experiment: A – Double row planting with row distance = 0.5 m, alternated 1.25 m and 0.75 m between rows, B – plant spacing 0.5 x 0.75 m. The article includes results from a third four-year harvesting period of willow in the presented locality (2004 – 2007). In this plantation, the crop biomass forecasting of willow is based on mathematical-statistical model, published by Špánik and Čimo (2009). Wood ash was applied in the autumn period (October 2009) and in the spring period (March 2010) in doses of 1.0, 3.0 and 5.0 t.ha⁻¹, while the control area was left without application of wood ash. Size of each area is: 2 x 162 m², i.e. 324 m².

3. RESULTS AND DISCUSSION

Number of individual willow plants (*Salix viminalis* L.) per unit area depends on the plant spacing of 2.00 individual plants per m² (planting space A) or 2.67 individual plants per m² (planting space B). According to Šimala – Habovštiak (1995), well-managed willow grows in the first year up to the height of 2.0 – 3.0 m and after the fourth year cultivation; the crop is 7.0 m high. Individual crops with height of 7.0 m can be harvested. From this finding it is difficult to conclude whether the authors considered these data also in assessing of the third harvest period, but for the comparison of results we indicate, that one year after the second harvest, the indicated height of all three varieties was not reached: ORM (1.70 m), ULV (1.77 m) and also variety RAPP (1.45 m, see Table 1) was below the height of 2.00 m. Better average height of rods was always reached at the plant spacing B, i.e. the one where denser planting was applied. In subsequent years, the height of the vegetation ranged from 1.95 m (variety, RAPP/A, in the 10th year after planting) to 4.27 m (variety ULV/B, in the 12th year after planting), and as it can be seen in Table 1 in neither of cases, the height reached 7.0 m. This we attribute to the impact of harmful agents, soil characteristics of the experimental unit as well as to the weather conditions during the period of observation. When observing an average rod thickness, the values were measured according to the forestry parameters i.e. at a level of 1.3 m above the soil surface. Based on observations in the second harvest period, in this parameter we reached relatively low values, since in neither of case the value got over 20 mm. For ULV variety grown in the plant spacing B, the highest average rod thickness observed was 18.2 mm.

Habovštiak – Daniel (2001) indicate that in the production year an average yield of 12.0 to 15.0 t.ha⁻¹ dry matter is probable. With this statement we can only agree with ULV variety, since its yield was higher than 12.0 t of dry matter.ha⁻¹.yr⁻¹ (plant spacing A: 12.46 t.ha⁻¹.yr⁻¹ and plant spacing B: 13.80 t.ha⁻¹.yr⁻¹).

Table 1. Measured parameters of basket willow – common osier (*Salix viminalis L.*) during four-year period (2004 – 2007)

Variety / Arrangement		ORM/A	ORM/B	ULV/A	ULV/B	RAPP/A	RAPP/B
Parameters							
Number of plants.m ⁻²		2.00	2.67	2.00	2.67	2.00	2.67
Average branch length (m)	9 th year	1.45	1.95	1.67	1.87	1.42	1.47
	10 th year	2.58	2.58	2.74	3.04	1.95	1.89
	11 th year	3.18	3.25	3.24	3.68	2.58	2.83
	12 th year	4.12	3.90	4.18	4.27	3.62	3.34
Average branch width (mm)	9 th year	8.5	10.8	9.5	9.3	8.1	7.6
	10 th year	10.7	13.4	11.0	12.4	10.2	9.8
	11 th year	12.8	15.7	13.8	15.4	12.5	12.1
	12 th year	13.7	17.6	16.6	18.2	14.0	13.2
Average weight of one branch after drying up (g)	9 th year	286	350	450	420	134	85
	10 th year	1050	960	1120	1090	460	385
	11 th year	2002	1680	1972	1851	820	765
	12 th year	2480	1940	2680	2490	1038	990
Weight of sample in dry matter (g)	9 th year	2860	3500	4500	4200	1340	850
	10 th year	10500	9600	11200	10900	4600	3850
	11 th year	20020	16800	19720	18510	8200	7650
	12 th year	24800	19400	26800	24900	10380	9900
Dry matter yield (t.ha ⁻¹)	9 th year	6.20	8.50	5.90	7.60	2.90	5.52
	10 th year	19.35	22.80	18.55	20.30	5.20	12.40
	11 th year	36.20	32.10	38.50	34.40	10.15	22.65
	12 th year	44.23	38.30	49.85	55.20	16.70	31.80

Wood ash obtained from a bottom area of the boiler after burning of biomass originated from the burning of clean and chemically untreated wood from the thermal CHP power plant in Hriňová. Content of hazardous elements in the applied wood ash (As, Cd, Cr, Hg, Pb) was lower than limit values of risk mineral elements of calcium and magnesium-calcium fertilizer under the Ministry of Agriculture Regulation from 15.12.2000, stipulating the types of fertilizers, the content of risk elements, conditions of sampling and methods for testing fertilizers, Coll. of Laws 26/2001, Supplement No. 2., content and other elements considered to be risky in the raw material for compost (Cu, Mo, Ni, Zn) was lower than the limit values of risk elements in raw materials for composting, according to STN 46 5735 "Industrial composts". Wood ash contained 11.5% calcium, 4% potassium and 1.4% magnesium.

4. CONCLUSION

Fast growing basket willow – common osier (*Salix viminalis* L.) has been grown on experimental base in Dolná Malanta, Nitra, Slovakia since 1996. In 12 years of its cultivation, the crop has been retained in a condition suitable for energetic, but also for therapeutic purposes and creates conditions for further observation and assessment in future. By experiment, the influence of factors on above-ground biomass production was studied: variety (ORM, RAPP, ULV), design of crop organization (method A – double rows = 0.5 m × 0.75 m or 1.25 m; method B = 0.5 m × 0.75 m) and the impact of crop years (2004 – 2007). From dried and weighted samples of plant rods following conclusions can be drawn. In the 12th year of cultivation, the height of vegetation ranged from 3.34 m (RAPP/B) to 4.27 m (ULV/B). The highest average height of vegetation was in variety ULV 4.23 m, followed by ORM 4.01 m and the lowest height was recorded in a variety RAPP 3.48 m. The average thickness of plant rods ranged from 13.2 mm RAPP/B to 18.2 mm ULV/B. Yield of the third harvest period measured in dry matter varied in significantly wide range: from 16.7 (RAPP/A) to 55.2 t.ha⁻¹ (ULV/B). Based on measured and calculated data the varieties of willow can be ordered according to their suitability for the conditions of southern Slovakia as follows: 1. ULV (52.5 t.ha⁻¹); 2. ORM (41.3 t.ha⁻¹); 3. RAPP (24.3 t.ha⁻¹). In terms of planting organization, better results were achieved in planting space B (41.8 t.ha⁻¹) than in planting space A (36.9 t.ha⁻¹).

The result of the project "Efficiency of fertilization potential of wood-ash for energy plants cultivation as renewable energy resources (Ash as fertilizer)" will be the determination of an appropriate procedure in application of wood ash for the intensification of energetic plants cultivation. Since, in accordance with the Slovak Republic legislation, it is allowed to use wood ash only for the scientific purposes, we assume that the results obtained in this project will be applied in the modification of legislative framework to enable the use of wood ash for applying nutrients in energetic plants cultivation.

ACKNOWLEDGEMENT

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RESEARCH AND EDUCATION OF THE APPLICATION OF RENEWABLE RESOURCES AT THE FACULTY OF ENGINEERING UNIVERSITY OF SZEGED

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ABSTRACT

At the Faculty of Engineering and its legal predecessor – the College Faculty of Food Engineering – we research the utilizing of solar energy since 2004. In our narrower region – the south of the Great Hungarian Plain – the utilizing of solar energy could be advantageous, therewith in our new building we will be able to study the utilization of geothermal heat. We can use our results in the education, too. The equipments we applied to researches our students could use during the making of their diploma work or preparation for competitions, too. In this article we would like to introduce our results and plans about solar and geothermal energy utilizing.

1. EXPERIMENTAL SOLAR EQUIPMENT

Using our prior experiences we have designed a newer experimental measuring system in 2010:

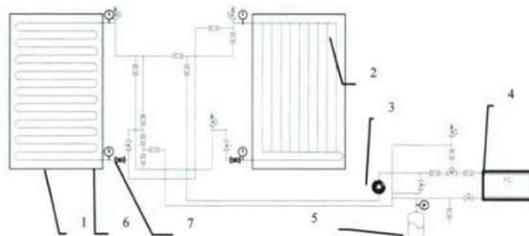


Figure 1. Experimental equipment for measuring the efficiency of solar collectors.

1 – collector with coil-pipe, 2 – collector with parallel pipes, 3 – circulation pump, 4 – fancoil, 5 – expansion tank, 6 – thermometers, 7 – volume flow rate measuring

We used our own-designed collectors. The covering of these collectors is removable, so we could test the collectors with different polycarbonate sheets and uncovered. With the unit we can operate the collectors in parallel or serial connection. In the serial connection we can change the order of the two collectors. It is possible to lock out either collector.



Figure 2. Experimental solar equipment

The equipment transfers the heat output of the collectors to the external air by a fancoil. The cooling fan can be adjusted continuously. The cooling capacity can be decreased further with a bypass pipe.

The circulation pump is adjustable in five steps. In function of the return temperature the pump does further adjusting.

Differently from the conventional ones the water-meters in the equipment measures by displacement, with rotating piston. The volume flow rate could be measured from 7.5 l/h, which is an extremely low value. The accuracy of the water-meters is $\pm 2\%$. The impulse-relays signals by liters. We saved the impulse signals with a two-channel datalogger.

The temperatures were measured by K-type thermocouples with two Testo 177-T4 datalogger. The accuracy of the measuring is ± 0.3 °C.

Besides the measuring of the volume flow rates and the temperatures marked in Fig. 2., we measured the temperature and humidity of the external air and the solar irradiation. The irradiation was measured by a Lambrecht 16131 pyranometer mounted between the collectors in the same plane.

Fig. 3 represents the results of a diurnal measuring.

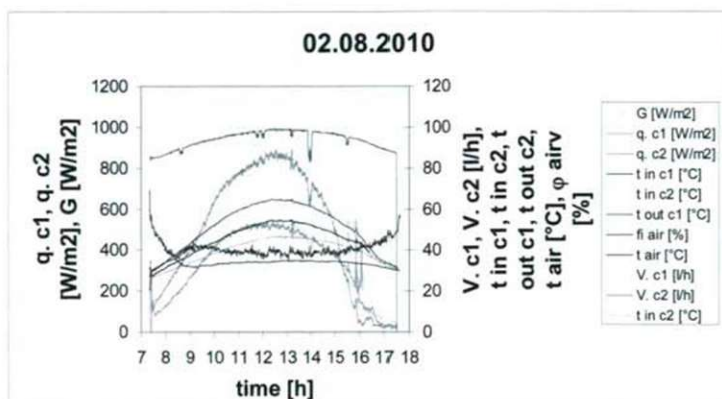


Figure 3. Results of a diurnal measuring

During the most of the measuring we have saved the datas by 5 sec. It enables to analyze the transient processes. It results very high amount of datas, so it requires a database management software.

The equipment used by our students during measuring exercises and making of their diploma work. By these tasks they acquire practice of collectors, pump controlling, measuring of temperature, solar irradiation and volume flow rate, handling of dataloggers and database softwares.

2. MEASURING SYSTEM WITH BUDERUS COLLECTORS

Beside of the analysis of the own-designed collectors we have started to utilizing of Buderus atmospheric flat collectors, argon-filled flat collectors and vacuum-tube collectors.



Figure 4. Measuring system with Buderus collectors

There are three independent collector system available for the students. Each system has two collectors, which could be connected in parallel or serial. Each system has a solar tank: two systems have conventional solar tanks, and the third has a solar tank with thermosiphon. This construction has an inner core. With the valves of this inner core this tank can especially keep the temperature-layering during the diversion of domestic hot water.

This system also has a pyranometer to measure the global irradiation, so we can calculate the efficiency. Later the measuring system will be available for students via Internet too.

3. WIRELESS MEASUREMENT AND DATALOGGER SYSTEM

In 2010 we put in practice our National Instruments WSN system. With this equipment we can measure temperatures and collect impulse signals in distant places at the same time.

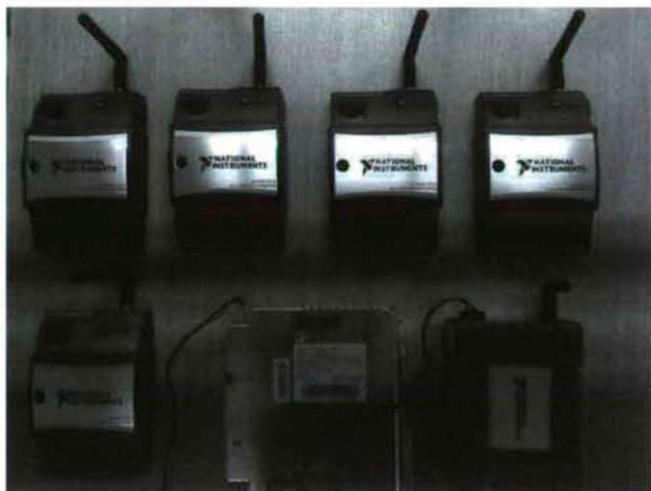


Figure 5. National Instruments Wireless Sensor Network

The gateway communicates with the PC via the network interface. We have 5 nodes. The nodes can measure 4-4 temperatures with thermocouples. One node can handle impulse signals. The nodes send the data to the gateway via wireless connection. In case of line of sight transmission the system can measure from hundreds of meters. Beside the test on the equipments of the Faculty, our students can measure in industrial establishments. The WSN-system is suitable for measuring, data logging and controlling too: we can adjust industrial procedures according to the measured parameters, so our students could test different control algorithms.

The system is operated by a virtual instrument made with LabVIEW software.

The course of the LabVIEW graphical program environment is a part of the engineering education at the Faculty, so our students can apply the acquired knowledge during the test of solar and other systems.

Actually we use the system in industrial environment: the system is measuring the temperature distribution of a vacuum-tube collector field. Fig. 6 represents the layout of the collector field and the arrangement of the thermocouples:

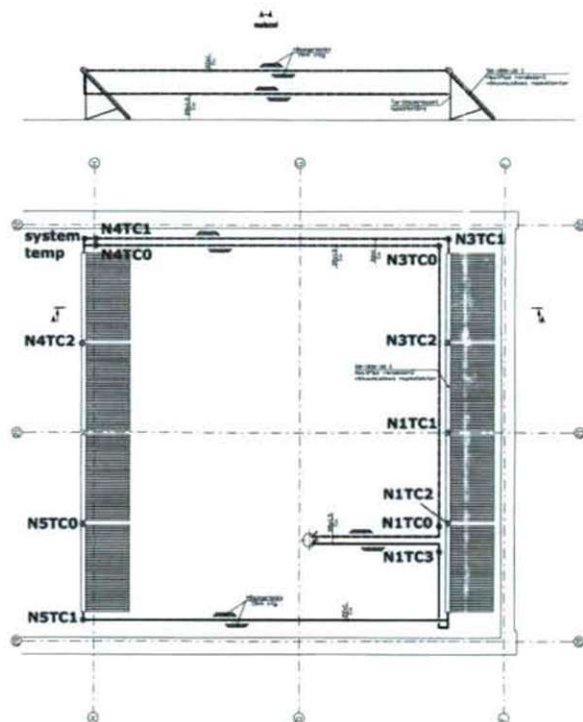
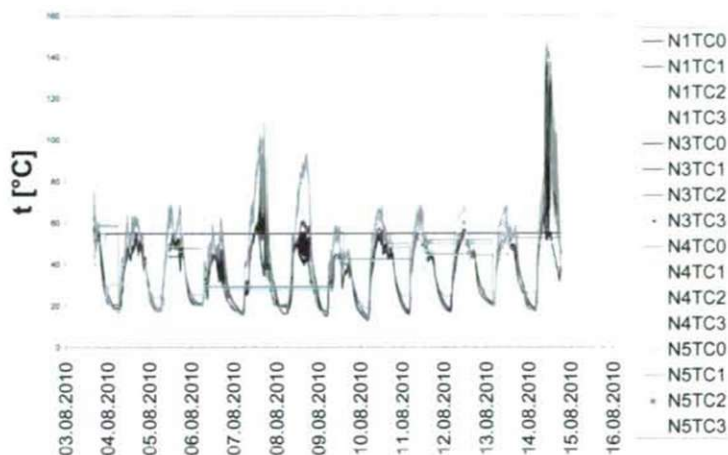


Figure 6. Arrangement of the thermocouples in the collector field

This collector field has compound connection: 4-4 collectors are connected to serial, and this two group are in parallel. The control system of the collectors has only 1 thermocouple. It measures the hypothetical average temperature (system temp in Fig. 6).

The higher the temperature of the collector, the higher the heat loss by the cooling effect of the external air, so the efficiency of the next collector in serial is lower than the previous, because the temperature is higher. Depending on the volume rate flow it is possible to reach the maximum temperature before the last collectors. In this case the the last collectors performance is negative: the heat loss is higher than the irradiation. This kind of operation is unwanted. With the WSN system we could measure this unwanted operation.

Fig. 7 represents the temperature distribution of a two weeks interval:



After the evaluation of the database we will be able to do the necessary modifications of the control to reach higher efficiency.

4. SOLAR COLLECTOR, SOLAR CELL AND GEOTHERMAL HEAT PUMP SYSTEM IN THE NEW BUILDING OF THE FACULTY

The acceptance of the building was in March, 2011. The heating, the domestic hot water and the lighting system uses renewable resources.

The heat demand is supplied by two geothermal heat pump with blow pipes. The natural gas used only to aid the heating if it is necessary.

The solar collectors join to the domestic hot water system. In summer the collectors can supply the heat demand of the DHW system, in autumn, winter and spring the collector system is a pre-heater of the DHW system.



Figure 8. The new building of Faculty of Engineering, University of Szeged

The lighting and the outer decorative lighting is particularly supplied by the solar cell system.

The controlling system of the building will measure and logging the parameters hereafter:

- temperatures of the blow pipes of the heat pumps,
- temperatures of the heating subsystems,
- temperature and amount of the domestic hot water,
- solar radiation and external air temperature,
- internal temperatures,
- power and efficiency of the solar cells,
- heat output and efficiency of the solar collectors,
- total energy and renewable energy demand of the building.

By the temperature database we will able to optimize the system. We will able to analyse the long term environmental effect of the building and confirm the researches of the geothermal heat pumps.

The building and the database from the controlling system will give a unique possibility to improve the practical education for the mechanical engineering, technical manager, materials engineer, bioengineer and environmental engineer students.

5. DIPLOMA WORKS

Joining our researches our students in the past years making diploma works about the themes hereafter:

- Utilizing of solar collectors in domestic hot water systems
- Utilizing of solar collectors in low-temperature heating systems
- Solar water supply systems
- PCM solar tank
- Heating systems with heat pump
- Payback-time analysis of building services systems for renewable resources
- Combined building energy supply systems

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INDUSTRIAL POLLUTION AND CONTROL MEASURES IN ROMANIAN FOUNDRIES

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ABSTRACT

Over the last decades significant improvements have been achieved in industry regarding the control of major polluting substances and gradually the environmental impact has shifted towards the so-called diffuse sources of pollution. Nevertheless, industrial processes still account for a considerable share of the overall pollution in Europe and it is very important to further reduce their contribution to "unsustainability". The European Union (EU) has a set of common rules on permitting of industrial installations. These rules are set out in the so-called Integrated Pollution Prevention and Control Directive of 1996 (IPPC). Romania is one of the countries which became a full member of the EU and is currently in the implementation process, in order to fulfill all the obligations that apply to the Member States. A large number of these obligations derive from the IPPC Directive, which aims at the protection of the environment as a whole and the public health as well. In this framework, the paper aims to present a synthesis of the findings issued after a thorough examination of a large number of documents relevant to the Best Available Technologies. On this basis, guidelines were developed for the application of BATs for several categories of the industry branches in Romania. This paper concerns the developed guidelines for foundries. It was concluded that in order to reduce the emissions and to keep the emissions as low as necessary it is not sufficient to implement technical measures only. It is also important to consider the "human factor" in the environmental regulations. Therefore it is suggested that a log file of the maintenance actions be required to be reported in the future regulations.

Keywords:

environmental impact, pollution, Best Available Technology, guideline.

1. THE IPPC DIRECTIVE: CONTENT AND SPIRIT

Pollution prevention is preferable to reliance on end-of-pipe pollution control. Cleaner production encompasses production processes and management procedures that entail less use of resources than conventional technologies and also generate less waste and smaller amounts of toxic or other harmful substances. It emphasizes the human and organizational dimensions of environmental management, including good plant operation to avoid deliberate or accidental discharges. Nowadays, cleaner production aims at including everything from the drawing board to final disposal or reuse of the product.

Prior to the adoption in September 1996 of Council Directive 96/61/EC on Integrated Pollution Prevention and Control (IPPC), air and water pollution and waste disposal were generally regulated separately, while others operated some form of integrated pollution control. However, emphasis on control of pollution in a single medium, focusing particularly on air and water quality, has resulted in many cases in a poor balance of priorities for processes emitting to different environmental media, and inconsistency in the environmental standards achieved. This is set to change with the implementation of the IPPC Directive, which aimed at the introduction of a Europe-wide system of integrated pollution prevention control to achieve a high level of protection for the environment as a whole, and to establish a

general and common framework of integrated pollution control. This means that no medium will be compromised in order to protect another. Instead of independently concentrating on air, water and land, the IPPC Directive focuses on controlling the source of pollution where emissions from a facility will be preferentially eliminated, reduced, recovered or recycled. In the case where pollutant emissions cannot be prevented they will be treated using the best available 'end-of-pipe' treatment technologies [1].

IPPC sets the standards for all activities for which environmental permits are required. The permitting system that needs to be established, in the framework of the IPPC Directive, shall be integrated, considering the environment as a whole. The permits shall cover both direct and indirect discharges to any medium, as well as issues of waste minimization, energy efficiency, resource utilization, prevention of accidents, and the restoration of sites after the industrial activity has ceased. Permits shall be re-examined and updated at periodic intervals, especially when excessive pollution occurs, or when technical or other developments allow a significant reduction in emissions at a reasonable cost [2].

The Directive introduces the Best Available Technologies (BATs), which are considered the most effective and advanced stage in the development of activities and their methods of operation, which indicate the practical suitability of particular techniques for providing, in principle, the basis for Emission Limit Values (ELVs) designed to prevent and, where that is not practicable, to reduce emissions and the impact to the environment as a whole.

Techniques include both the technology used and the way in which the installation is designed, built, maintained, operated and decommissioned. This is a broad term to include all factors relevant to the environmental performance of an installation. Available techniques are those developed on a scale which allows implementation in the relevant industrial sector, under economically and technically viable conditions, taking into consideration the costs and advantages. Best available techniques are the most effective in achieving a high general level of protection to the environment as a whole. This means that all the different types of environmental impacts an installation could have, must be considered when determining which techniques are considered 'best'. It should be noted that the determination of BAT should always take into account the potential costs and benefit for the implementation of the measures. This means that although environmental protection is the core issue of the IPPC Directive other factors such as economic and social need to be considered as well, in order to reach the most effective and feasible solution [3].

The concept of BAT plays a central role in the Directive because its objective as made clear in Article 2, "is to provide a basis for ELVs". These are primarily the ELVs set by the competent authorities as permit conditions. In addition to forming the basis for ELVs, the BAT concept provides the principal benchmark for determining the obligations of industrial operators in respect of pollution prevention and control. Although ELVs will be based on BATs, there is a provision in Article 9, which should also take account of the geographical location of the activity and local environmental conditions. Therefore, BATs can vary from place to place so that sensitive environmental problems can be addressed locally [1]. It has to be noted that the IPPC Directive does not cover health issues concerning the workers. In determining the best available techniques, special consideration should be given to the following items, [3]:

- the use of low-waste technology.
- the use of less hazardous substances.
- the furthering of recovery and recycling of substances generated and used in the process and of waste, where appropriate.

- comparable processes, facilities or methods of operation, which have been tried with success on an industrial scale.
- technological advances and changes in scientific knowledge and understanding.
- the nature, effects and emissions concerned.
- the commissioning dates for new or existing installations.
- the length of time needed to introduce the best available technique.
- the consumption and nature of raw materials (including water) used in the process and their energy efficiency.
- the need to prevent or reduce to a minimum the overall impact on the environment and the risks to it.
- the need to prevent accidents and to minimize the consequences for the environment.
- the information published by the Commission or by international organizations.

2. FOUNDRIES: DESCRIPTION AND PRACTICES

In foundries, molten metals are cast into objects of desired shapes. Castings of iron, steel, light metals (such as aluminum), and heavy metals (such as copper and zinc) are made in units that may be independent or part of a production line. The main production steps include: *i) preparation of raw materials, ii) metal melting, iii) preparation of molds, iv) casting and v) finishing* (which includes fettling and tumbling) [6]. Electric induction furnaces are used to melt iron and other metals. However, large car component foundries and some small foundries melt iron in gas or coke-fired cupola furnaces and use induction furnaces for aluminum components of engine blocks. Melting capacities of cupola furnaces generally range from 3–25 metric tons per hour (t/h). Induction furnaces are also used in zinc, copper, and brass foundries. Electric arc furnaces are usually used in stainless steel and sometimes in copper foundries. Flame ovens which burn fossil fuels are often used for the melting nonferrous metals. The casting process usually employs non-reusable molds of green sand, which consists of sand, soot, and clay (or water glass). The sand in each half of the mold is packed around a model, which is then removed. The two halves of the mold are joined, and the complete mold is filled with molten metal, using ladles or other pouring devices.

Large foundries often have pouring furnaces with automatically controlled pouring. The mold contains channels for introducing and distributing the metal. For hollow casting, the mold is fitted with a core. Cores must be extremely durable, and so strong bonding agents are used for the core, as well as for the molds themselves. These bonding agents are usually organic resins, but inorganic ones are also used. Plastic binders are being used for the manufacture of high-quality products. Sand cores and chemically bonded sand molds are often treated with water-based or spirit-based blacking to improve surface characteristics. Centrifugal casting methods are used for pipes. Finishing processes such as fettling involves the removal from the casting of the gating system, fins (burrs), and sometimes feeders. This is accomplished by cutting, blasting, grinding, and chiseling. Small items are usually ground by tumbling, carried out in a rotating or vibrating drum, usually with the addition of water, which may have surfactants added to it.

Emissions of particulate matter (PM) from the melting and treatment of molten metal, as well as from mold manufacture, shakeout, cleaning and after-treatment, is generally of greatest concern. PM may contain metals that may be toxic. Oil mists are released from the lubrication

of metals. Odor and alcohol vapor (from surface treatment of alcohol-based blacking) and emissions of other volatile organic compounds (VOCs) are also of concern. Oil and suspended solids are released into process effluents, and treatment is warranted before their discharge. Wet scrubbers release wastewaters that may contain metals. Wastewater from tumbling may contain metals and surfactants. Cooling waters, used in amounts of up to 20 m³/t, may contain oil and some chemicals

for the control of algae and corrosion. Sand molding creates large quantities of waste sand. Other wastes include slag (300–500 kg/t of metal), collected particulate matter, sludges from separators used in wastewater treatment, and spent oils and chemicals. Discarded refractory lining is another waste produced.

The primary hazardous components of collected dust are zinc, lead, and cadmium, but its composition can vary greatly depending on scrap composition and furnace additives. Nickel and chromium are present when stainless steel scrap is used. Generally, foundries produce 10 kg of dust per ton of molten metal, with a range of 5–30 kg/t, depending on factors such as scrap quality. However, induction furnaces (with emissions of 3 kg/t of molten metal) and flame ovens tend to have lower air emissions than cupolas and electric arc furnaces (EAF).

Major pollutants present in the air emissions include particulates of the order of 1000 mg/Nm³. Foundries can generate up to 20 m³ of wastewater per metric ton of molten metal when cooling water, scrubber water, and process water are not regulated. Untreated wastewaters may contain high levels of total suspended solids, copper (0.9 mg/l), lead (2.5 mg/l), total chromium (2.5 mg/l), hexavalent chromium, nickel (0.25 mg/l), and oil and grease. The characteristics of the wastewater will depend on the type of metal and the quality of scrap used as feed to the process. Solid wastes (excluding dust) are generated at a rate of 300–500 kg/t of molten metal. Sludges and scale may contain heavy metals such as chromium, lead, and nickel [7].

3. IPPC IMPLEMENTATION GUIDELINES FOR FOUNDRIES

Compliance with the EU environmental acquis will inevitably improve the quality of the natural environment in Romania through:

- Reduced levels of air pollution,
- Reduced levels of water and ground contamination,
- The provision of suitable sanitation capacity to support tourist growth.

This overall view will have benefits in terms of increased efficiency, as well as with respect to the integration of environmental protection, [10]. We are presenting some of the developed guidelines for the implementation of the BATs for foundries in Romania that fall under the provisions of the IPPC directive. The guidelines are constituted in three parts:

- Control techniques: for load minimisation, for prevention of pollution, for recovery and recycling, for treating emissions.
- Emission limit values (ELVs).
- Compliance monitoring.

After thorough elaboration of data and information available in the scientific community and related to foundries, the following guidelines were developed:

3.1. Pollution Prevention and Control Measures

The following pollution prevention measures should be considered [6]:

- Prefer induction furnaces to cupola furnaces.
- Replace the cold-box method for core manufacture, where feasible.
- Improve feed quality: use selected and clean scrap to reduce the release of pollutants to the environment.
- Preheat scrap, with afterburning of exhaust gases.
- Store scrap under cover to avoid contamination of stormwater.
- Provide hoods for cupolas or doghouse enclosures for EAFs and induction furnaces.
- Use dry dust collection methods such as fabric filters instead of scrubbers.
- Use continuous casting for semifinished and finished products wherever feasible.
- Store chemicals and other materials in such a way that spills, if any, can be collected.
- Control water consumption by recirculating cooling water after treatment.
- Use closed-loop systems in scrubbers where the latter are necessary.
- Reduce nitrogen oxide (NO_x) emissions by use of natural gas as fuel, use low-NO_x burners.
- Reclaim sand after removing binders.

3.2. Pollution Reduction Targets

The recommended pollution prevention measures can achieve the target levels given below.

- **Air Emissions:** recover metals from collected dust. The target value for PM from furnaces and die casting machinery is not to exceed 0.5 kg/t of molten metal (after controls). The oil aerosol should not exceed 5 mg/Nm³.
- **Wastewater:** Recycle wastewater, if any. Avoid allowing contamination of stormwater with oil; oil in stormwater should not exceed 5 mg/l.
- **Solid Waste** Reclaim sand used in molding.

○ Treatment Technologies

- **Air Emissions:** use dust emission control technologies include cyclones, scrubbers (with recirculating water), baghouses, and electrostatic precipitators (ESPs). Scrubbers are also used to control mists, acidic gases, and amines. Gas flame is used for incineration of gas from core manufacture. Target values for emissions passing through a fabric filter are normally around 10 mg/Nm³ (dry). Emissions of PM from furnaces (including casting machines used for die casting) should not exceed 0.1–0.3 kg/t of molten metal, depending on the nature of the PM and the melting capacity of the plant. At small iron foundries, a somewhat higher emission factor may be acceptable, while in large heavy-metal foundries, efforts should be made to achieve a target value lower than 0.1 kg PM per metric ton. Odors may be eliminated by using bioscrubbers.
- **Wastewater Treatment:** recirculate tumbling water by sedimentation or centrifuging followed by filtering (using sand filters or ultrafilters); separate oil from surface water. In the very rare cases in which scrubbers are used, recirculate water and adjust its pH to precipitate metals. Precipitate metals in wastewater by using lime or sodium hydroxide. Cooling waters should be recirculated, and polluted stormwater should be treated before discharge.

3.4. Emissions Guidelines

The emissions levels given here can be consistently achieved by well-designed, well-operated, and well-maintained pollution control systems. The guidelines are expressed as concentrations to facilitate monitoring. Dilution of air emissions or effluents to achieve these guidelines is unacceptable. All of the maximum levels should be achieved for at least 95% of

the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours, [6].

- **Air Emissions:** air emissions of PM should be below 20 mg/Nm³ where toxic metals are present and 50 mg/Nm³ in other cases. This would correspond to total dust emissions of less than 0.5 kg/t of molten metal.
- **Liquid Effluents:** for foundries, the effluent levels presented in Table 1 should be achieved. In Table 2 the emission limits applied in some EU member states are presented.
-

Table 1: Effluents from foundries

Crt. no.	Parameter	Maximum value ^a
1.	PH	6–9
2.	TSS	50
3.	Oil and grease	10
4.	Copper	0.5
5.	Zinc	2
6.	Temperature increase	<3°C ^b

a - (mg/l, except for pH and temperature).

b - The effluent should result in a temperature increase of no more than 3°C at the edge of the zone where initial mixing and dilution take place. Where the zone is not defined, use 100 m from the point of discharge.

Table 2: Emission limits applied in some EU member states

Component	Limit-value (mg/Nm ³)	Remark
Dust	20	Germany, TA-Luft 1986
Dust	10	Dutch, Emission guidelines (NeR)
SO ₂	200	Dutch, Emission guidelines (NeR)
NO _x	200	Dutch, Emission guidelines (NeR)
NH ₃	20	Germany, TA-Luft 1986
NH ₃	200	Dutch, Emission guidelines (NeR)
VOC	20	Dutch, Emission guidelines (NeR)
Fluoride-compounds	5	Dutch, Emission guidelines (NeR)
Lead	5	Dutch, Emission guidelines (NeR)
Lead	5	Germany, TA-Luft 1986
Cr ³⁺	5	Germany, TA-Luft 1986
Cr ⁶⁺	1	Germany, TA-Luft 1986
Ni	1	Germany, TA-Luft 1986
Cd	0.2	Germany, TA-Luft 1986
Benzene	5	Germany, TA-Luft 1986
Benzo[a]pyrene	0.1	Germany, TA-Luft 1986

- **Solid Waste:** sludges from wastewater treatment operations should be disposed off in a secure landfill after stabilization.
- **Ambient Noise:** noise abatement measures should achieve either the levels given below in Table 3, or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

Table 3: Maximum acceptable noise level

Receptor	Maximum allowable log equivalent (hourly measurements), in dB(A)	
	Day (07:00–22:00)	Night (22:00–07:00)
Residential, institutional, educational	55	45
Industrial, commercial	70	70

3.5. Monitoring and Reporting

Air emissions should be monitored continuously for PM using an opacity meter (for an opacity level of less than 10%). Wastewater discharges should be monitored daily except for metals, which may be monitored monthly or when there are process changes. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. The results should be reported to the responsible authorities and relevant parties, as required.

4. EMISSION MITIGATION – PROPOSED MEASURES FOR ROMANIAN FOUNDRIES

In Table 4, a comparison is made between the techniques generally applied and the techniques already applied in Romanian foundry. Special attention has to be paid to the selection and the quality of the raw materials (cast iron) to prevent unnecessary emissions to the air during the melting process. At the foundry, a cupola oven is used for melting the iron and a Venturi scrubber is used to clean the air. Considering the results of the dust measurements, which exceed the emission limits used in the EU, this installation is not applying BAT. The reason for this lack of performance is malfunction of the scrubber, bad design or bad maintenance of this equipment. Furthermore it was observed that the contaminated water is released to the surrounding area, which is considered as a shift of the environmental problem from air to the soil.

Table 4: Comparison between generally applied and existing techniques

Process	Emission characteristics	General applied techniques	Installed
Metal melting	Dust, SO ₂ , CO, VOC, NO _x metaloxides	Wet scrubbers; Dry collectors	Wet scrubbers installed, odour and thick plume noticed during production, emission limits above guidelines
Sand preparation	Dust	Incinerations	Cyclones installed, minor fugitive emission
Mould and core production	Dust, VOC	Fabric filters	VOC emission detected, no suction or treatment system
Pouring, casting	Dust, CO, VOC	Suction; No specific treatment	Observed closed
Finishing	dust	Closed production; Fabric filters	

The emissions during casting are not collected or treated. There is no need to treat the air from the casting process because the composition of the mould depends upon bentonite. The following measures are suggested:

➤ **Process integrated measures**

- Investigation of the possibilities to use alternative binder materials
- Use quality criteria to select scrap metal that will be molten in the oven
- Set up a maintenance program where the equipment is maintained on a regular basis
- Keep a log-file where the results of the inspections and measurements of every installation is described.
- Give training to people on the working floor and teach the basics of 'good housekeeping'.

➤ **Technical measures**

- Upgrade and optimize existing scrubbers or install new techniques by
- Repairing and cleaning the scrubber, spraying nozzles and droplet collector
- Increasing the amount of washing water
- Introducing chemicals in the washing water to remove specific (organic) compounds
- Suction of released fumes during casting and emission through a stack if resins are used as a binder material
- Find solution for disposal of contaminated washing water and waste from cupola oven.

➤ **Regulations**

- Regulate emission limits for dust, SO₂, NO_x and CO and eventually VOC
- Prescribe an investigation of the possibility to collect the diffusive emissions during casting and allow their release at a height if the investigation of the possibilities of the use of alternatives proves to be negative
- Provide regulation to be sure that the contained water and melting waste (slag) from the oven is disposed properly.

5. CONCLUDING REMARKS

Nowadays, the need for integrated prevention and control of pollution is unquestionable. Although specific techniques are not obligatory and their application lay on self-imposed grounds, the concept of BATs is underlined as it provides a basis for setting ELVs. Furthermore, it establishes the principal benchmark for determining the obligations of industrial operators in respect of pollution prevention and control. Therefore, coordinated efforts are needed on behalf of industry, the Ministry of Environment and the local competent authorities for the elaboration of studies in order to determine BATs, to trace and address adequately the sensitive environmental issues. In this framework, financial incentives should be given to industrial operators to overcome the reluctance of traditional techniques and apply BATs. Then, the implementation of a pilot IPPC application should take place, on behalf of selected plants and a relevant licensing from the competent authorities. Finally, the planning-out and the implementation of an action plan is essential in order to adopt the IPPC Directive.

In general, it can be stated that the Romanian foundries applies to generally accepted techniques according to European Standards. Therefore it is remarkable that these techniques do not meet the emission standards although the same are used by the Member States. The reason for this rather high dust emission might be the malfunctioning of the installed scrubbers due to engineering (not engineered to meet the rather low emission limits used in the EU) or bad maintenance of the equipment. It can be assumed that the dust emission will meet the standards by upgrading or changing the existing equipment and improving maintenance. It is also suggested that CO, VOC and SO₂ be measured on a regular basis. In any case, specific small or big technical objectives should be set, which shall be feasible and measurable and shall result in the improvement of the environmental performance of foundries.

To reduce the emissions and to keep the emissions as low as necessary it is not sufficient to implement technical measures only. It is also important to consider the 'human factor' in the environmental regulations. Therefore it is suggested that a log file of the maintenance actions be required to be reported in the future regulations.

Moreover, incentives should be established in order to promote research activities, in order to develop modern, feasible and efficient techniques to minimize the environmental impacts from the operation of the foundries.

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RESEARCH ON DESULPHURIZATION OF STEEL WITH CALCIUM ALUMINATE SYNTHETIC SLAG WITH ADDITION OF TITANIUM OXIDE

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ABSTRACT

In the practice of deoxidation with synthetic slag, we usually use the slag from the binary systems: CaO-Al₂O₃, CaO-TiO₂ and CaO-CaF₂ or from the ternary systems: CaO-SiO₂-Al₂O₃ and CaO-CaF₂-Al₂O₃. According to the literature, the best results were obtained with synthetic slag from the binary system CaO-Al₂O₃ (50-52% CaO and 38-42% Al₂O₃).

The paper presents the results of laboratory experiments on steel desulphurisation with slag from the system CaO-SiO₂-TiO₂.

To determine the influence, on the desulphurisation process, of the titanium oxide added in calcium aluminates slag, we experimented, in the laboratory phase, the steel treatment with a mechanical mixture consisting of lime, aluminous slag and slag obtained from the titanium making process through the aluminothermy technology.

The steel melting was carried out in an induction furnace of 10 kg capacity, existent in the "Metallic Melts" laboratory of the Engineering Faculty of Hunedoara.

During the research, we aimed to establish correlation equations between the sulphur distribution coefficient and the slag components (CaO, Al₂O₃, TiO₂, FeO, MgO and MnO). The data obtained in the experiments were processed in Excel and MATLAB programs, resulting simple or multiple correlation equations, which allowed the elucidation of some physical-chemical phenomena specific to the desulphurisation processes.

Keywords:

steel treatment, desulphurization, synthetic slag, calcium aluminate, titanium oxide

1. GENERAL CONSIDERATIONS

The steel refining with liquid slag or various powder mixtures of synthetic slag is based on the intensification of the unwanted impurities (sulphur, non-metallic suspensions & oxygen) passage from the liquid steel in the slag, mainly by diffusion, or partly through the entrainment of some suspensions by settling the synthetic slag particles found in the treated steel bath. The synthetic slag can be also obtained by adding mechanical mixture directly in the casting ladle; in this case, for compensating the cooling of the steel in the casting ladle due to the addition of materials (melting and superheating), the steel temperature should be at least 20-40°C higher than the normal one. In the practice of deoxidation with synthetic slag, we usually use slag that correspond to the binary systems CaO-Al₂O₃, CaO-TiO₂ and CaO-CaF₂, or to the ternary systems CaO-SiO₂-Al₂O₃ and CaO-CaF₂-Al₂O₃. According to the literature, the best results were obtained with synthetic slag that corresponds to the binary system CaO-Al₂O₃, containing 50-52% CaO and 38-42% Al₂O₃.

The viscosity of the synthetic slag has significant influence on the development of physical and chemical processes during the treatment of the liquid steel, interfering with significant weight on the emulsifying capacity of slag. The increase of the slag viscosity from 0.15 to 0.45 Ns/m² (from 1.5 to 4.5 Poise) determines the decrease with approx. 30% of the steel-slag interaction surface. Such increasing of the calcium aluminate slag viscosity can be seen when its temperature is decreasing (for example, from 1600°C to 1470°C). Therefore, it is very important to ensure, during processing the steel with liquid slag, the optimum thermal regime specific to the chosen slag type and to realise its convenient fluidity (viscosity).

At the temperatures of treating the steel with synthetic slag in the ladle, the minimum viscosity corresponds to the slag with 56% CaO. But, taking into account the fact that frequent deviations (1-2%) may occur from this optimum composition under industrial conditions, we should also consider the danger of reaching unwanted values (higher than 57% CaO). Therefore, in the industrial practice it is recommendable a content of 52-54% CaO in slag, for which the normal composition deviations can't provoke sudden viscosity increases.

The viscosity of the synthetic slag is also influenced by other components; it increases significantly with the increasing of the SiO₂ content, while MgO contents up to 8% are favourable. At temperatures higher than 1500°C, the viscosity is slightly decreasing when adding TiO₂ in the calcium aluminate slag.

Usually, the chemical composition of the synthetic slag that corresponds to the CaO – Al₂O₃ system, frequently used in practice, varies between the following limits: CaO = 48 – 55%; Al₂O₃ = 40 – 45%; SiO₂ = maximum 3.0%; MgO = maximum 3% and FeO = maximum 1%, the balance being other oxides.

Because the diffusion speed in slag increases with increasing temperature (T) and decreasing viscosity (η), we can highlight the special importance of the synthetic slag viscosity (i.e. its fluidity $\varphi=1/\eta$) in the process of treating the steel with synthetic slag. Similarly, the bigger is the contact surface between the synthetic slag and the metallic bath, the faster is the passage of the significant elements to the slag, the contact surface being, along with the viscosity, another determinant element in treating the steel with synthetic slag.

2. LABORATORY EXPERIMENTS

To determine the influence, on the desulphurisation process, of the addition of titanium oxide in the calcium aluminate slag, we performed laboratory experiments, i.e. we treated the slag with liquid synthetic slag obtained by melting the mixture consisting of limestone, aluminate slag and slag obtained from the titanium making process through the aluminothermic technology.

The steel melting was carried out in an induction furnace of 10 kg capacity and the slag melting was carried out in a crucible furnace, both existent in the "METALLIC MELTS" laboratory of the Engineering Faculty of Hunedoara.

The charge to be melted consisted *of steel samples* (samples of steel for tubes, taken from the casting ladle before the LF treatment, i.e. before introducing the steel in the LF).

To form the liquid synthetic slag, we melted in the crucible furnace a mechanical mixture consisting of limestone, calcium aluminate slag (from melting the aluminium scrap) and slag obtained from the titanium making process through the aluminothermic technology. The steel quantity obtained was 10 kg/heat, and the addition of liquid slag was 3% (300 g/heat). The

synthetic slag was added directly in the casting ladle; so, the slag reached the ladle before the steel, ensuring a good mix between the two melts. To determine the sulphur distribution coefficient, we took steel and slag samples before and after the treatment, to find the sulphur content and the chemical composition. We also measured the steel and slag temperature before and after the treatment.

3. RESULTS OBTAINED FROM PROCESSING THE EXPERIMENTAL DATA

By processing the data obtained in the laboratory phase, we obtained equations of correlation between the chemical composition of the synthetic slag and the sulphur distribution coefficient (L.S.). The data were processed in Excel and MATLAB programs, the results being presented hereunder, in graphical and analytical forms.

In Fig. 1, we can see that a TiO_2 content increase up to 5-6% leads to the increasing of the L.S., fact explicable, from a technological point of view, through to the positive influence of the titanium oxide on the slag fluidity, especially at temperatures above $1500^{\circ}C$. Therefore, we recommend contents of 3-6% TiO_2 in the refining slag.

In Fig. 2, we see that the increase of the MgO content up to approx. 8% leads to the increasing of the L.S., fact explicable, from a technological point of view, by the favourable influence of this oxide on the viscosity (the viscosity is decreasing). Therefore, from a technological point of view, we recommend the maximum MgO content to be 6%.

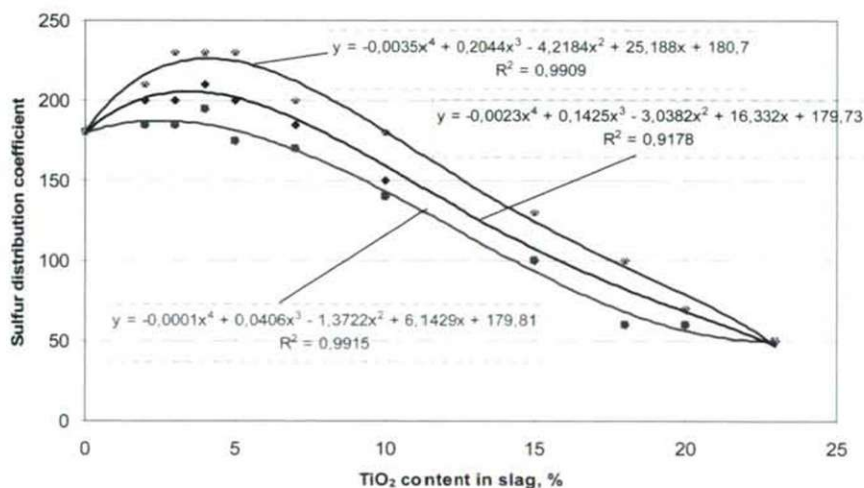


Fig.1 The variation of the sulphur distribution coefficient versus the TiO_2 content in slag

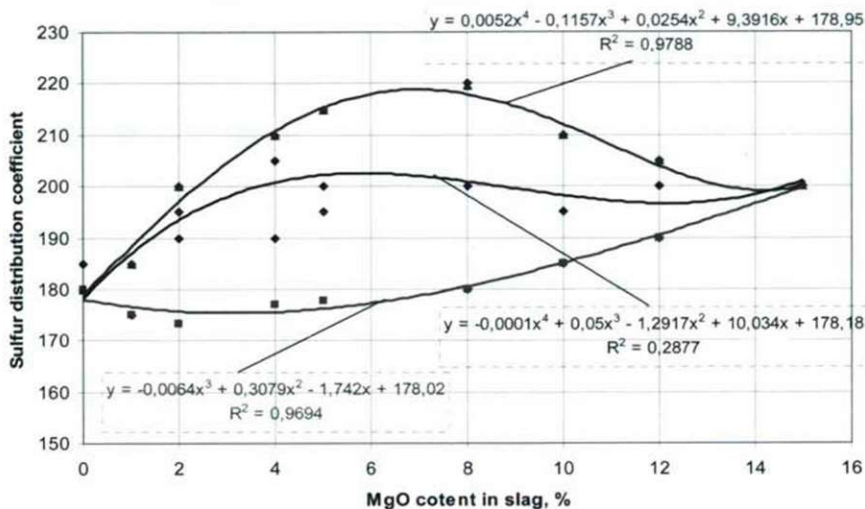


Fig.2 The variation of the sulphur distribution coefficient versus the MgO content in slag

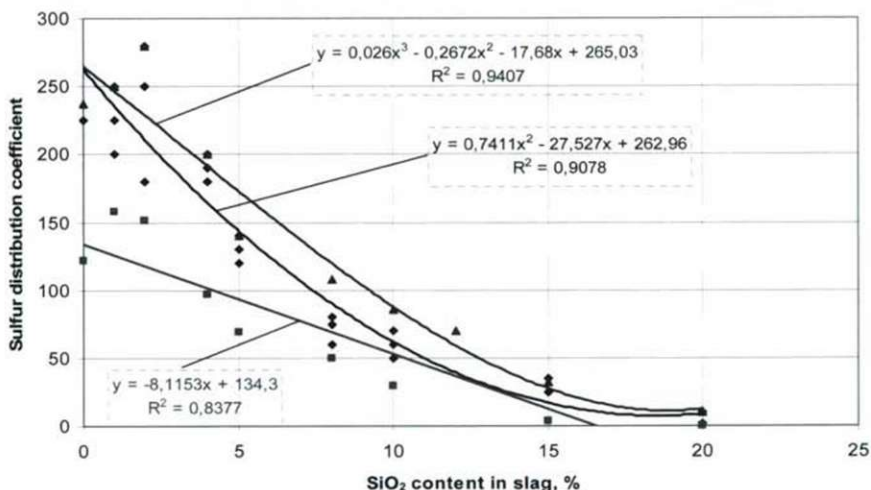


Fig.3 The variation of the sulphur distribution coefficient versus the SiO₂ content in slag

In Fig. 3, we see that the increasing of the SiO₂ content leads to the decreasing of the L.S., which can be explained, from a technological point of view, on the one hand by the slag viscosity increasing with the SiO₂ content increasing and, on the other hand, by the decreasing of the free CaO content, the main oxide in slag that directly participates to the desulphurisation process. From the graphical representation, we can see that, when the SiO₂ content is increasing, the variation range of the L.S. becomes narrower and narrower, especially for values higher than 5%. Technologically, we recommend the maximum SiO₂ content to be 3%.

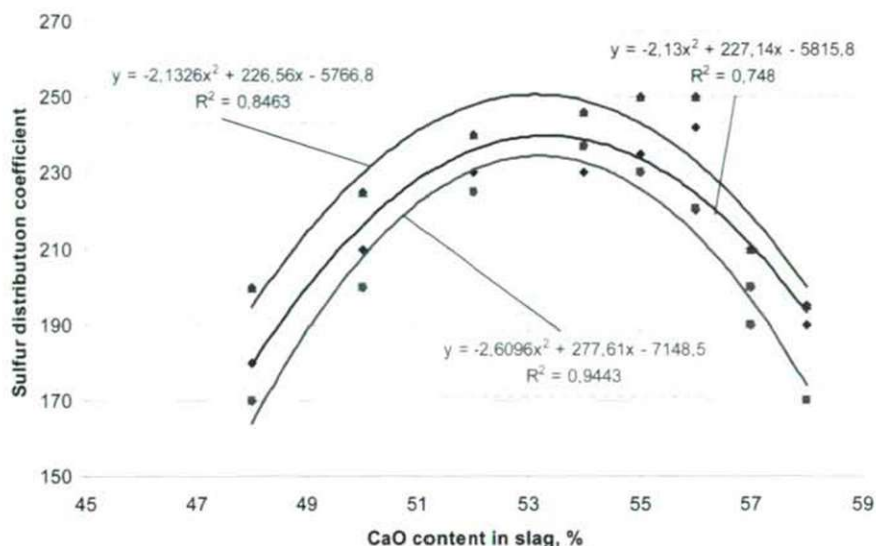


Fig.4 The variation of the sulphur distribution coefficient versus the CaO content in slag

The graphical representation presented in Fig. 4 shows that the higher values for the L.S. (230-250) were obtained for a CaO content of 52 -54%. According to the data presented in the literature [2] the minimum viscosity of the slag that corresponds to the CaO – Al₂O₃ system is obtained for contents of approx. 56% CaO, which confirms the results obtained for the slag used in our experiments. The CaO contents higher than 55%, determine the decreasing of the L.S. values, because the slag viscosity is increasing. Having in view that, in industrial conditions, there are frequent deviations from the above mentioned range of chemical composition, we recommend contents of 52-56% CaO.

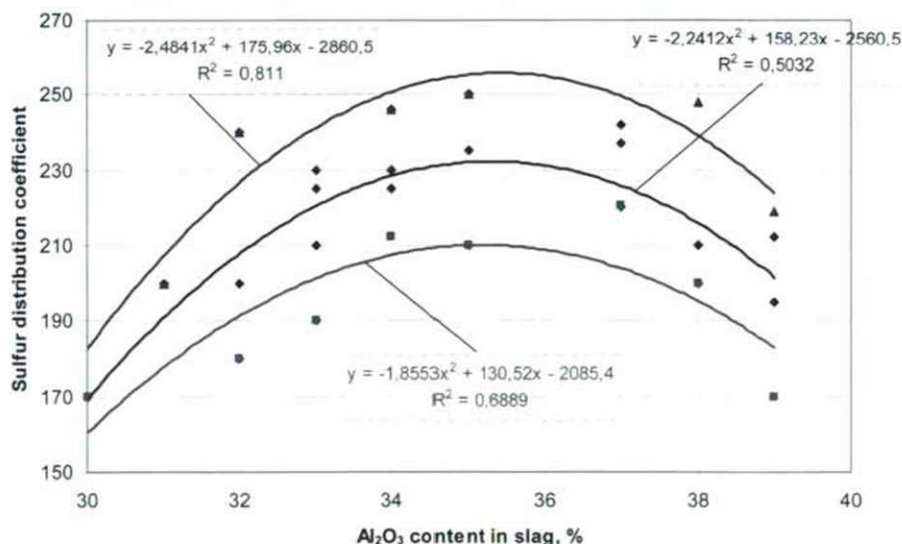


Fig.5 The variation of the sulphur distribution coefficient versus the Al₂O₃ content in slag

Analysing the graphical representation presented in Fig.5, we can see a variation in the L.S. depending on the Al_2O_3 content, similar to the variation depending on the CaO content in slag. The maximum L.S. value was obtained at 34–37% Al_2O_3 . The increasing of the aluminium oxide content up to values that vary between the above mentioned limits is due to the decreasing of the slag viscosity and, in consequence, the intensification of the sulphur diffusion in the slag bath. The increasing of the Al_2O_3 content beyond the above mentioned limits determines the decreasing of the L.S. values, as a consequence of the slag viscosity increasing. We recommend contents of 33-37% Al_2O_3 in slag.

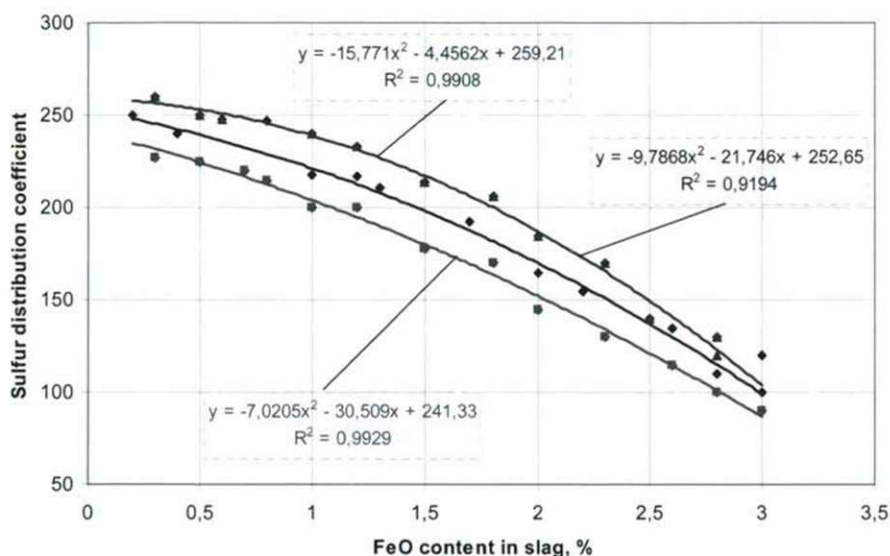


Fig.6 The variation of the sulphur distribution coefficient versus the FeO content in slag

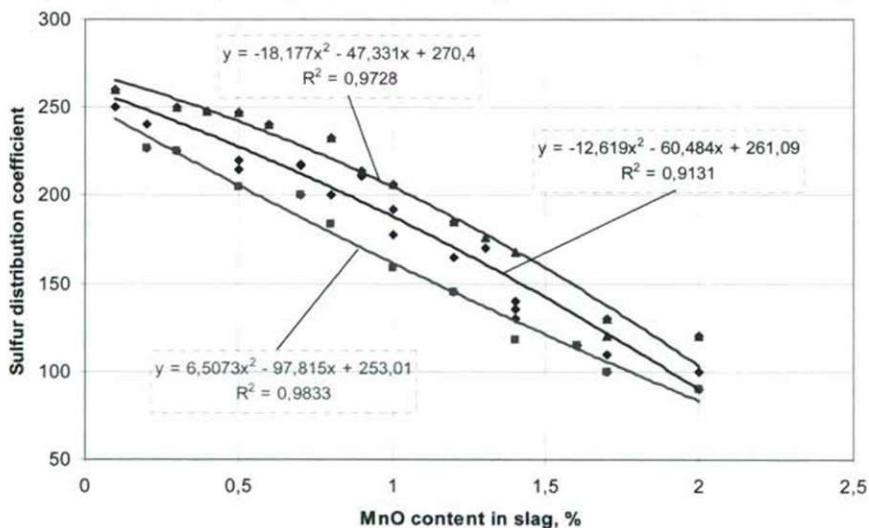


Fig.7 The variation of the sulphur distribution coefficient versus the MnO content in slag

From the graphical correlations presented in Fig. 6 and 7, we can see that the increasing of the FeO and MnO contents in slag leads to the decreasing of the L.S., which is consistent with the fact that the steel desulphurisation is encouraged by strong basic slag (which presents high $[O^{2-}]$ values) and low $[O]$ contents. Technologically, for the slag types we have studied, we recommend the maximum FeO content to be 1.5% and the maximum MnO content to be 1.0%.

From the above mentioned things, we can see the significant influence of the chemical composition on the desulphurisation process. We consider that this influence is manifested either by the action of the oxides on the slag viscosity (Al_2O_3 , TiO_2) or by the affinity of some cautions (Ca, Mg) to sulphur in slag.

For each correlation, we determined the equation of the regression curve, along with the equations afferent to the curves that bound the variation range (both upper and lower limits).

By processing the data in the MATLAB program, we obtained multiple correlation equations and, by graphically represented them, we obtained the correlation surfaces. To establish the optimum chemical composition range, we analysed the regression surfaces for finding the value of the L.S., desirable above the average value obtained from the data afferent to the analysed heats.

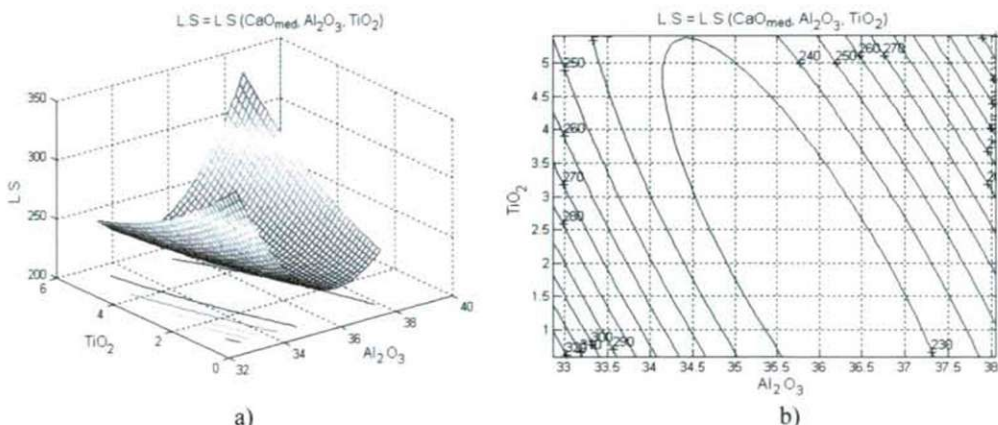


Fig.8 The variation of the sulphur distribution coefficient (L.S) versus the TiO_2 and Al_2O_3 content in slag: a) surface; b) contour lines

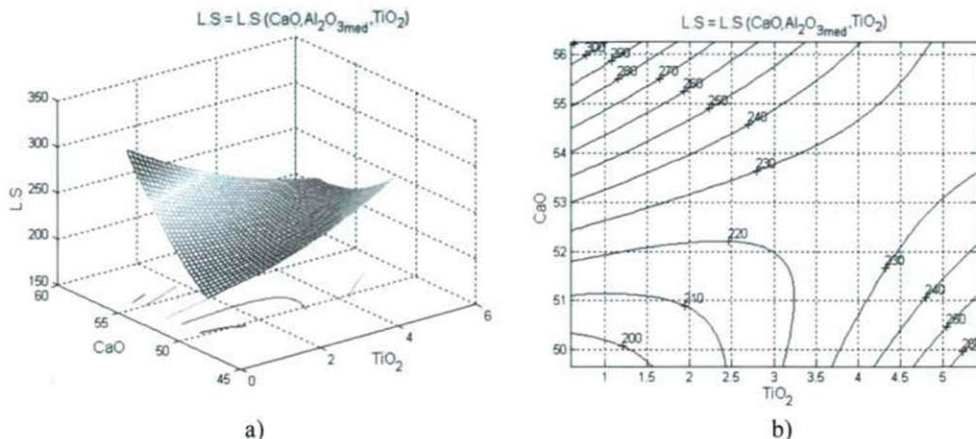


Fig.9 The variation of the sulphur distribution coefficient (*L.S*) versus the TiO_2 and CaO content in slag: a) surface; b) contour lines

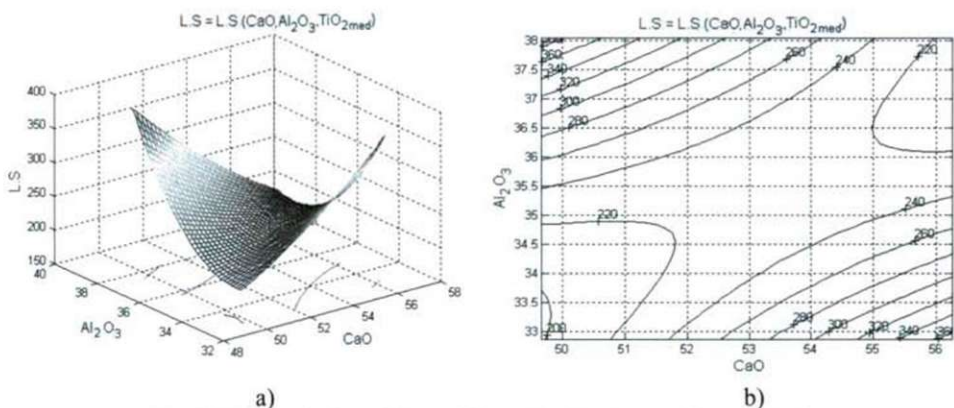


Fig.10 The variation of the sulphur distribution coefficient (*L.S*) versus the CaO and Al_2O_3 content in slag: a) surface; b) contour lines

4. CONCLUSIONS

Based on the experiments, on the results obtained from data processing and on the technical analysis of these data, we concluded the followings:

- From a technological point of view, the slag types used in our experiments met our needs, mainly due to their adequate fluidity;
- The chemical composition of the slag has a significant influence on the L.S., either indirectly, due to the viscosity, or directly, due to the affinity of the oxide cautions to the sulphur anions;
- We consider that it is possible to obtain very good results in the desulphurisation process by using synthetic slag having the following chemical composition: ...;

- Based on the results obtained during the laboratory phase, we believe that good results can be achieved under industrial conditions, too. So, we propose to perform such experiments in a future stage.

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CHARACTERIZATION AND EXTRACTION OF MARIGOLD (*CALENDULA OFFICINALIS* L.) CULTIVATED IN THE REPUBLIC OF MACEDONIA

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ABSTRACT

Chemical composition of marigold (*Calendula officinalis* L.) cultivated in Republic of Macedonia, as well as the fatty acid content in the extracts of marigold whole flower, petals and receptacles, were determined.

The dry petals are characterised with the lowest content of total proteins, ash and sand. In dry receptacles the content of ash and proteins is the highest. Total sugars and sand contents in marigold dry whole flowers are higher than in dry petals and receptacles.

The highest extract yield is obtained by dichloromethane extraction of dry whole flowers. The extract yield obtained from dry petals with *n*-hexane extraction is higher than those obtained from dry whole flowers and dry receptacles, under the same conditions.

The content of myristic (C14:0), palmitic (C16:0), stearic (C18:0), *cis*-oleic (C18:1), linoleic (C18:2) and linolenic acid (C18:3) was determined in the *Calendula* extracts. It is determined that in all extracts linoleic acid has the highest content. *Calendula* extracts are rich in oleic and linoleic acids. The content of palmitic acid is the highest compared with other saturated acids found in the extracts.

1. INTRODUCTION

Calendula officinalis L. (Asteraceae), a bright yellow and orange flower, commonly known as marigold or cultivated marigold, is an annual herbaceous plant, native to Mediterranean countries. The flower is used as food additive to confer both foods color and flavor. Marigold is also widely used in traditional and homeopathic medicine since its petals are used for preparing infusions and ointments. Phytopharmacological studies of different *Calendula* extracts have shown antiinflammatory, anti-viral and anti-genotoxic properties of therapeutic interest (1, 2, 3). Several studies involving marigold extracts have been performed, mainly related to the characterization of extracts obtained by extraction with organic solvents. The results indicate that such extracts have therapeutic characteristics partially due to the terpene content, however, the most important compounds are triterpenoids, flavonoids, essential oils and sesquiterpenes (4).

Characterization of dry petals, receptacles and whole flowers of *Calendula officinalis* L. cultivated in Republic of Macedonia by determination of the content of moisture, crude proteins, ash and sand in, was the aim of this study. The influence of the organic solvents on the extracts quantity was followed by extraction of different part of marigold using Soxhlet method and *n*-hexane, dichloromethane,

benzene and diethyl ether as solvents. Determination of the fatty acid composition of the *Calendula* extracts was also objective of this work.

2. EXPERIMENTAL

Material. The orange, double-flowered cultivar (cv. "Double Orange") of *Calendula officinalis* L. (Figure 1) was grown at experimental field at Scientific Tobacco Institute in Prilep, Republic of Macedonia, under recommended agricultural practice (fertilization, irrigation, plant protection) in 2008. Seed purchased from "Dr. Josif Pancic" Institute for Medical Plan Research in Republic of Serbia, was breed in greenhouse, and seedlings were field planted in plots with randomized design in six repetitions. Rows were spaced 40 cm apart, and plants were spaced 50 cm within each row. Flowers were hand harvested at full flowering stage. Petals and receptacles were separated from fully-opened flowers. The flowers, petals and receptacles were dried on mats in the shade and at room temperature, spread into thin layers that were not mixed over the 20 days. After this interval, water loss by both drying and desiccation, according to technique by drying on 105°C to constant mass achievement, was determined (AOAC, 925.10). Plant material was dried in oven (35 °C, 5 h), then milled and sieved to a powder (0.250 mm) with grinder (Retch, Germany) immediately before the extraction.



Figure 1. *Calendula officinalis* L. (cv. Double Orange)

Chemical analysis. *Content of dry matter* was determined by drying on 105°C to constant mass achievement (AOAC, 925.10) and *content of ash* by burning at 900°C to constant mass achievement (AOAC, 923.03). *Proteins content* was determined from the nitrogen content by Kjeldahl method using factor 6.25 (AOAC, 978.04) and calculated as $N \times 6.25$ (5). *Total sugars* were determined by Bertrand method (6).

Extraction of the plant material. Soxhlet procedure was used for extraction of whole flowers, petals or receptacles (AOAC, 920.85). 5 g of powdered plant material (0.0001 g accurately weight, 0.25 mm particles size) was extracted in the presence of 4-5 boiling glass regulators by using pro analysis-grade solvents: *n*-hexane, diethyl ether, methylene chloride

and benzene. After 5 h extraction, the solvent was released in rotary vacuum evaporator (35°C) and solvent traces were removed by drying in vacuum drier (40°C, 105mbar) followed by cooling in a dessicator and weighting. The steps of drying, cooling and weighting were repeated until the difference between two consecutive weights was smaller than 2 mg. The yield of extract was estimated according to the dry matter weight in plant material used for extraction.

Preparation of fatty acid methyl esters (FAMES). 100 mg of extract was transesterified with freshly prepared 0.28 mol L⁻¹ solution of sodium methoxide in methanol. Reaction mixture was stirred with magnetic stirrer and heated using water bath at 75 °C, for 20 min. After the transesterification was done, saturated sodium chloride solution was added and ester layer was extracted with diethyl ether and distilled water. Prepared sample was dried with anhydrous Na₂SO₄ and then filtered. In order to remove the solvent, sample was evaporated on the rotary vacuum evaporator (35 °C). Sample was cleaned-up on the silica gel column. Clean-up column was prepared in Pasteur pipette by placing the plug of glass wool, then adding silica gel activated at 120 °C and, at the top, anhydrous sodium sulfate. It was conditioned with cyclohexane and then the sample was transferred on the top of the column. FAMES were eluted from the column with the solution of cyclohexane/ethyl acetate mixture (2:1, v/v). Toluene was added to the sample and then solvent was evaporated on the rotary vacuum evaporator (50 °C, 150 mbar) to the volume of app. 1 mL. Sample was transferred to the 2 mL vial, evaporated in the stream of nitrogen to the dry residue and additionally dried in heating cabinet at 40 °C for 30 min.

For the GC/MS analysis, sample was diluted with *n*-hexane to obtain the concentration of sample solution of 1 mg mL⁻¹.

GC-MS analysis. The fatty acid content in extracts were determined by GC-MS, using Thermo Finnigan Trace GC unit furnished with Optima 240 capillary column: 60 m x 0.25 mm i.d. x 0.25 µm film thickness, whose working temperature was programmed as follows: 80°C at the start, 20°C/min to 120°C, 3°C/min to 240°C that held for 10 min. Helium constant flow was 1.5 mL/min. 1 µL of the sample dissolved in hexane was injected by Thermo Finnigan AS 2000 autosampler. PTV injector was used with the split ratio 10:1, at initial temperature of 60°C and heated up to 280°C. The Finnigan Trace mass selective (MS) detector, coupled to GC *via* transfer line set on 250°C, worked with ion source temperature at 220°C. The response factors were obtained using standard FAME mixture solution as external standard.

3. RESULTS

Moisture content in air-dried whole flowers, petals and receptacles were 6.80%, 6.20%, and 7.0%, respectively.

Chemical composition of whole flowers, petals and receptacles is presented in Table 1. The dry matter content was higher in petals than in receptacles. The highest content of proteins as the main nutritional relevant was determined in marigold receptacles.

In the whole flowers determined content of sugars was the highest compared with the sugars content in receptacles and petals.

Table 1. Chemical properties of *Calendula officinalis* L.

Characteristic	Whole flowers	Petals	Receptacles
Dry matter (%)	85.15	90.44	88.41
Total nitrogen (%)*	3.59	1.44	3.96
Proteins (%)*	22.44	9.00	24.75
Ash (%)*	9.98	8.29	11.87
Total sugars (%)*	12.44	7.02	5.36
Sand (%)*	7.05	2.16	3.79

* calculated to the corresponding dry matter

In Table 2 are presented the quantity of *Calendula officinalis* L. extracts obtained using different extraction solvents. Extract yield obtained from petals was higher than from whole flowers and receptacles, for all solvents used. The highest extract yields of 13.79%, 16.81% and 9.57% for whole flowers, petals and receptacles, respectively, were obtained using benzene. *n*-Hexane gave the lowest quantity of extracts from all plant materials, compared with other used solvents.

Table 2. Extract yield (%*) of *Calendula officinalis* L.

Solvent	Whole flowers	Petals	Receptacles
<i>n</i> -Hexane	8.95	13.76	5.72
Methylene chloride	10.67	14.44	5.11
Benzene	13.79	16.81	9.57
Diethyl ether	10.05	14.63	7.62

* calculated to the corresponding dry matter

In the extracts of *Calendula officinalis* L. according to the determined contents, palmitic (C16:0), stearic (C18:0), oleic (C18:1), linoleic (C18:2) and linolenic (C18:3) fatty acids are dominant (Table 3). The content of oleic acid in extracts obtained from whole flowers, petals and receptacles, was higher than of other fatty acids content, doesn't matter which solvent was used for extraction. The highest content of oleic acid was determined in the extract obtained from whole flowers by applying methylene chloride as extraction solvent. The highest ratio of oleic to linoleic fatty acid, in the range of 0.39 - 0.93, is determined for the extracts of whole flowers, petals and receptacles obtained with *n*-hexane. Also, in this extracts the content of saturated fatty acids (SFA) was higher than in extracts obtained by methylene chlorid, diethyl ether and benzene. The ratio of mono-unsaturated fatty acids (MUFA) to poly-unsaturated fatty acids (PUFA) was the lowest for the extracts obtained with *n*-hexane.

Table 3. Fatty acid composition (% of total fatty acid content) in extract of *Calendula officinalis* L.

Fatty acid*	Fatty acid composition					
	n-Hexane			Methylene chloride	Diethyl ether	Benzene
	whole flowers	petals	receptacles	whole flowers	whole flowers	whole flowers
14:0	3.51	6.44	0.63	0.68	1.94	3.17
16:0	11.29	10.89	12.22	3.10	7.09	8.79
18:0	6.89	7.28	7.12	7.78	7.25	6.84
18:1 cis	38.31	42.23	35.65	53.49	46.67	42.85
18:2	23.69	16.60	33.04	14.32	18.92	16.97
18:3	11.48	11.69	6.53	15.88	13.33	16.56
C18:2/C18:1	0.62	0.39	0.93	0.27	0.41	0.40
SFA	21.69	24.61	19.97	11.56	16.28	18.80
UFA	73.48	70.52	75.22	83.39	78.92	76.38
PUFA	35.17	28.29	39.57	29.90	32.25	33.53
MUFA/PUFA	1.09	1.50	0.90	1.79	1.45	1.28

* Shorthand designations: 14:0, myristic acid; 16:0, palmitic acid; 18:0, stearic acid;
 18:1 cis, oleic acid; 18:2, linoleic acid; 18:3, linolenic acid;
 SFA, saturated fatty acids; UFA, unsaturated fatty acids;
 MUFA, mono-unsaturated fatty acids; PUFA, poly-unsaturated fatty acids

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COFERMENTATION OF ORGANIC WASTE OF THE PILOT FARM OF SZTE MGK

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ABSTRACT

The exploitation of the actual capability of renewable energy sources can run with the choosing the most perfect utilization territory and taking the fitting technical solutions to the demand of utilization. By the planning of a biogas plant at a smaller, bigger, heavily environment polluted agricultural territory it is necessary to make experiments, measurements if it is possible in industrial size in the goal of successful operation. The experiments proved the entitling energy aimed anaerobic treatment of the organic waste at the pilot farm. The results of experiments are a little bit far from the values in the literature, because the releasing of gas the most intensive after the stabilization, and because the manure is not the freshest, the gas production can be extremely smaller because of the evaporation and resting of the manure. In my experiments there can be high pressure problems when there is no perfect gas removing, which is can destroy the instruments.

Keywords: environmental protection, sustainable agriculture, cofermentation, organic waste, energy production from agricultural byproducts.

1. INTRODUCTION

The importance of waste treatment is extremely increasing, because of the environmental aims are the main driving force. The stricter regulations for land filling will to lead to the development of alternative treatment methods for waste management. For the agro-mechanical research, animal rearing's and food-industry's waste material, the secondary-tertiary biomass, is a highest concern. This technology is versatile and relatively simple to use as a reliable and effective means of producing a gaseous fuel from various organic waste. The most common application has been the digestion of animal dung, agricultural, and food-industrial waste. This was studied by our Institute in our pilot farm of our Faculty. The 50 dairy cow, family sized model farm was built in the summer of 1991 as a result of □olland – Hungarian cooperation at the territory of the Faculty. The new pigfarm with 30 sows and the new goatfarm with 100 nannies were given to the Faculty on the 25th of April of 2001. Trough the livestock data the annual dung production were specified and calculated the energy by the biogas production coefficients in my formal reports. I want to find solution by the cofermentation of the organic waste, for example: pig manure, cattle manure, waste water of cheese factory, milking parlour to treat the dangerous materials attached with the energy production.

2 METHODS AND MATERIALS

The experimental laboratory was established in the SZTE MGK's formally social rooms: in one bath room and in one dressing room with 4 vertical fermentors filling every requirements of the perfect operation. The composition of the substratum models the content of the daily production of the organic waste. The quantity of the different type of waste water is measured, the mass of the manures is calculated by the literary data in the 1. chart FENYVESI-MÁTYÁS (2001). Trough the experiments we can construct the best formula concerned with the highest gas production. The pilot farm has beyond the mentioned waste materials manure from ships, poultry, ostrich, and from the primary plant production: winter wheat, maize, sunflower, lucerne, hay, but the utilization depends on especially the type of the manure, the technology of the dung removal. The utilization of the ship manure is solved, the poultry dung contents floating and residual elements, which can cause problems through the fermentation. That's why I chose the pig manure and the cattle dung to use energetically. To produce energy from the plants is another question, which is not the topic of this paper.

Table 1. The calculation of the organic waste produced by the SZTE MGK pilot farm

	Number of animals	Dung production/ Day (kg/d*peace)	Total organic waste (t/d)
Cattle	47	46	3,7
Pigs	22	15	2,1
Waste water of creamery			6
Waste water of milking parlour			1
Total			12,8

Table 2.: The animal originated organic biomass quality in the substratum and the possible gas yield from this waste

The components of the substrate	Weight (kg)	DMC (%)	DMC (kg)	OMC /DMC. (%)	OMC (%)	OMC (kg)	Theoretical gas yield (l/d)
Cattle dung	14,5	21,32	3,09	60,68	12,94	1,88	375 *
Pig manure	8,2	22,49	1,84	71,40	16,06	1,32	586 **
Waste water of creamery	23,4	0,08	0,0187	51,25	0,0410	0,0096	0
Waste water of milking parlour	3,9	0,15	0,0059	40,00	0,06	0,0023	0
Total:	50	9,92	4,96	64,62	6,41	3,21	961

Dry matter content = DMC; Organic matter content –OMC; *200 l/kg OM; **445 l/kg OM.

Table 3.: Determination of the dry matter content of different straw manures

	Pig sample weight (g) I.	Pig sample weight (g) II.	Pig sample weight (g) III.	Pig sample weight (g) IV.	Mean	Cattle sample weight (g) I.	Cattle sample weight (g) II.	Mean
Tara	315,05	306,2	70,56	323,2		113,01	163,6	
Brutto wet sample weight	421,07	686,8	531,46	701,1		419,2	683,8	
Brutto dry sample weight	340,46	387,8	169,2	410,6		180,59	270,6	
Netto wet sample weight	106,02	380,6	460,9	377,9		306,19	520,2	
Netto dry sample weight	25,41	81,6	98,64	87,4		67,58	107	
DMC (%)	23,97	21,44	21,40	23,13	22,49	22,07	20,57	21,32

Dry matter content = DMC; Organic matter content –OMC;

Table 4.: Determination of the organic matter content of different straw manures

Pig								Mean
Tara(g)	68,44	67,87	67,5	23,36	71,03	67,35	376,7	
Brutto dry sample weight (g)	83,21	88,71	95,42	25,1	96,05	138,73	457,6	
Netto dry weight (g)	14,77	20,84	27,92	1,74	25,02	71,38	80,9	
Brutto inorg. Residue (g)	71,75	73,44	74,8	23,92	79,13	90	403,7	
Netto inorg. Residue (g)	3,31	5,57	7,3	0,56	8,1	22,65	27	
Org. matter weight (g)	11,46	15,27	20,62	1,18	16,92	48,73	53,9	
OMC/DMC. (%)	77,59	73,27	73,85	67,82	67,63	68,27	66,63	71,40

Dry matter content = DMC; Organic matter content –OMC;

Table 5.: Determination of the organic matter content of different straw manures

Cattle							Mean
Tara(g)	68,03	67,36	67,33	51,1	51,15	51,15	
Brutto dry sample weight (g)	105,48	120,58	107,97	55,36	59,88	56,51	
Netto dry sample weight (g)	37,45	53,22	40,64	4,26	8,73	5,36	
Brutto inorg. Residue (g)	81,97	86,44	82,53	52,76	54,48	53,34	
Netto inorg. Residue (g)	13,94	19,08	15,2	1,66	3,33	2,19	
Org. matter weight (g)	23,51	34,14	25,44	2,6	5,4	3,17	
OMC/DMC. (%)	62,78	64,15	62,60	61,03	61,86	59,14	60,68

Dry matter content = DMC; Organic matter content –OMC;

To measure the dry matter content I heated the straw manure till mass permanence in 105 °C in the case of more relatively big mass of sample. I determined the organic matter ratio compared the dry matter content from the heating loss on 700 °C, at present of air. In my formal calculations the dry matter content of the cattle straw manure was 25%, the organic matter content was 19% by the literature's data, but the local data are about 21-22%, and 13-16%. These differences can decrease the recovered energy. I examined the earlier supplied,

almost half year old dung first, and after it I changed them for fresh waste, it was in mezophil temperature range, in intermittent-duty. I let in the fermentor from the digested bio-manure about 5 volume % quantities to generate the fermentation, to accelerate the stabilization, the digestion. I chose the batch system, because to change the composition in the continuous system can produce more efficient exploitation of the equipments, the opportunities in the laboratory (for example the shortage of the fridge capacity) disables the permanent quantity of the components. The results of investigation I examine practically in two parts, because the long periods compressed produce misshapen figures. I controlled the methane content with Dräger X-am 7000 portable gas tester. Unfortunately I wasn't able to measure the gas production and methane content at the same time regularly, so I made charts and figures for the intensity of the gas releasing.

3. RESULT AND DISCUSSION

Results in connection with the development of the half industrial sized laboratory equipments

There was in the top level of the substratum a strong straw layer in the formal fermentors without automatic mixing, so I lift the mixer turbine higher and it had to size the axle for the power-driven mixing. I constructed the power-driven mixer to the fermentor in my invention, which produced the good efficiency of the biodegradation with one minute working duration eight times daily. Of course it needed more than two month retention time. Even so the emptying of the fermentor wasn't able to solve, the straw residue caused serious clogging up. It needs to check the possible clogging up of the gas tube too, because it can produce big pressures, destroys the cover of the fermentor.

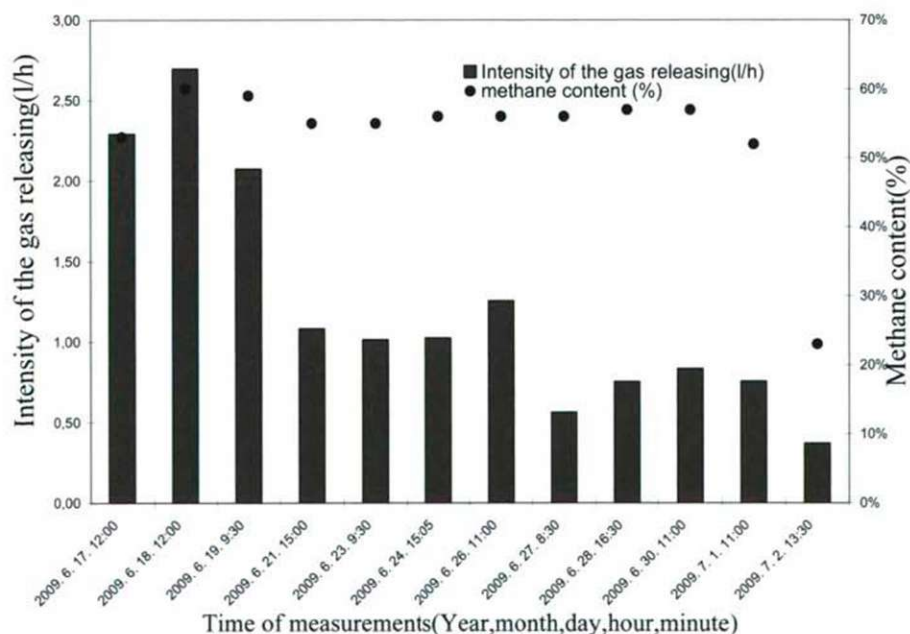


Fig.1. Data of the gas yield (1. sequence)

RESULTS IN CONNECTION WITH THE GAS YIELD

I calculated the theoretical gas production values with the input data in the *table 2*. based on the generally available literature coefficients. The measured data essentially differs from these, but the conditions are the same (38 °C). I diagnosed that the biodegradation ran in the ordinary way. The rapid increasing of the methane content is parallel with the changing of the intensity of the gassing, the decreasing doesn't follow it, quite well kept the relatively high, 50-60 % ratio (*Picture 1. Picture 2.*). Comparing the data, the gas production of the manure which was stored in anaerobe condition for almost half of a year, is faster decreasing, the peak production was almost the 60% of the fresh one. In the aspect of methane content there is no significant difference between the two compositions. The energy balance is negative, because besides the 21 MJ/Nm³=5,9 kWh/Nm³ (60% methane) heating value I produced max. 0,1 m³/d biogas, which energy content had approximately 0,59 kWh(2,1 MJ), with daily 8-9 kWh electrical energy used for the heating and the circulation of the heating water.

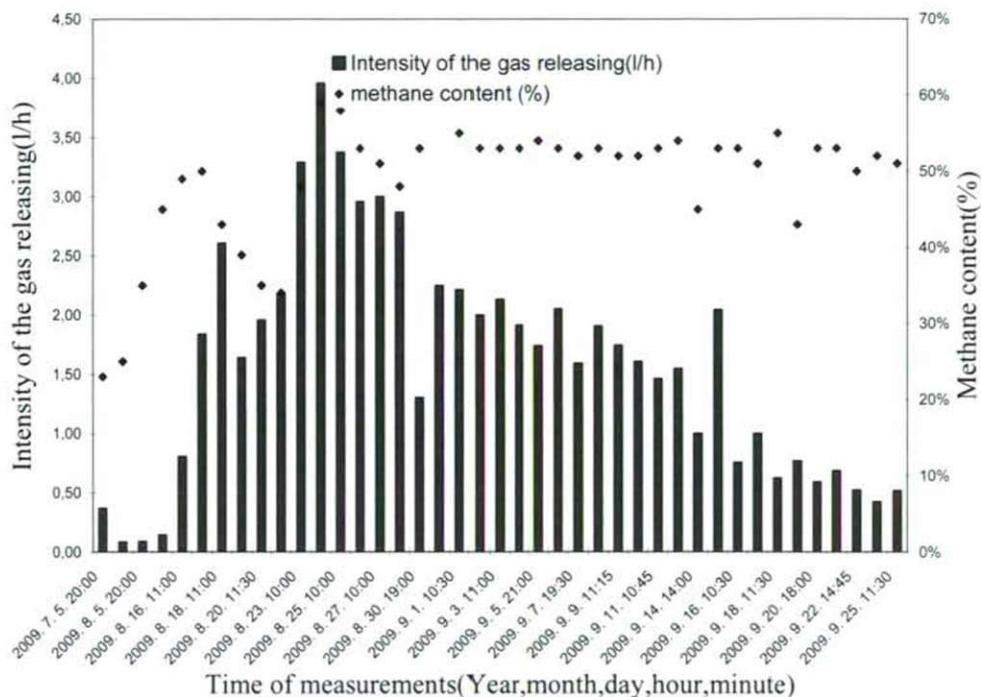


Fig.2. Data of the gas yield (2. sequence)

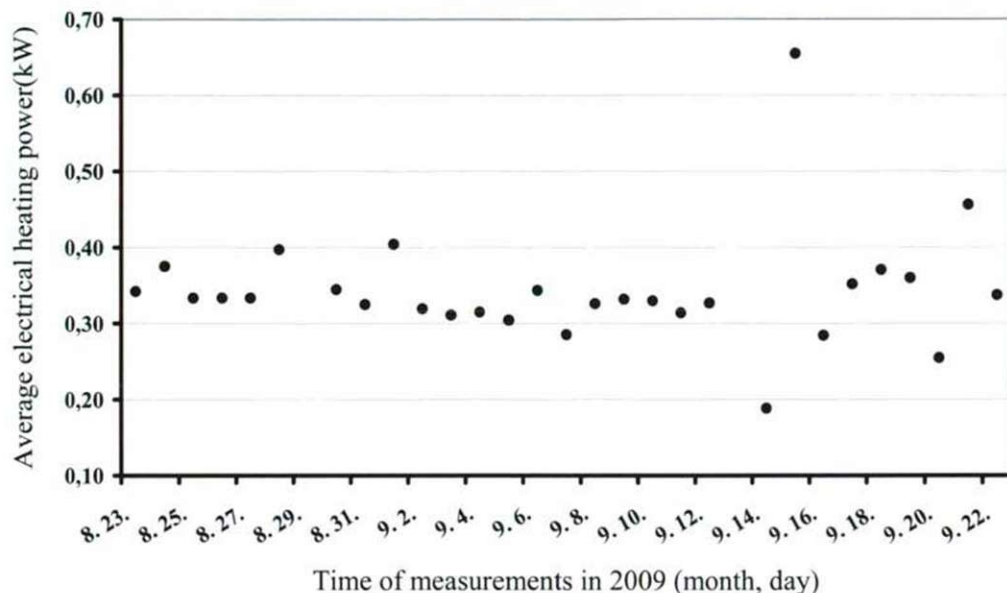


Fig.3. The energy consumption of the fermentation process (heating and heating water circulation)

Table 6.: Examination of the digested (bio-)manure

	Netto wet weight (g)	Nettó dry weight (g)	Netto inorg. Residue (g)	Org. matter weight (g)	OMC/DM C. (%)	DMC (%)	OMC (%)
Digested liquid phase	299,7	34,1	11,55	22,55	66	11,4	7,5
Digested solid phase	457,3	80,9	27	53,9	67	17,7	11,8
Mean						14,5	9,7

Dry matter content = DMC; Organic matter content –OMC;

I divided the digested material by the liquid content in two phases, I measured separately, and calculated the important data. The two phases represented the same masses inside the whole weight. (Table 6.). In the view of degradation the dry matter content was decreased of the straw manures, the ratio of the organic matter content compared to the dry matter content didn't change.

4. CONCLUSIONS

The experiments justified the energy aimed anaerobic treatment of the organic waste of the pilot farm. The laboratory results didn't reach the theoretical values, because the gas realizing after the stabilization the most intensive, the available amount of energy can be dramatically less in consequence of the evaporation, resting of the dung. By the literature the presents of the

methane decreases the methane production, that's why the process can be self controlled, but in my experiences it would be high pressures, that is in the case of imperfect gas removing it can destroy the techniques. That's why it is important the automatization of the gas collection.

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IMPORTING AND ANALYSING LIVE ELECTROENCEPHALOGRAPH DATA IN MATLAB/SIMULINK ENVIRONMENT

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ABSTRACT

The utilization of non-invasive human-computer interfaces makes it possible to develop limb prostheses that recognize the cognitive intentions of the user, and act accordingly. Our goal is creating such a prosthesis that is actuated by pneumatic artificial muscles (PAM). One of the possible approaches to accomplishing this is electroencephalography (EEG). In this paper we describe a method of adapting EEG signals acquired with a concrete EEG device, the Emotiv EPOC, to the MATLAB/Simulink environment, and recommend the next step to using them.

1. INTRODUCTION

The use and development of non-invasive human-computer interfaces is a new and promising area. Research results can be used in a wide range of areas, including rehabilitation of motion-impaired people with limb prostheses that require no special control methods from the user's point of view, but detect and react to the intentions of the user in a natural way. Our goal is developing a prosthesis that accomplishes this goal by using pneumatic artificial muscles as actuators and an electroencephalography-based brain-computer interface as its data source.

Electroencephalography (EEG) is the field of measuring, processing, and analysing small electric voltage fluctuations with a frequency between DC and approximately 100 Hz, generated by neurons firing in the brain, that can be measured using electrodes attached to the scalp, commonly known as brainwaves. Patterns in these voltage fluctuations reflect specific activities in the brain. Depending on the number and parameters of sensors used, recognizable activities range from simple emotions (e.g. alertness) to cognitive concepts, such as „left” or „disappear”.

The most important property of EEG is its non-invasiveness, which means it is not needed to break the integrity of the human body in any way (e.g. needles) to use the technique. Multiple types of sensors exist. Most medical devices require a conductive, adhesive substance to attach to the scalp. Other designs use a headset form factor that supports the sensors in their intended positions, eliminating the need that the conductive substance be adhesive. Some devices also do not need any separate conductive substance for proper operation.

A similar technology to EEG is electromyography (EMG). EMG operates by the same general principle as EEG, and it is generally used to sense and analyse electrical activity of skeletal

muscles. Some EMG data can be present in EEG signals, especially activity resulting from ocular and facial muscle actuation in data acquired from sensors close to the forehead, shown in Figure 4. This can be used to detect other states of the user, e. g. blinks, direction of looking, and facial expressions.

The aforementioned states of the user are reflected in the spectrum and spatial distribution of electrical fluctuations measured by the sensors. These patterns can be recognized using data classification algorithms.

A good environment to experiment in with different processing and classification methods is vital to obtain the best possible results. We chose Simulink, a part of the well-known MATLAB environment, as it also provides tools to simulate the mechanical system of the prosthesis we are developing.

2. MATERIALS AND METHODS

The concrete EEG device we are using is an EPOC neuroheadset by Emotiv Systems. It is a wireless PC peripheral that features 14 channels, 2 reference electrodes, and a 2-axis (yaw and pitch) gyroscope. Its sensing elements are wet electrodes, which mean they have to be moistened with a saline solution to maintain proper electrical contact with the user's scalp [1]. The positions of the electrodes are in accordance with the international 10-20 system. The EPOC is a commercially available product that is sold with different types of licensing. We chose the Research Edition, because it gives access to raw EEG and gyroscope data. The EPOC set can be seen in Figure 1. On the left is the hydrator pack for moistening the felt pads of the sensors, which are currently inserted into the hydrator. On the right is the wireless receiver that can be connected to a PC. The next item from the right is the saline solution used for moistening the felt pads to ensure high contact quality and good electrical conductivity. On the bottom is a standard mini-USB cable for charging the battery of the headset. In the centre is the headset itself.



Figure 1. The Emotiv EPOC set

The Simulink environment currently lacks support for the EPOC. To be able to conduct real-time experiments, we need to be able to directly import live streams of data from the headset. To this end, we have created two Simulink blocks that accomplish this task. One of these blocks import the 14 EEG channels, and the other adapts the gyroscope data. The latter was created because the method required to acquire gyroscope data from the headset is almost the same as for EEG data, so it was straightforward to implement, and could be used to test the implementation controllably, as head movements are easily reproduced multiple times and provide more predictable output than EEG patterns.

3. RESULTS AND DISCUSSION

Multiple methods exist that enable the use of the collected data in simulations. One of these is recording the data to a file, and then using the file as the data source. A disadvantage of this method is that it permits only off-line processing of the data. Another method is using C MEX S-functions. A C MEX S-function is an extension to the MATLAB environment written in the C programming language that can be used as an optionally multi-input, multi-output system in Simulink. The Emotiv EPOC Research Edition Software Development Kit (SDK) provides ANSI C libraries to facilitate communication with the headset. A C MEX S-function, being a C program, can thus access the data provided by the SDK, and make it available on its output ports in Simulink. As mentioned above, two Simulink blocks were created this way, one for gyroscope data, and one for the 14 EEG channels. These two blocks can be seen in Figure 2.

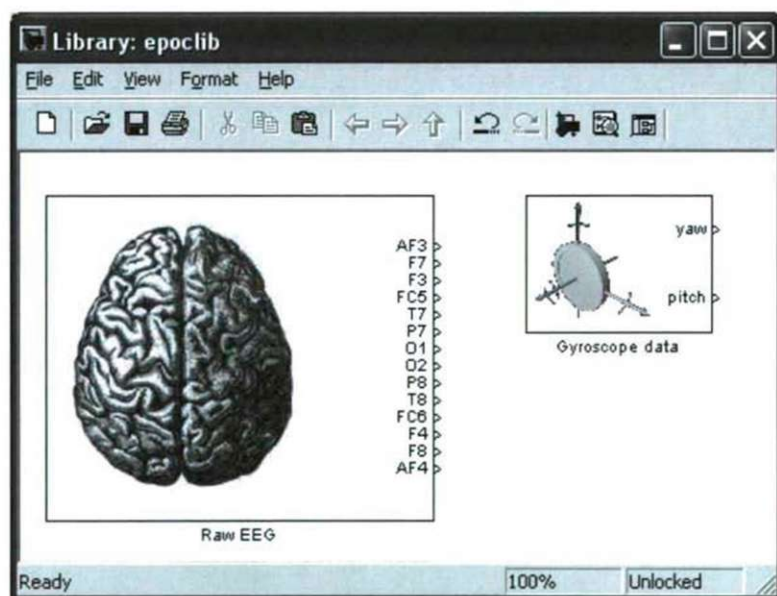


Figure 2. The Simulink blocks for EED and gyroscope data

The process of reading live data from the headset can be divided into three distinct major stages: initialization, acquisition, and clean-up. The first task of the initialization stage is to establish a connection to the Emotiv headset software called the EmoEngine. The available headsets are then discovered. The next step is to set up buffers for data acquisition, and to start the process itself. In the acquisition stage, measurements are taken periodically, and the results are stored in an internal data buffer in EmoEngine. This buffer must be read to a local buffer at a rate that does not permit the buffer in EmoEngine to overflow. As our Simulink block always reads the whole EmoEngine data buffer, and the smallest local buffer that can be set up holds one second of data, an overflow condition is theoretically possible only if the sampling time is longer than one second. The outputs of the aforementioned Simulink blocks can be updated from the local buffer. In the clean-up stage, which in the case of Simulink blocks, is executed on stopping the simulation, first the data acquisition is disabled using an explicit function call. The local buffers are then freed. As a last step, the clean-up stage closes the connection to EmoEngine. For testing purposes, we visualized EEG channels F3 and F7 on a scope in real time. As the raw signal acquired from the headset is discrete-valued and discrete-time, there are sharp jumps on the original graph of the channels at time values that are multiples of the sampling time. This can be solved by using a low-pass filter on the data. On Figure 4, the signals were filtered using low-pass filters with a cut-off frequency of 20 Hz. Real-time operation was achieved using a third-party extension called RTBlock, shown in Figure 3. The artefacts circled in red in Figure 4 are electromyographic signals denoting blinks. The yellow graph corresponds to channel F3, and the purple one to F7.

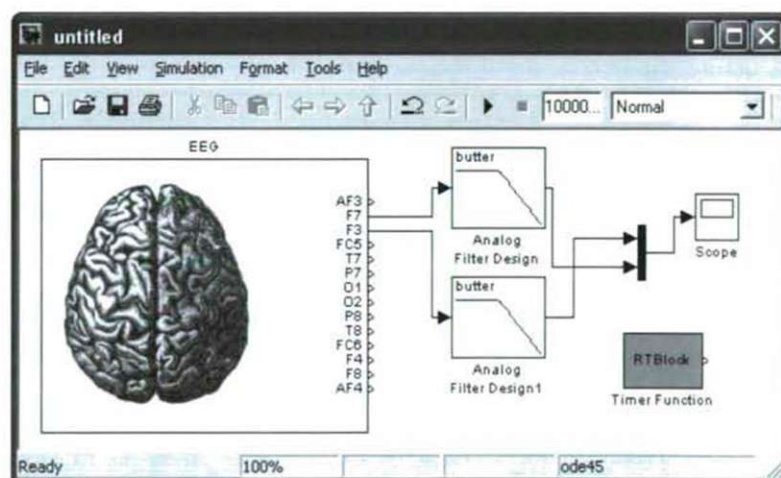


Figure 3. The Simulink model for experimental filtering

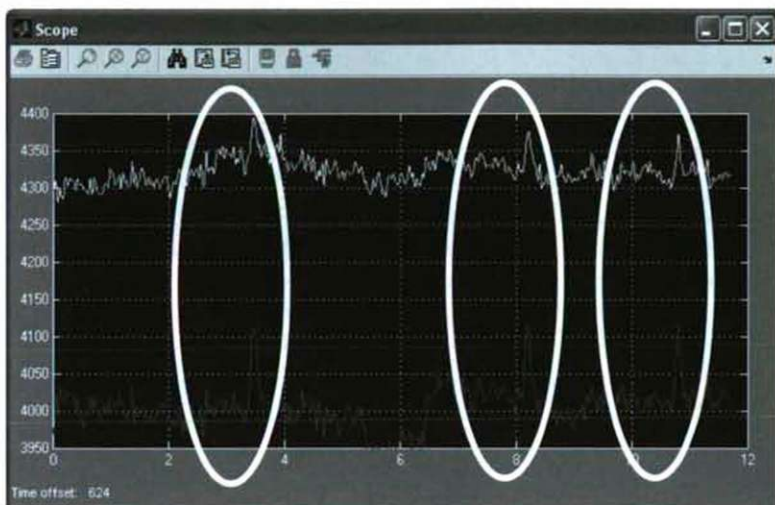


Figure 4. Measurements taken on channels F3 (yellow) and F7 (purple), filtered with Butterworth low-pass filters with 20 Hz cut-off frequency

Having imported the signals, it is possible to experiment with various signal processing and data classification tools. For example, as relevant information is carried by the spectrum and spatial distribution of the signals, it is useful to carry out frequency domain analysis on the data. Simulink provides various tools to support this, such as Fourier and wavelet transforms, filters, and other signal processing blocks.

For our task of controlling a prosthetic limb, a major challenge is to reliably detect signatures of the user's cognitive intentions in the data. Multiple present EEG-based brain-computer interfaces, such as the ones described in [2] and [3], utilize a type of supervised learning classifier to accomplish this. There has been research on using neural networks to classify the EEG data that shows promising results, described in [4].

4. CONCLUSION

In this paper, we described the method of importing live EEG data to the Simulink environment, and discussed the possible approaches to using them as a data source for controlling a pneumatic artificial muscle actuated limb prosthesis. It was also stated that, besides experimenting with signal processing and data classification methods, it is possible to simulate the mechanical hardware of the prosthesis, and control the simulated hardware with the outputs of the classifier, making it possible to test the whole system in a virtual environment, facilitating changes, and accelerating research.

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EDUCATIONAL SOFTWARE USED IN CHEMISTRY FOR DETERMINING CHEMICAL COMPOSITION/MOLECULAR WEIGHT CHEMICALS

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ABSTRACT

We must admit that within the last years the importance of using computers became more and more obvious. Thus it was important to train specialists with skills in using computers to find, acquire, and understand information; to apply information and communication technologies to processing it; to build virtual models of real world objects and actions.

Advanced information technologies have increased motivation to study some subjects which may have nothing in common with computers, because they facilitate learning by considering the individual characteristics of the students, by providing feedback information amongst pupils/students and programs, and by increasing the efficiency of education.

To sum up, we stated that implementation of information technologies in teaching/ learning is a priority. The best example is this paper work. This is further evidence of the interference between technology and traditional methods.

It's no surprise that in an information society, the real and the virtual world tend to merge, thanks to new communication and information technologies, education is able to change its traditional methods and be "up to date".

Educational software of this paper is addressed to pupils/students who wish to use another variant, which is much easier and more attractive in terms of solving some calculations to determine the chemical composition of molecular weight chemicals.

The software can be used by any pupil/student with minimal knowledge of PC use, since it has a modern design and attractive interface, with the help of Microsoft Access.

Keywords:

molecular weight, chemical composition, database, interface.

1. INTRODUCTION

Over 20 years have passed since the educational system introduced computerization. If above normal specialist in our field could not dream to having a personal computer at the office, now we can say that they we cannot imagine a home without a computer.

In all cases, the computer is a tool who helps us organize our learning environment better, guided by our teacher or developed by software application. Computers provide self-teaching, but remain an educational tool which assists training - self-teaching; we combine it with other means and methods of work organization, as elements of the teaching strategy.

In the second half of last century, the changes of the planet (information explosion, population growth, economic development, and political empowerment) have generated new demands

from school in general and university in particular, especially with regard to meet high education demand.

We should not wonder whether training and evaluation improves by using computers, but how can we use them better for their unique qualities, which distinguish them from other media. These unique qualities are computer interactivity, precision operations, ability to carry out and provide multiple representations of dynamic phenomena, and especially how they interact differently with each pupil/student separately.

Almost all research show the benefits of using computers compared with other learning methods and assessment:

- ❖ reducing the time of study;
- ❖ enabling a positive change towards complex attitudes;
- ❖ computers are used more efficient in teaching and learning than any other method;
- ❖ computer-assisted instruction is more effective as an alternative form of training than alternative methods;
- ❖ students who learn slowly and those left behind have better results than top students.

Chemistry is a natural science and enables science progress. To show pupils/students that chemistry is present all around us and it is essential in everyday life, they must observe that learning this discipline not only allow the acquisition of theoretical knowledge but develops practical skills, too.

Chemistry teaching-learning methods require the active participation of pupils/students for learning and being aware of new knowledge. A modern lesson is an active lesson. This can be achieved only if the teacher uses his teaching skills. The teacher must find different ways to determine his pupils/students to attend class, to use active techniques of self-control, to keep heuristic conversation, collective debate, by questioning and investigating.

2. DETERMINING THE CHEMICAL FORMULA OF SUBSTANCES WITH MICROSOFT ACCESS

Using Microsoft Access, you can manage all information in one database (Database). Inside this Microsoft Access file, data are divided into separate structures called tables (Tables); to view, add, and update data from a table using forms (Forms); data are available and can be extracted using queries (Queries); data could be analyzed or printed in a special format using reports (Reports). Tables, Queries, Forms, and Reports are the most important entities to create an Access database.

Data is stored in one location (the table), but can be viewed in different forms: query, report or form. When that changes and saves the information in table then it will be seen in other forms. To find and retrieve information only in certain conditions specified by the user and who include information from several tables, you can create a query.

To view, enter or change data directly in a table, you have to create a form. When opening a form, Microsoft Access extracts data from one or more tables and displays them on screen using the display method selected/created by the user (by shape).

Chemistry, and other related disciplines (Physics, Mathematics, etc.) enjoyed new perspectives due to computers and Internet training (teaching/learning/assessment). Chemistry learning by computer is a challenge and a necessity at the same time.

Using Computer Assisted Training in Chemistry teaching is a method more efficient than any traditional method, for at least two reasons: attractive method of teaching/learning; the opportunity of a virtual presentation of chemical phenomena which is impossible otherwise. Chemistry uses a wide variety of educational software for learning used to acquire new knowledge through static or dynamic simulation of events/processes. This kind of software has the advantage that it enables us to see some images again and use the so-called image selection. Still, there is some software that shape up features of objects and concepts (with diagrams, graphs, etc.).

There is also some software that represents still models and turns them into dynamic, like animations. They stimulate the functionality of high complexity devices or devices impossible to study directly. Educational Software is designed to be interactive.

The book and the additional software are designed as a new tool for the Chemistry teacher and not as a substitute.

Therefore, we have developed this application, which primarily addresses to secondary schools students and for I and II-year college students, to develop their understanding of the determination of chemical formulas, knowing the percentages corresponding components of substances, or their mass report.

We hope that program will be useful to pupils/students and it is a means of verification of science knowledge.

Composition of substances can be expressed by:

- ❖ chemical reports;
- ❖ mass reports;
- ❖ weight percentage within the molecules' constitution.

The application opens with an attractive interface (Fig. no 1), which in turn will open the "Application" form (Fig. no 2), which includes other forms. When you click the three buttons on the Application form, forms will open up.



Fig.1. Interface

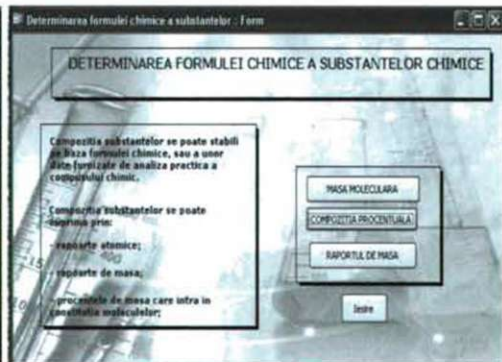


Fig.2 Form_Application

Fig.3. Form_Determination of molecular weight and percentage composition

Fig.4. Form_Application Molecular computing and percentage composition

"Molecular weight" form calculates molecular weight of substances we want. As we progress in entering data in combo boxes and text boxes below them, the chemical formula will be played in the side and so, whenever we will be filling in the text box, calculated molecular weight be displayed.

Fig.5. Form_Determining the chemical formula knowing the percentage composition

Fig.6. Form_Calculation of chemical formula knowing the percentage composition"

"Percentage composition" form merely determines the chemical formula of a substance, knowing the percentage quantities of elements constituting the substance. (Fig. no. 5; Fig. no. 6).

For example, if the analysis suggests that a substance containing 37.92% A, 20.72% B, and 41.36% C, the chemical formula should be $A_xB_yC_z$, the coefficients x , y , and z must be determined.

Steps in this form are:

- ❖ substance components and their respective percentages are selected;
- ❖ note atomic weights of substances that make up the particular substance down in the table;
- ❖ calculate the number of gram-atoms of each element within the molecule, dividing it to the atomic weight percentage of that element;
- ❖ determine the number of atoms of each element contained in its chemical formula (we divide the numbers obtained to the lowest quotient);

- ❖ finally, we write down the resulting chemical formula.

DETERMINAREA FORMULEI CHIMICE / RAPORTUL DE MASA

A) In raportul de masa la masa atomica a elementelor respective.

B) Formula chimica a substantiei

Table of atomic weights (MASA ATOMICA) with columns for element symbol and atomic weight.

Buttons: Găsiți, Ștergeți

Fig.7. Form_Knowing the chemical formula determination of mass ratio

DETERMINAREA FORMULEI CHIMICE / RAPORTUL DE MASA

A) In raportul de masa la masa atomica a elementelor respective.

B) Formula chimica a substantiei

Table of atomic weights (MASA ATOMICA) with columns for element symbol and atomic weight.

Buttons: Găsiți, Ștergeți

Fig.8. Form_Application Calculation of chemical formula knowing the mass ratio

The form “Weight percentage” simply determines the chemical formula of a substance, knowing the mass ratio of elements constituting the substance. (Fig. no. 7; Fig. no. 8). If the analysis suggests, for example, that a substance containing the mass ratio A: B: C = 1: 1: 4, the chemical formula should be $A_xB_yC_z$, the coefficients x , y , and z should be calculated.

The steps in this form are:

- we selected the components of the substance and their corresponding weight percentage;
- we note down the atomic weights table record of substances that make up the particular substance;
- we divide the atomic mass ratio by the weight of that element;
- we calculate the number of atoms of each element contained in its chemical formula (we divide the numbers obtained to the lowest quotient);
- finally, we write down the resulting chemical formula.

3. CONCLUSIONS AND PROPOSALS

- ❖ Using computers as an education means in teaching Chemistry is a real factor of progress, helping to optimize the training-education process, both by *improving the quality* of the teaching-learning process and motivation by increasing the motivation factors involved in this process;
- ❖ Generalizing Chemistry learning based on introducing ICT and communication as part of an effective method framework could improve the competence and development to attract learners to this area;
- ❖ The key element of using computers as teaching technology means is not mainly material, whose failure or failure is often invoked, but also the human factor (decision makers, trainers, trainers of trainers);
- ❖ Any attempt to reform this area should start by educating them in the spirit of the information society.

The development of the Chemical University system is aimed at creating usable means both for pupils/students and perhaps especially for teachers, given that its success depends on a very large extent on how responsive teachers are to making such educational programs more attractive. Feedback is always assured.

Developing educational software, with the help of the learners, is a way to attract those who are less interested in Chemistry.

I must mention that this application is part of my doctoral thesis (still unfinished at this point), which includes a number of such applications developed with Microsoft Access and more.

The starting point of the implementation of this system was that the information could greatly facilitate the study of Chemistry of pre-university and university Romanian teaching system, because using computer knowledge can become more intuitive and attractive.

Those interested in remodeling the Romanian education system required by the EU reform should be focused not so much on obtaining funds or national strategies, but especially on teacher education: psychological-technological preparation and teaching-method training.

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THE NUTRITION SITUATION AND THE FOOD SAFETY CHALLENGES OF THE 21th. CENTURY

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ABSTRACT

This study attempts to provide a brief picture on the growth of population and wages in developing countries that will have a much more direct effect on the demand for agricultural goods than that of the more developed ones. On one hand, huge demands are not satisfied, that means that the growth in wages will effect in direct demand for food (as the evidence of the Engel law). On the other hand, over a certain wage level the consuming structure will move towards foods with higher nutritional value (as the evidence of the Benett law), which results in the transformation of demand structure.

This paper introduces factors which can jeopardise the sufficient food security. New element is the rivalry between energy crop farming and food production due to the high oil prices. Furthermore the competition for the scarce available goods and resources (like soil and water) has an impact on increasing of food price. Because of climate change huge part of arable lands will disappear. The questions of animal and plant hygiene make this issue more complicated.

1. INTRODUCTION

The detailed and long term analysis of the changes of food consumption is not autotelic at all. We can make conclusions for the Hungarian experts working in agriculture based on research. The agroecology sector analyses procedures and phenomena in order to reveal the factors affecting development, whereas the main goal of agroecology is to define the ways of development and the future trends throughout analysing the past and present. (Vasa-Villányi, 2008)

The food consumption side is the user of the production, the demand itself. We always should be aware of the way the market changes and of its requirements. Unfortunately, the production launched its output without really being aware of the demands, forcing the supply to the market. Though market processes work other way. This is why it is essential to have realistic knowledge of the demands of the market. What conclusions can we draw for the agriculture?

People gain or regain energy necessary for surviving when they nourish. The food needed for this is produced by agriculture. It cannot be disregarded, even if agricultural production in developed countries gives only 2% of the GDP. I would consider wiser not to talk about its repression or its decreasing essence, but about its modified condition: agriculture itself changes as it tries to adapt to global changes. Despite the fact that it loses its socio-economic importance, the agriculture is not stagnating. Even, as nutritional ideas and images change (the growing consciousness to consume better quality food), we can witness the strengthening of stock-breeding.

2. TRENDS OF DEVELOPMENT IN THE FIRST DECADE OF THE 21ST CENTURY

The food production worldwide will be demand-driven, considering the population, the wages and their distribution as well as urbanisation. It is evident that the results of analysing this region can be applied for the global world, where similar processes are in process.

The increase of the growth potential of world population will slow down compared to the previous decade: the annual 1,26% growth will decrease to 1,10%. This is how world population will be over 7 billion by 2015. Almost half of the population will live in countryside.

The forecast of the OECD-FAO – despite the current world economic crisis- expects growth of the GDP. However, significant development will not have the same extent throughout the whole region; the main areas will be the big and developing (India, China, Brazil) and oil exporting countries. Parallel to this, wages will grow dynamically, though its distribution will differ by areas.

Table 1. The average pace of annual growth of population and wages (2005-2015)

	Population			Wages		
	Pace of annual growth		Rural	Pace of annual growth		Proportion
	1996-2005	2006-2015	%	1996-2005	2006-2015	%
World	1,26	1,10	50,8	2,64	2,90	100
Africa	2,24	2,08	60,3	3,50	3,78	1,8
Latin-America	1,47	1,20	22,4	2,03	3,61	5,7
South-America	1,00	0,87	19,2	3,02	3,21	28,7
Europe	0,00	-0,11	26,7	2,33	2,17	32,1
Asia	1,28	1,07	60,1	2,64	3,13	30,21
Oceania	1,36	1,10	26,7	3,48	3,09	1,6

Source: OECD-FAO Agricultural Outlook 2006-2015

The growth of population and wages in developing countries will have a much more direct effect on the demand for agricultural goods than that of the more developed ones (Kiss, 2002). On one hand, huge demands are not satisfied, that means that the growth in wages will effect in direct demand for food (as the evidence of the Engel law). On the other hand, over a certain wage level the consuming structure will move towards foods with higher nutritional value (as the evidence of the Benett law), which results in the transformation of demand structure.

Urbanisation has double effect: it affects supply as well since the output of the agriculture decreased due to migration to towns not being involved in agriculture. By 2015 75% of the world population will live in developing countries, while demand for food will grow and the structure of consumption will change.

The consumption of agricultural products has been increasing enormously. Increase in demands mentioned in the above paragraph is realised in developing countries. Due to

increased demand for quality food, demands for animal products, fruits and vegetables is growing.

*Table 2. The average pace of annual growth of production and consumption
(2005-2015)*

	Production			Consumption		
	(%)			(%)		
	All	OECD	Non-OECD	All	OECD	Non-OECD
Wheat	1,2	1,0	1,3	1,1	0,9	1,2
Rice	1,5	0,0	1,6	1,3	0,1	1,4
Cereal feed seeds	1,6	1,3	2,0	1,5	1,4	1,6
Oily seeds	2,2	0,6	3,3	2,4	1,4	3,1
Beef	1,9	0,7	2,7	2,0	0,8	2,7
Pork	1,9	0,8	2,4	1,9	0,8	2,4
Poultry	2,4	1,6	3,0	2,4	1,8	2,9
Milk	1,5	0,7	2,2	-	-	-
Butter	1,6	-0,4	2,8	1,7	-0,3	2,7
Cheese	1,5	1,4	2,0	1,6	1,5	2,0
Vegetable oil	2,6	1,5	2,9	2,7	1,8	3,2
Sugar	1,9	-1,1	2,9	1,7	0,4	2,2

Source: OECD-FAO Agricultural Outlook 2006-2015

The growth of demand also generates export. The pace of output growth in developing countries exceeds that of developed countries as for each examined product group, according to the table. Developing countries' produced quantities are available in world markets as well. As a result, we do and will witness a close fight. Hungarian producers have to face the usual competitors as well as the developing countries, since they have lower production costs (Kapronczai-Udovecz, 2009), this is how they can enter markets. This is why their production efficiency is higher.

The tendency is that the traffic of manufactured goods will grow aggressively compared to mass products. The developing countries usually enter into the mass products' market, whereas developed countries produce added valued goods for the world agricultural market.

3. ISSUE OF FOOD SAFETY

The changes in food consumption lead to the strengthening of food safety, which means to deal with food safety issues. It should happen because this has a close connection with food prices. It may have a strong effect on the environment, operational conditions of Hungarian manufacturers, as well as on their export trade. In case someone disagrees that supplying the poor with food is a major issue today, here are some convincing data for them: between 2000 and 2002 malnutrition was evidenced in case of 852 million people. The number of world population will be 7,5 billion by 2020, and 9 billion by 2050, which means that a further 1,5 billion people should be supplied with a certain quantity and quality of food.

Table 3. The world population and the average pace of its annual growth (2000-2050)

	Annual pace of growth (million people)	Population (billion people)
2000	73,0	6,06
2010	71,0	6,79
2020	61,0	7,50
2030	47,0	8,11
2040	32,9	8,58
2050	11,0	8,91

Source: United Nations Population Division

Experts agree that climate changes are going on these days, which changes effect agricultural production too. The manifestation of extreme weather conditions are getting common: draughts, floods and storms are everyday phenomena. While a huge part of arable lands will disappear in developing countries thanks to global warming (some sources estimate this increase more than 10%) during the first 25 years, developed countries can begin cultivating their northern territories also (Kiss, 2007). This is how poorer countries will need to import food, which will be rather hard, since wages will also decrease thanks to devastations. The phenomenon of malnutrition and starvation will not be unusual. Let alone the fact that disasters will destroy infrastructure too, making it harder to get the food supply.

It may be in connection with climate change as well, but the occurrence of diseases of the flora and fauna are also a risk factor. Foot-and-mouth disease, mad cow disease, bird flu and other new types of flu, the most aggressive phytocidal pests are getting more and more common. Another risk factor is that they may affect humans. Some of the reasons responsible are the globalisational, migrational and trading processes. This will have a stronger effect on developing countries, since there are no methods and tools to prevent and treat epidemic (Tóth et al, 2008). As a consequence, the production quantity will decrease, which will affect food safety via food price increase. Another outcome may be that food consumption structures will change: certain products will be refused, as seen in case of pork consumption happening due to pig flu.

High oil prices also influence the food safety issues. This rises the expenditures of agricultural production, and parallel to this the costs of distribution and logistics. On the other hand, it promotes bioenergy (especially biofuel) consumption. During biomass production there is a huge demand for agricultural goods (maize, wheat, oilseeds, sugar cane, animal fats) as ingredients of the mass. This will help grow prices. Furthermore, the structure of agricultural production may change a lot, from the production of energy consuming products (e.g. food ingredients) to energy crops. This decrease in supply will result in price increase, so high food prices will generate worse food safety.

The competition between energy crop farming and food production jeopardises the agriculture itself. The competition for resources such as land and water may increase the prices of the goods that put up the costs of agricultural production. As for the environment, it would have

disadvantageous outcomes: the sufficient lands can be available only with cutting down forests. Intensive farming would enhance fertilizer and pesticide usage to a great extent, which will be harmful to the nature.

4. CONCLUSIONS

It is evident from the matters above that the big losers of these processes will be the developing countries. The differences between the centre and peripheries will be bigger and bigger. Though world agriculture has already developed, there are gaps between levels. I claim that the example of ASEAN (Association of Southeast Asian Nation) shows that closing up is possible (Bellin-Sesay-Zingel,2005), though this is not so general. To reach this, the developed countries should give a lot of help (in the field of science and technology) as well as utilizing the opportunities of integrations. According to researchers, if advanced technologies could be applied worldwide, the demand for food of double today's population would be solved. Unfortunately this issue involves politics too.

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EVALUATION OF FOOD ADDITIVES ON THE RHEOLOGIC PROPERTIES OF WINTER WHEAT FLOURS

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ABSTRACT

The effects of different flour additives on the Farinograph, Alveograph and Extensograph properties of BL-80 flour were evaluated. The purpose of the study was to evaluate the way and degree of their influences to establish a subsequent research on their possible substitution by natural ingredients. We found that the effects of flour additives can be measured by rheologic methods and the extends of changes determined by different methods are similar.

1. INTRODUCTION

The significant changes in the baking industry resulted significant changes in the bread making process. A hotly-debated question became the utilization of different flour additives. It is necessary, because the industry must satisfy the quantity requirements, and a part of consumers requires relatively cheap bread with homogenous quality. Opposers emphasizes that the dose-depending long-term effect of the artificial additives is not known, and the reactions between the different additives, consumed by different foodstuffs, is also not clearly revealed.

The main reasons of using optional additives in bread making are the helping the crumb structure development, improvement of nutritional and sensory quality and making longer shelf-life for the products (Singh et al., 2003). The main groups of ingredients are acids, enzymes, surfactants, sugar, milk or milk solids and improvers (Hoseney, 1994) and they have an important effect on dough and bread properties but the consumers are increasingly abandoning the artificial or simply unknown food ingredients. An Eurobarometer survey found in 2006 that 57% of consumers believed that food additives were potential food risk – it is 4% higher value than the rate of those, who were afraid of BSE and the proportion is almost the same in the case of GMOs, dioxin and microbiologic spoilage (Bánáti, 2008).

Research project was started to evaluate the possibility of substitution of artificial additives by natural food components to decrease the non natural components in our general foodstuff, the bakery products. This project includes the evaluation of commercially available complex flour improvers and the possible natural materials and ingredients. Our examinations includes the study of the effect of the type and dose of these additives on the traditional quality parameters (e.g. their effect on the solubility of protein by determination of wet gluten content and gluten

properties), rheologic parameters (as Farinograph, Alveograph and Extensigraph parameters) and bread properties (examined by test loaf making).

2. MATERIALS AND METHODS

Analyzed flour samples were made from standard commercial flour type BL-80 from ABO MILL LTD, Nyíregyháza. Flour additives were provided by Stamag-Ireks Ltd and ABO-MILL LTD. The following flour additives and concentrations were applied: Rónapán, Tigris, Negropán, Multec Data HP20, Multec tac 20, Enzypán, Enzy Passat, Intenzív Tornádó "S" and Soja Austria PAN were added in 0.5%; Aromapaszta, enzyme active wheat flour and Buláta were added in 1%; Soy isolate, Soja Austria SAN, Lupisan and artichoke flour were added in 5%; Fevepur fava bean flour and Pur Malt were added in 0.3%, Novo2zm2 Bisc, Multazyme plus optimal enzyme, Multazyme plus Ait enzyme were added in 0.005% concentration of the wheat flour. The amounts of additives were specified by recommendations of producers.

Laboratory tests were made in the accredited laboratory of University of Debrecen, Centre for Agricultural and Applied Economic Sciences, Institute of Food Science, Quality Assurance and Microbiology. Analyzed parameters were the Farinograph value, according to MSZ ISO 5530-3:1995 using Brabender Farinograph (Duisburg, Germany), Alveograph parameters, according to AACC Method 54-30.02 using Chopin Alveograph (Villeneuve-la-Garenne, France) and Extensograph parameters, according to AACC Method 54-10.01 using Brabender Extensograph (Duisburg, Germany).

3. RESULTS AND DISCUSSION

3.1. Effect of flour additives on the Farinograph parameters

The examined flour additives significantly affected the Farinograph value (Table 1). The most of additives increased the baking value of BL-80 wheat flour; Tigris, Negropán, Soy isolate, Multec Data HP20, Multec tac, Lupisan, Fevepur fava bean flour and Multazyme plus optimal enzyme also resulted improved baking value. Whereas, addition of Negropán and Buláta resulted significant decrease in Farinograph value and rushed down the quality of base flour to feed (C) quality. The reactions of additives are more balanced in the case of water absorption capacity. It was increased by Soy isolate and Lupisan to a great extent but Artichoke flour resulted high decrease. Other additives slightly decreased or did not influenced the water absorption capacity of flours.

Table 1. Effect of flour additives on Farinograph and Alveograph properties of BL-80 flour

	Baking value	Water absorption, %	P, mm	L, mm	P/L	G, ml	W, 10 ⁻⁴ J
Control	69,0	69,4	140	76	1,86	19,4	374
0,5% Rónapán	71,6	68,6	102	93	1,09	21,5	346
0,5% Tigris	70,7	67,0	93	96	0,97	21,8	324
0,5% Negropan	34,5	66,4	41	175	0,24	29,5	152
5,0% Soy isolate	79,0	72,0	203	26	7,72	11,4	239
0,5% Multec Data HP 20	81,0	69,0	90	107	0,84	23,1	299
0,5 % Multec tac	81,5	69,0	97	89	1,09	21,0	291
5,0% Lupisan	77,1	72,2	135	56	2,43	16,6	284
0,5% Enzypán	54,6	67,4	90	99	0,9	22,2	318
0,5% Enzy Passat	57,2	68,0	94	101	0,93	22,4	342
1,0% Buláta	31,4	67,2	91	96	0,95	21,8	296
0,5% Intenzív Tornádó "S"	58,6	66,4	92	80	1,15	19,9	282
1,0% Aromapasztta	64,0	66,0	93	92	1,01	21,4	285
0,3 % Fevepur fava bean flour	71,6	66,6	70	103	0,68	22,6	241
0,1% Pur Malt enzyme active wheat flour	63	65,8	67	93	0,72	21,6	216
10% Artichoke flour	67,7	58,6	106	29	3,7	11,9	139
0,005% Novo2ym2 Bisc	48,8	66	41	98	0,42	22	87
0,005% Multazyme plus optimal enzyme	70,7	66,8	65	121	0,53	24,5	245
0,005% Multazyme plus AIT enzyme	66,4	66,6	68	105	0,68	22,8	239

3.2. Effect of flour additives on the Alveograph parameters

The P value was increased by more than 25% by the addition of soy isolate. Highest decreases were achieved by addition of Negropan and Novo2ym Bisc; both additives decreased the P value by about 40%. Enzyme products, enzyme active wheat flour and faba bean flour resulted similar effect. L value was significantly increased by Negropan and Multazyme plus optimal enzyme but soy isolate, artichoke flour and Lupisan resulted the highest decrease of extensibility.

These changes of Alveograph curve also resulted differences in P/L values. Emerging increases were observed in the case of addition of soy isolate, artichoke flour and Lupisan, while Negropan and enzyme products resulted the highest decrease in P/L value. Other additives resulted decrease in lower measure. W value was decreased by all the examined additives. Highest decreases were caused by Novo2ym 2 Bisc, artichoke flour and Negropan, but other additives also resulted 15-25% lower W values than original BL-80 flour.

3.3. Effect of flour additives on the Extensograph parameters

The effects and the measure of effects of different additives on Extensograph parameters were different than we have expected by the Alveograph parameters (Table 2). Highest decreases of deformation energy after 45 minutes of dough were resulted by Multec tac, Pan and Lupisan, while Rónapán, Tigris, Enzipan, Enzy passat, Buláta, Intenzív tornádó S, Aromapaszta and faba bean flour resulted increase. The energy of control flour was almost linearly increased by resting time, but only the character of changes remained in the case of additives. Only soy isolate and Multazyme plus optimal enzyme did not affected the value of Extensograph energy of flours.

Resistance to extension of flour was increased by artichoke flour in the highest degree. Other additives also resulted increase, only Negropan resulted decrease in resistance. The resting of dough decreased the improving effect of additives or their resistance values were lower than the values of BL-80 flour. These additives (e.g. soy isolate) stabilized the resistance value of resting dough.

Similarly homogenous are the effects of additives on the extensibility of flours. It was significantly decreased by Negropan and artichoke flour in all examining time, while the effects of other additives are only a small degree increase or decrease. The effect of resting time was not significant on extensibility values.

Maximum resistance to extension was also significantly increased by addition of artichoke flour regarding to control flour, but its effect was observable only after the 45th minute. Lupisan and Multazyme plus optimal enzyme decreased the value of maximal resistance by 25-50%, soy isolate, Multec Data HP20, Multec tac and Multazyme plus AIT had no significant effect, while the other additives unambiguously increased it in the first examination time. These effects were observed in the other examination times or their small increases were found.

4. CONCLUSIONS

We found that all the examined flour additives had significant effect on the rheologic properties of BL-80 wheat flour. The same flour became suitable for pizza and pasta making by the application of adequate additive, regarding the Farinograph parameters. Although the Alveograph and Extensograph measurement results similar values, the application of different flour additives results different effect on dough energy and extensibility. This means it is not enough to examine the results of either, the other test is required to do to determine the real behaviour of dough.

Table 2. Effect of flour additives on Extensograph properties of BL-80 flour

	Energy, cm ²			Resistance to extension, BU			Extensibility, mm			Max resistance, BU		
	45	90	135	45	90	135	45	90	135	45	90	135
Control	44	34	19	116	114	83	180	165	147	190	157	98
0,5% Rónapán	66	84	84	168	235	262	184	188	167	279	344	384
0,5% Tigris	62	91	74	174	309	280	171	164	156	280	437	374
0,5% Negropan	-	7	26	-	45	88	-	103	165	-	46	122
5,0% Soy isolate	46	40	25	118	138	87	186	157	157	190	187	123
0,5% Multec Data HP 20	43	34	20	120	106	82	176	170	148	185	152	99
0,5 % Multec tac	39	33	25	116	115	104	179	162	141	169	151	135
5,0% Lupisan	27	24	49	76	88	163	171	148	155	123	124	246
0,5% Enzypán	87	102	94	194	278	291	197	173	167	343	470	452
0,5% Enzy Passat	69	92	110	168	258	325	188	179	178	285	411	486
1,0% Buláta	60	64	48	136	162	138	195	188	174	242	261	209
0,5% Intenzív Tornádó "S"	70	108	84	173	331	244	185	168	175	302	495	378
1,0% Aromapaszta	86	74	59	204	208	188	186	171	165	356	326	266
0,3 % Fevepur fava bean flour	54	70	61	138	197	194	180	176	163	231	300	278
0,1% Pur Malt enzyme active wheat flour	56	65	55	132	166	161	186	186	171	235	271	245
10% Artichoke flour	97	182	163	414	850	820	135	137	126	262	1001*	1001*
0,005% Novo2ym2 Bisc	cannot valueable											
0,005% Multazyme plus optimal enzyme	35	33	13	86	87	60	191	180	138	139	138	66
0,005% Multazyme plus AIT enzyme	42	49	43	102	124	126	193	194	176	167	193	186

*Values above 1000 BU are uncertain values

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CONNECTIONS BETWEEN THE MECHANICAL PROPERTIES OF WHEAT

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ABSTRACT

The new method was developed, with which we can directly determine the breaking force and the breaking work, needed for snapping a kernel, and a parameter that gives information about the kernel flexibility (deformation modulus). To determine these values, we developed a measuring method, with which a single kernel can be measured. For this task we considered the measuring equipment Lloyd 1000 R to be appropriate, which is a precision stock measurer. We compared the results with outcomes from other kernel hardness measuring techniques (Perten SKCS 4100 machines). The significant level was 95%. The Lloyd instrument measures the pressure power on the kernel, due to the way that the pressure head has taken. The machine records data during the measurement, and draws the load – extension curve (with mm on the X axis and Newton on the Y axis). According to data we can instantly see the measure of power, which the kernel can not withstand and it snaps. Due to the 0 N and max. N values of the diagram and the path related to them, the max. power to snap a kernel can be determined, further called as snapping power and the snapping labour related to it, which is given by the field under the curve. From the power, path curve, the deformation modulus can be determined. The experiment was carried out on horizontally and vertically set crops as well. We tested two different sample sets, adjusted on different levels of moisture. Sample mark "A" was called "air-dry" (10.59% moisture content) and the "B" sample had 13.52 % moisture content. From the Hardness Index and the quasi static procedure we found that, with sample set mark "A", in case of "air-dry" set (moisture content 10.59%), the vertical experiments were more useful, in kernel hardness assortment, than experimenting in a horizontal position. We found that, the hardness index of the kernel with the average moisture of 10.6%, in vertical compression procedure, with the breaking work, has tight, and with the breaking force, has acceptable correlation. In case of sample set "B" (13.52% moisture content) Hardness Index has a close relationship with the deformation modulus of compression procedure in vertical procedure, with breaking force and the breaking work. Hardness Index has a close relationship with deformation modulus measured on horizontal compression procedure, and an acceptable relationship with breaking force. There has been a correlation between the Hardness Index measured by SKCS 4100 equipment and some of the mechanical characteristics of the wheat measured by Lloyd 1000R equipment when investigating a group of soft and hard- wheat varieties. A strong correlation was found between the Harness Index and the deformation modulus ($R^2 = 0,813$), between the Hardness Index and breaking force ($R^2 = 0,882$), and also a strong correlation between the Hardness Index and the breaking work ($R^2 = 0,881$) in the case of samples that have 13 % moisture content in average. A strong correlation was found in the case of samples that had 10.6 % moisture content in average between the Harness Index and the breaking work measured (in the vertical state) by the compression method ($R^2 = 0,791$), and a good correlation between the Hardness Index and the breaking force ($R^2 = 0,690$).

1. INTRODUCTION

In the past 20 – 25 years , the interest in connection with commercial assortment, has grown considerably. Among from the previously mentioned emerges the significance of endosperm

classification, rating according to the inner structure of the kernel. At wheat rating, postulating the inner structure of the kernel, it is extremely important that kernel hardness is the dependant of many properties in connection with the grain's technological quality. The system of endosperm classification of wheat means essential advantage for all participants of the wheat sector, from the grower, through the dealer to the user (Békés, 2001).

For the determination and measuring of the endosperm structure, kernel hardness indicators were made, which measures the power needed to snap a seed. With this method, they determine a ration: Hardness Index (HI), which is one of the bases of mill crop's acceptance qualification.

Kernel hardness reliant assortment, and the quality acceptance is essential for the companies, and this is why the identification of hardness that can be automate if is so necessary (Bloch et al., 2001).

The primary objective was to find a measuring method for the kernel mechanical properties; especially deformation modulus, breaking force and work, measuring by compressional procedure, and to establish a link at corn sample sets between the mechanical properties, produced by the developed procedure, and the kernels Hardness Index.

2. MATERIALS AND METHODS

2.1. Materials

In the course of our experiments, we examined 23 different wheat samples. Out of these samples 10 sets can be classified as soft and 13 as hard grain structured. This numeral difference is due to that one of the aims of wheat breeding, is to selecting hard wheat, and because of this, softer sets become insignificant. We used Hungarian wheat as samples. The samples were provided by the Cereal Research Ltd, Szeged.

2.2. Method

Determining the kernel hardness by Lloyd 1000R Testing Machines

The instrument measures the pressure power on the kernel, due to the way that the pressure head has taken. The machine records data during the measurement, and draws the load – extension curve (with mm on the X axis and Newton on the Y axis).

According to data we can instantly see the measure of power, which the kernel can not withstand and it snaps. Due to the 0 N and max. N values of the diagram and the path related to them, the max. power to snap a kernel can be determined, further called as snapping power and the snapping labour related to it, which is given by the field under the curve. From the power, path curve, the deformation modulus can be determined. The experiment was carried out on horizontally and vertically set kernels as well.

Determining the kernel hardness by Perten SKCS 4100 equipment

During the measurement, the instrument measures the weight, size, moisture content and the hardness of the kernels. After determining 300 kernels unique properties it counts the average of the data gathered and counts standard deviation value and also, there is an opportunity to illustrate the measured results in column charts. The program provides an opportunity to see the last results after the following measurement. The measured results and their histograms can be printed if wished. The Hardness Index, produced by the machine as final results, is a physically non determined ratio, so in extremes cases the outcome can be zero or negative value. The SKCS 4100 compartmentalize the results in two groups. Fewer than 50 is soft grain, above 50 is hard grain (Gyimes, 2004).

3. RESULTS

From the Hardness Index and the quasi static procedure we found that, with sample set mark "A", in case of "air-dry" set (moisture content 10,59%), the vertical experiments were more useful, in kernel hardness assortment, than experimenting in a horizontal position. We found that, the hardness index of the kernel with the average moisture of 10.6%, in vertical compression procedure, with the breaking work, has tight, and with the breaking force, has acceptable correlation.

In case of sample set "B" (13.52% moisture content) Hardness Index has a close relationship with the deformation modulus (Figure 1.) of compression procedure in vertical procedure, with breaking force (Figure 2.) and the breaking work. Hardness Index has a close relationship with deformation modulus measured on horizontal compression procedure, and an acceptable relationship with breaking force.

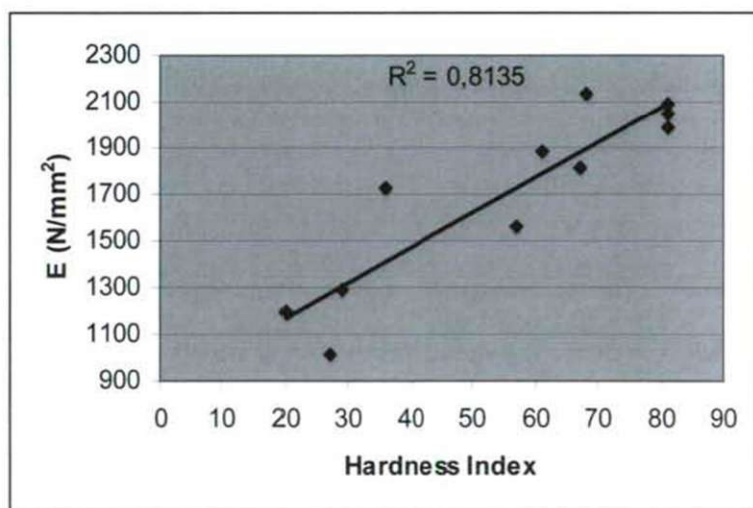


Figure 1. Connection between the deformation modulus (E) and the Hardness Index (set "B", vertical position, moisture content: 13.52%)

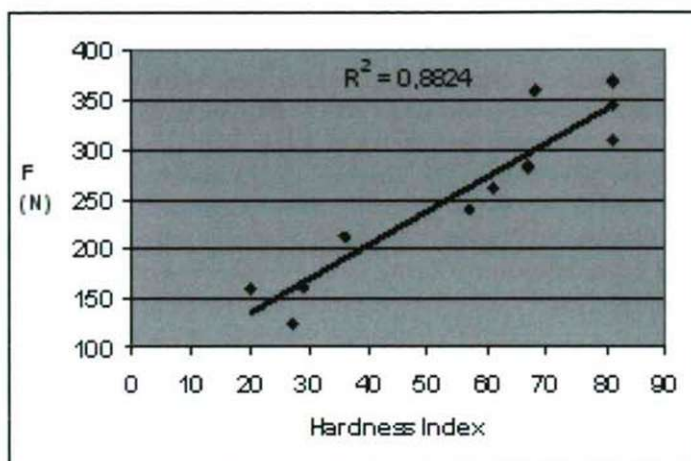


Figure 2. Connection between the breaking force (F) and the Hardness Index (set "B", vertical position, moisture content: 13.52%)

4. CONCLUSION

We worked out a measuring method, for measuring the mechanical properties of wheat species, by quasi static compression procedure. According to this method, after burnishing both ends of the wheat kernel, we measure the geometric properties and than put the kernels between the sheet of the precision pressing disks and the plane in vertical position. During the measurement, we record the load - extension curve, out of which the mechanic properties can be counted.

There has been a correlation between the Hardness Index measured by SKCS 4100 equipment and some of the mechanical characteristics of the wheat measured by Lloyd 1000R equipment when investigating a group of 23 different- 10 soft and 13 hard- wheat varieties.

In vertical position, a strong correlation was found between the Harness Index and the deformation modulus ($R^2 = 0,813$), between the Hardness Index and breaking force ($R^2 = 0,882$), and also a strong correlation between the Hardness Index and the breaking work ($R^2 = 0,881$) in the case of samples that have 13 % moisture content in average. In horizontal position the Hardness Index has a strong correlation with the deformation modulus.

A strong correlation was found in the case of samples that had 10.6 % moisture content in average between the Harness Index and the breaking work measured (in the vertical state) by the compression method ($R^2 = 0,791$), and a good correlation between the Hardness Index and the breaking force ($R^2 = 0,690$).

So there is a correlation between the dynamics method (Hardness Index) and the vertical measuring of static test (mechanical parameters). This static test is a good method to determine the kernel hardness.

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RISK PERCEPTION OF FOOD ADDITIVES IN HUNGARY

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ABSTRACT

On the basis of international surveys, Hungarian consumers stated serious aversion against food additives.

The aim of our work was to get more detailed information about Hungarian consumers' risk perception with special regard to food additives.

For this purpose a self-administrated questionnaire was developed. Four hundred respondents completed the questionnaires in 2009. The collected data were analysed by the SPSS 18.0 statistical software.

Respondents expressed serious aversion against food additives amongst different risk factors. The responses on different statements highlighted that consumers did not have proper knowledge about food additives.

In order to explore the directly not perceptible connections, factor analysis was done, but the "goodness-of-fit test" did not show significant fitting. So with the help of the factor analysis' results 5 principal components were created.

According to the results it can be stated that - similarly to previous studies - Hungarian respondents felt food additives to be hazardous. On the basis of the principal components respondents who were not satisfied with the quantity of the information about food additives, had mixed and ambiguous knowledge about food additives. Thus Hungarian consumers need more authentic information to help their food choice to be more established and be more conscious.

1. INTRODUCTION

Due to the changing lifestyle and consumption habits and furthermore the continuously appearing food scandals and media awareness consumer's mistrust against food additives is constantly rising. According to the survey of the Eurobarometer (2006a) 13% of the respondents stated that eating healthy diet involved the avoidance of foods containing food additives (Figure 1), while in Hungary this rate was 16%.

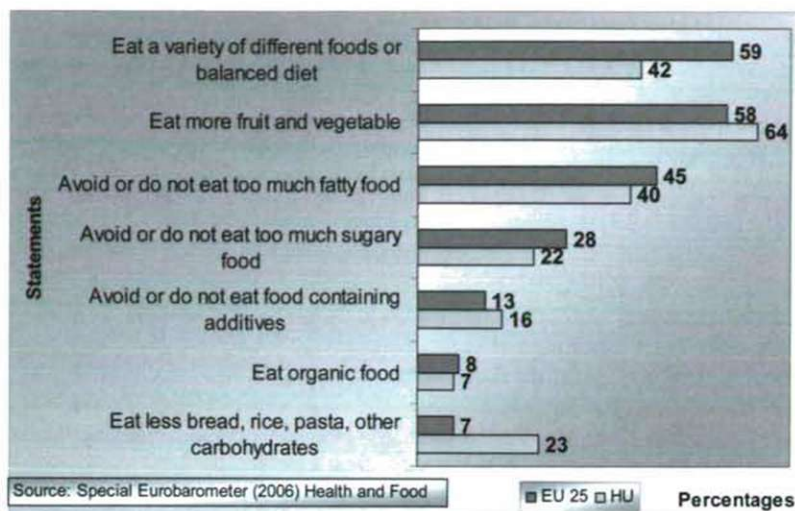


Figure 1. "What do you think eating "healthy diet" involves?"

On the basis of another survey (Eurobarometer, 2006b) 61% of the European participants worried about "additives like colours, preservatives and flavorings". This rate was higher in Hungary 76% (Figure 2) too.

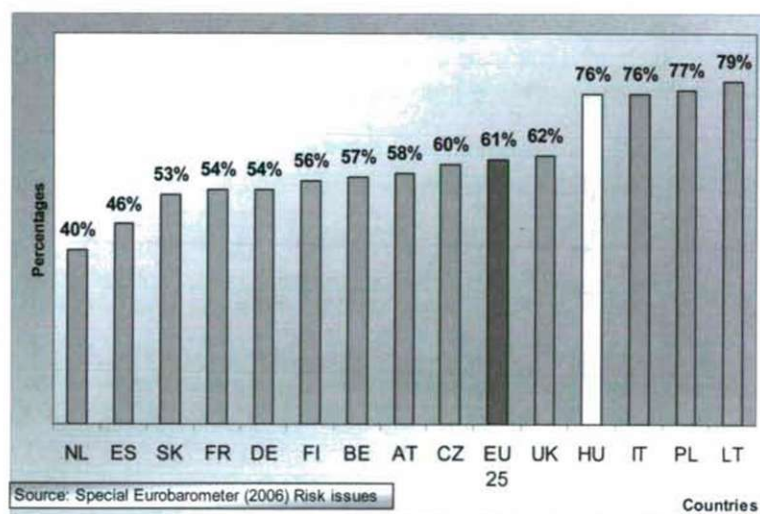


Figure 2. Worry against food additives

2. MATERIALS AND METHODS

In order to get information on the perception of the Hungarian adults' about food additives a self-administrated questionnaire was developed in the Central Food Research Institute. Based

on the snowball method 400 respondents completed the questionnaires in spring of 2009. The collected information was analysed by the SPSS 18.0 statistical software.

3. RESULTS

3.1 Judgement of different risk factors

Respondents expressed serious aversion against the listed potential risk factors. The most hazardous factor was the "pesticides" (1.85 on a 1-5 Likert scale), while the least hazardous was the "gases of the modified atmosphere in food packaging" (3.06) (Figure 3). There was a small difference between the judgement of "Food additives" (2.64) and "E numbers" (2.66), thus on the basis of this result Hungarian consumers were aware of the proper connection between these two concepts.

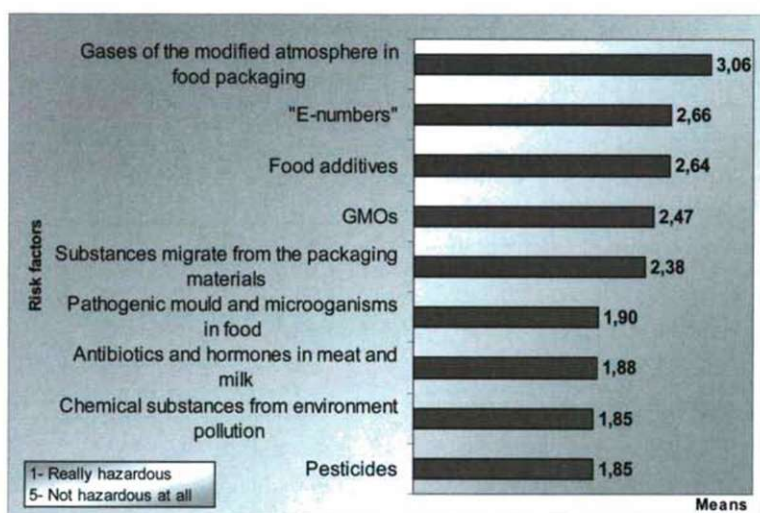


Figure 3. Judgement of different risk factors

3.2 Knowledge of food additives and "E-numbers"

Our previous result was confirmed by two statements. 84.8% asked were aware what food additives, and 72.5% that what "E-numbers" meant on food packaging. However only 53.5% understood the statement that "Every food additive can be linked to an "E-number".

3.3. Principal component analysis

In order to explore the directly not perceptible connections about respondents' knowledge and attitude related to food additives, factor analysis was done, but the "goodness-of-fit test" did not show significant fitting. So with the help of the factor analysis' results principal components were created. 7 principal components were differentiated from the 48 statements, but two of them were not created dimension (Table 1).

Table 1. Some statements of the principal components with their factor components and means

<i>Principal components with some statements</i>	<i>Factor components</i>	<i>Means¹</i>	<i>N (means)</i>
1. Food additives' risks			
Safer foodstuffs contain fewer additives.	0.727	3.79	389
One reason of the more often occurring allergies is the foodstuffs' food additive content.	0.769	3.90	352
Excessive food additive consumption can cause cancer.	0.706	3.68	340
2. Indispensability of food additives			
Permitted food additives pose no danger to our health.	0.683	2.31	382
Food additives are safe in the amount used by food industry.	0.637	2.80	382
Preservatives are necessary for safety foodstuffs.	0.547	2.92	381
3. Judgement of food safety			
I think food safety is declined because of the accession to the EU.	0.700	3.00	372
I believe that labelling information reflects the truth.	-0.698	2.72	396
Food industry utilizes only permitted additives.	-0.644	2.88	378
4. Knowledge of food additives			
It is difficult to be familiar with information about food additives.	0.638	3.85	399
It is a fundamental human right to know what foodstuffs contain.	0.544	4.80	399
Different food additives mean different risks.	0.677	4.23	383
5. Food additives' communication			
Consumers have to have more information about food additives to reduce risks.	-0.504	4.32	398
I am satisfied with the information about food additives on the labelling.	0.849	2.24	394
I am satisfied with the media information about food additives.	0.828	1.93	395

1- Not agree at all 5- Strongly agree

On the basis of the principal analysis it can be stated that Hungarian respondents' attitude regarding food additives was aggregated into 5 components.

1. Food additives' risks

This principal component contains statements related to health related risks of food additives. Respondents reported strong connection between different diseases like allergy (3.90) and cancer (3.68). Furthermore this component contains statements like additive free foodstuffs are safer than foodstuffs containing number of additives (3.79).

2. Indispensability of food additives

This principal component summarized statements that food additives have an important role in foodstuffs, and their utilization is necessary. Participants were distrustful against the food industry (2.80), they did not perceive strong connection between the utilization of food additives like preservatives and safe foodstuffs (2.92). Their worries about health destroying effect of food additives (2.31) appeared again.

3. Judgement of food safety

This dimension shows that attitude related to food additives is influenced by common factors like food safety and the judgement of the work of the authorities'. In addition, trust in the producers rule observance practice and the pertinence of food labelling information. Hungarian respondents did not believe in food labelling information (2.72) and in producers (2.88), furthermore they thought that the level of food safety was not increased by the accession to the European Union (3.00). This can be caused partly by the constantly increasing number of appearing foreign foodstuffs on the Hungarian market.

4. Knowledge of food additives

The "Knowledge of food additives" principle factor summarizes the claims related the differentiated knowledge of Hungarian respondents about food additives. On the basis of the results it was not too difficult for the Hungarian respondents to be familiar with information about food additives (3.85) and they strongly agreed with the statement that "Fundamental human right is to know what foodstuffs contain" (4.80). It was favourable that they thought that they could make difference between the hazardous levels of food additives (2.88).

5. Food additives' communication

The fifth dimension bands together claims in connection with the communication about food additives like media, labelling and the level of knowledge. According to the answers it can be stated, that most of the respondents agreed (4.32) with the statement that "Consumers have to have more information about food additives to reduce risk" in addition consumers' dissatisfaction with information about food additives on food labellings (2.24) and the media (1.93).

3.4 Results for the planning of consumer communication

Independent principal component connection resulted in relevant conclusions. On the basis of linear regression those who reported higher demand for differentiated information about food additives were significantly conducted with the information of the media and food labellings. Thus one segment of the consumers needs more detailed information, so it is important to find the best way to satisfy of these requests e.g. with easy-to-understand guidelines. Consumers' present negative perception related food additives can be moderated with the help of detailed and differentiated information.

4. CONCLUSIONS

According to the results it can be stated that - similarly to previous international studies - Hungarian respondents felt food additives to be hazardous.

On the basis of the principal components Hungarian participants expressed worried about the contingent health destroying effects of food additives and stated distrust against food industry. Thus Hungarian consumers need more authentic information about food safety and food additives to help their food choice to be more established and conscious.

In order to get more exact and detailed knowledge about the different consumer segments and to determine the required steps for a more effective consumer communication cluster analysis will be done on the basis of the principal components.

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AGRI-FOOD BUSINESS OPTIMIZATION USING ARTIFICIAL INTELLIGENCE METHODS

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ABSTRACT

In this paper is proposed the use of methods specific to artificial intelligence in financial management, aiming at finding some pairs {artificial intelligence method, financial management problem} in which the results have to be optimal and better than traditional methods.

1. INTRODUCTION

Artificial Intelligence (AI) can be regarded as that part of informatics that aims to design those systems that are endowed with certain properties that we normally associate with human intelligence: language understanding, learning, reasoning, problem solving, theorems' demonstration.

Different definitions of artificial intelligence focus differently, either on cognitive processes or behavior. Thus, Artificial Intelligence can be regarded as the study of systems which:

- think like people do;
- think rationally;
- act like people do;
- act rationally.

In this paper is proposed the use of methods (paradigms) specific to artificial intelligence in financial management, aiming at finding some pairs {artificial intelligence method, financial management problem} in which the results have to be optimal and better than traditional methods.

2. EXPERT SYSTEMS

Among methods and paradigms specific to Artificial Intelligence, expert systems are most "well-known", being the first which were imposed in practice, overcome the theoretical research framework, in author's appreciation, the avant-garde character, novelty, unconventional feature of expert systems is somehow obsolete, the membership to "artificial intelligence" field being in this moment questionable.

The reasons of this chapter in the present paper, taking into consideration the innovations and the author's original contribution are significant, and are the followings:

- uniformity and minimum claim of completeness of the paper;
- design some hybrid systems, in which expert systems are a component;

In Fig.1 it is presented an expert system case used in deciding when to grant a customer credit.

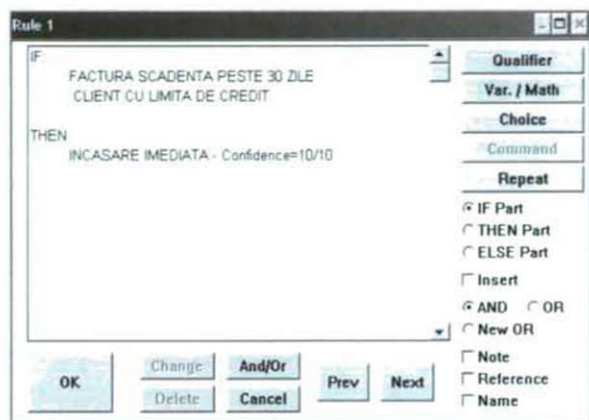


Fig.1. Input window rules.

In the category of premises one can have pieces of knowledge in the form of questions, variables, goals (if it wants to test the level reached by certainty factors). The same components are also found in conclusion category, stating that the goals are followed by a value award for certainty factor taking into consideration one of the variants specified in the control panel parameters. Control panel allows the printing as a file or directly to the printer of all parts of knowledge in a continuous or on different pages using one of three front sizes: 10, 12 or 14. Knowledge base of the prototype ANALYSIS was redirected to the file "CLIENT" from EXSYS working directory. This is presented below:

Subject:

OUTSTANDING INVOICE CUSTOMER TREATMENT

Author:

TITUS SLAVICI

Starting text:

EXSYS DEVELOPER EXPERT SYSTEMS OF MAKING DECISION OF CUSTOMER TAXES COLLETION

Ending text:

FOLLOWING EXSYS EXPERT SYSTEMS CONSULTATION IT HAS REACHED THE FOLLOWING CONCLUSIONS:

Uses all applicable rules in data derivations.

Probability System: 0 - 10

DISPLAY THRESHOLD: 2

QUALIFIERS:

1 OUTSTANDING INVOICE OVER 30 DAYS
CUSTOMER CREDIT LIMIT
BAD CUSTOMER

2 OUTSTANDING INVOICE OVER 60 DAYS
CUSTOMER CREDIT LIMIT
BAD CUSTOMER

GOALS:

- 1 IMMEDIATE CASH
- 2 SUPPLY SUSPENSION UNTIL THE COLLECTION OF OUSTANDING INVOICES

RULES:

RULE NUMBER: 1

IF:

OUTSTANDING INVOICE OVER 30 DAYS
CUSTOMER CREDIT LIMIT

THEN:

IMMEDIATE CASH - Confidence=10/10

RULE NUMBER: 2

IF:

OUTSTANDING INVOICE OVER 30 DAYS
BAD CUSTOMER

THEN:

SUPPLY SUSPENSION UNTIL THE COLLECTION OF OUSTANDING INVOICES -
Confidence=9/10

RULE NUMBER: 3

IF:

OUTSTANDING INVOICE OVER 60 DAYS
CUSTOMER CREDIT LIMIT

THEN:

IMMEDIATE CASH - Confidence=8/10

RULE NUMBER: 4

IF:

OUTSTANDING INVOICE OVER 60 DAYS
BAD CUSTOMER

THEN:

SUPPLY SUSPENSION UNTIL THE COLLECTION OF OUSTANDING INVOICES -
Confidence=7/10

3. ARTIFICIAL NEURAL NETWORKS

The question arises how efficient it is the use of neural networks in those types of applications that fully exploit the advantage of their specifics, obviously there are types of problems that almost perfectly folded using ANN, but other types that generate even incompatibles with them. Within this chapter were introduced basic concepts specific to use ANN, following to be repeated and developed within the present chapter together with examples and study cases related. Generally based on experience in the field can be said that ANN are used in those types of problems with the following features:

- mathematical model of the process is unknown, has too much complexity associated with insufficient accuracy (precision) and in some cases can not be determined;
- available data are incomplete in some cases, there are signals and noise disturbance (noise term can be extrapolated from technical field and in other types of economic, genetic processes,);
- there are a number of constraints (restrictions) applied to the process and have to be optimized simultaneously.

ANN Application for predicting stock market shares Nikko System

In the present paragraph is presented one of the most successful uses of ANN, the author's contribution is resumed to the data processing performed by ANN implementations in Matlab tool. The reason of application processing from bibliographic sources cited in the context of this paper is to illustrate a first example of data organizing with the aim of ANN use.

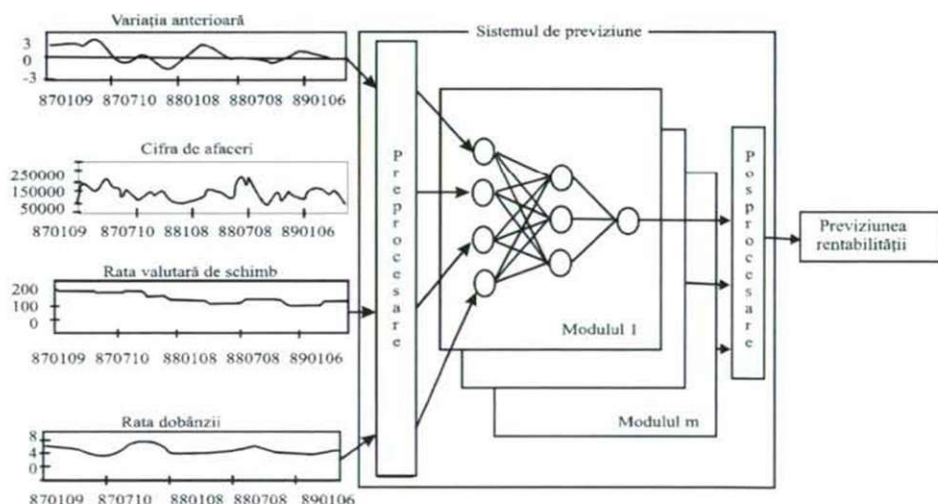


Fig.2. ANN structure.

4. OPTIMIZATING THE PORTFOLIO MANAGEMENT OF FINANCIAL SECURITIES USING FUZZY SYSTEMS.

For proposed optimizing that will be developed in this paragraph two input variables are considered:

X - tendency of financial securities;
 Y - the volatility of financial securities;
 and an output variable
 Z - position adopted in business.

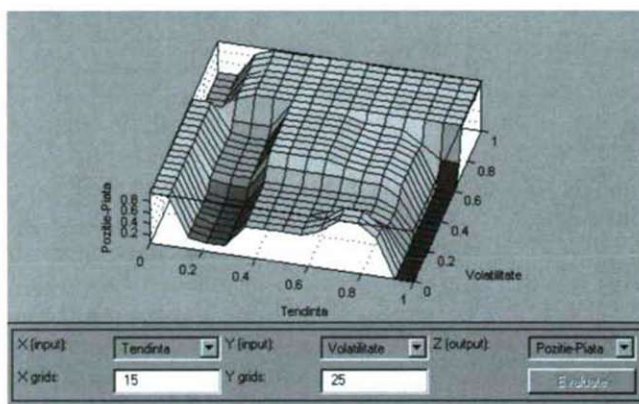


Fig.3. ANN structure.

5. GENETIC ALGORITHMS AND EVOLUTIONARY COMPUTATION

Opportunities to use genetic algorithms in classification operations, with applications in securities managing portfolio.

The problem of systems classification with GA aid is one of the most exciting applications GA, the power of this technique is extraordinary.

It is considered the example of a managing equity portfolio system; decisions taken are related to stakes that are appropriate to be sold and to be bought, obviously those decisions will be taken according to several criteria specified in the first line of the next table. In assessing inputs are used three codes, namely 1 for the situation acceptable from the point of view of that criterion, 0 unacceptable situation and # signifies irrelevance according to considered criterion.

Table. 1.

Criterion	Ex1	Ex2	Ex3
Tendency of share value	1	1	#
Issuer representativeness	#	#	1
Stock institution representativeness	#	#	#
Dividend growth tendency	#	#	#
Leverage factor	1	1	#
.....			
Purchasing decision	1	1	0
Sale decision	0	0	1

In case of outputs there are only two codes corresponding to validation option for purchasing, respectively for sale, for the first example is considered, reaching the conclusion that the purchase is appropriate.

6. DISCUSSION AND CONCLUSION

In certain situations, for example the use of artificial neural networks, has been found an exceptional applicability of those in economic field, fitting in the specifics of the economic data and processes: mathematical models of many economic processes have a high complexity associated with an insufficient accuracy and that available data are incomplete in many cases, there are disturbing signals, so for example: Percentage accuracy predictions of companies' bankruptcy were 93-97% higher than those obtained by traditional methods.

In other situations, for example in genetic algorithms case has been found a less efficient application of those in financial field; however their specific techniques could be used in case of some hybrid intelligent systems, helping to optimize other specific artificial intelligence methods.

In case fuzzy expert systems and expert one the results were relatively good, those being improved by their inclusion within hybrid systems.

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POSITION CONTROL OF PNEUMATIC ACTUATORS WITH PLC

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ABSTRACT

Design and application of the robust and accurate position control for pneumatic cylinders based on the sliding-mode technique is presented by experimental investigations. The paper describes the model of the pneumatic cylinder and the three main design steps of the proposed control method. The aim of this paper is to investigate controlling pneumatic actuators using a Programmable Logic Controller (PLC) instead of micro-controllers chips. As PLCs are now involved in most industrial processes.

1. INTRODUCTION

As an important driver element, the pneumatic cylinder is widely used in industrial applications for many automation purposes thanks to their variety of advantages, such as: simple, clean, low cost, high speed, high power to weight ratio, easy maintenance and inherent compliance. Traditionally, they are used for motion between two hard stop. The design of a stable robust position controller for a pneumatic servo-system is difficult since it is a very nonlinear time-variant controlled plant because of the compressibility of air, the friction force between the piston and the cylinder, air mass flow rate through the servo-valve, etc. By the advent of PCs with high computation power, the accurate and robust control of pneumatic actuators has become possible.

A good background of the pneumatic servo systems research can be found in [1]. The early applications based on linear PID controllers proposed by Burrows and Web, 1966; Vaughan, 1965 had limited operation area. A gain scheduling PID control is proposed by Pu et al., 1993 [2] to extend the operation area. Several papers proposed automatically tuned PID controller for pneumatic servo-systems at the end of last century. Fok and Ong, 1999 [3] reached ion of ± 0.3 mm. Another solution is to employ the advanced nonlinear control strategies developed in recent years (soft computing) [4][5]. Fujiwara et al., 1995 [6]; Matsukuma et al., 1997 [7] proposed artificial neural network and Jeon et al., 1998 [8] proposed genetic algorithm to tune the PID controller. The accuracy was ± 0.1 mm in the best case.

Nonlinear adaptive controllers were proposed by Wikander, 1988 [9]; Miyata, 1989 [10]; Bobrow és Jabbari, 1991 [11]; Oyama et al., 1990 [12]; McDonell, Bobrow, 1993 [13]; Tanaka et al. 1994 [14]; Li et al. 1997 and Soong et al., The best accuracy (0.01 mm) was reached by Wikander, 1988 [9]; Nakano et al., 1993 [15] proposed a piezo-electric method with accuracy of $2\mu\text{m}$.

Sliding-mode control was proposed by Noritsugu and Wada, 1989 [16]; Tang and Walker, 1995 [17]; Pandian et al., 1997 [18]; Hamerlain, 1995 [19]; Bouri et al., 1996; Surgenor and Vaughan, 1997 [20]; Paul et al., 1994 [21]; Song and Ishida, 1997 [22] but the accuracy was limited. The goal of this paper is to improve the accuracy of the existing sliding-mode type controllers (e.g. relay type).

Sliding-mode control was introduced in the late 1970's [23, 24] as a control design approach for the control of robotic manipulators. In the early 1980's, sliding-mode was further introduced for

the control of induction motor drives [25]. These initial works were followed by a large number of research papers in robotic manipulator control [26], in motor drive control and power electronics [27]. However, despite the theoretical predictions of superb closed-loop system performance of sliding-mode, some of the experimental work indicated that sliding-mode has limitations in practice, due to the need for a high sampling frequency to reduce the high-frequency oscillation phenomenon about the sliding-mode manifold - collectively referred to as „chattering”. In most of the experimental work involving sliding-mode, the effort spent on understanding the theoretical basis of sliding-mode control is generally minimized, while a great deal of energy was invested in empirical techniques to reduce chattering. Among these experimental studies, a few succeeded in showing closed-loop system behaviour which was predicted by the theory [28]. Those who failed to realize, the experimental designs successfully, concluded that chattering is a major problem in realizing sliding-mode control in practice.

The connection of sliding-mode control to model reference adaptive control introduced some excitement in the research community. In addition, the design of sliding-mode observers [29, 30], provided additional capabilities to a sliding-mode based feedback control loop. Finally, the issue of discrete-time sliding-mode was raised from the theoretical perspective, resulting in a number of different definitions of discrete-time sliding-mode, [31, 32].

In order to design a robust controller and predict the control performance for the pneumatic test rig, a theoretical and practical modelling of the rig is needed (Fig. 1). The equations derived are based upon Burrows [32], see Fig 1. The dynamic of the piston is modelled by the mass “ m ”, the damping “ d ” and the spring “ k ”. The friction force is denoted by “ F_f ”. The piston can be moved by the pressure difference between the two sides of the piston. The pressures p_a and p_b can be influenced by the input and output air flow rates, which can be controlled by the input and output valves. Of course, the role of input and output are exchanged as the direction of the motion is changed. Since the input and output valves can be tuned simultaneously in the actual pneumatic cylinder, it is a single input system, which can be described by a second ordered nonlinear motion equation

$$m\ddot{x} = p_a(u)A_a - p_b(u)A_b - d\dot{x} - kx - F_f \quad (1)$$

where x is the position, u is the control signal measured as a percentage value of the input and output spool valves. The percentage value of 0% means that the spool valves are closed and 100% means that they are open totally. The dynamics of the spool valves are ignored. The other parameters and variables T , V , A , Q and c are the temperature, volume, area, heat energy and specific heat respectively. The subscription refers to the location of actual variable.

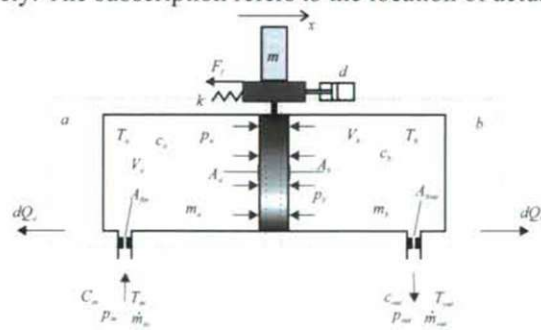


Figure 1. Structure of the pneumatic cylinder

The calculation of p_a and p_b is based on two main laws:

- balance of the input, output and inner energies
- balance of the input, output and inner masses.

Energy balance

Denoting the inner energy of the air by U_{in} , and the mechanical work made the air by W , the energy balance equation for the chamber a is

$$\Delta U_a = \Delta U_{in} + \Delta Q_a + \Delta W_a \quad (2)$$

Assuming adiabatic behavior $\Delta Q_a = 0$ and ignoring the kinetic energy of the input air, the rate of the energy change is

$$\frac{c_v(p_a \dot{V}_a + \dot{p}_a V_a)}{R} = c_p T_{in} \dot{m}_{in} - p_a A_a \dot{x} \quad (3)$$

Assuming that the c_v can be estimated by the specific heat value of air beside constant volume, and the c_p can be estimated by the specific heat value of air beside constant pressure

$$R = c_p - c_v \quad (4)$$

then the changing rate of the pressure can be expressed as

$$\dot{p}_a = RT_{in} \frac{c_p \dot{m}_{in}}{c_v V_a} - p_a A_a \frac{c_p}{c_v V_a} \dot{x} \quad (5)$$

Similarly, for the chamber b , the changing rate of the pressure is

$$\dot{p}_b = RT_{out} \frac{c_p \dot{m}_{out}}{c_v V_b} + p_b A_b \frac{c_p}{c_v V_b} \dot{x} \quad (6)$$

Mass flow rate

On the basis of Bernoulli equation, the mass flow rate can be expressed by a nonlinear function

$$\dot{m}_{in} = \mu_{in} A_{in} p_{in} \sqrt{\frac{2}{R \cdot T_{in}}} \Psi_{in} \quad (7)$$

where μ_{in} is a constant depending on the type of valve and Ψ_{in} is a nonlinear term based upon pressure ratio

$$\Psi_{in} = \sqrt{\frac{\chi}{\chi-1} \left[\left(\frac{p_a}{p_{in}} \right)^{\frac{2}{\chi}} - \left(\frac{p_a}{p_{in}} \right)^{\frac{\chi+1}{\chi}} \right]} \quad (8)$$

Here χ is the specific heat ratio. Note that (8) is valid only if $p_a/p_{in} > 0.528$. If $p_a/p_{in} \leq 0.528$, the speed of the air will be equal to the actual sonic speed and $\Psi_{in} = 0.484$.

The mass flow rate of the exhausted air can be expressed similarly but the roles of the "source" and "drain" must be exchange. According to that and based on (7), yields

$$\dot{m}_{out} = \mu_{out} A_{out} P_{out} \sqrt{\frac{\chi}{R \cdot T_{out}}} \Psi_{out} \quad (9)$$

where Ψ_{out} is defined as

$$\Psi_{out} = \sqrt{\frac{2}{\chi-1} \left(\frac{p_b}{P_{out}}\right)^{\frac{\chi-1}{\chi}} \left[\left(\frac{p_b}{P_{out}}\right)^{\frac{\chi-1}{\chi}} - 1 \right]} \quad (10)$$

Note that (10) is valid only if $p_b/P_{out} < 1.885$. If $p_b/P_{out} \geq 1.885$ then

$$\Psi_{out} = 0.578 \frac{p_b}{P_{out}} \quad (11)$$

A MATLAB and SIMULINK model based on the above equation is presented in paper [33] in order to investigate the basic properties of pneumatic actuators.

2. DESIGN OF A SLIDING MODE CONTROLLER

A good introduction into sliding-mode control can be found in [34]. The design of a sliding-mode controller consists of three main steps. First step is the design of the sliding surface, the second one is the design of the control which holds the system trajectory on the sliding surface, and the third and key step is the chattering-free implementation. The purpose of the switching control law is to force the nonlinear plant's state trajectory to this surface and keep on it. The control has discontinuity on this surface that is why some authors call it switching surface. When the plant state trajectory is „above” the surface, a feedback path has one gain; but if the trajectory drops „below” the surface, it has a different gain.

Consider a single-input, single-output second-order nonlinear dynamic system

$$\ddot{x} = f(x, \dot{x}, u) \quad (12)$$

where x is the output signal (position) of the controlled plant and u is the control signal. If x_d denotes the desired value, then the error between the reference and system states may be defined as

$$e = x_d - x \quad (13)$$

Sliding surface design

Classically, a scalar variable s is calculated as a linear combination of the error and its derivative.

$$s = e + \lambda \cdot \dot{e} \quad (14)$$

Let $s(\dot{e}, e) = 0$ define the sliding surface in the space of the error state. The purpose of the sliding-mode control law is to force the state trajectory of the error to approach the sliding surface and then move along the sliding surface to the origin, Fig.2.

The process of sliding-mode control can be divided into two phases, that is, the approaching phase with $s(\dot{e}, e) \neq 0$ and the sliding phase with $s(\dot{e}, e) = 0$. Here 1 denotes the approaching phase, 2 and 3 denote the sliding phase. If the system is in sliding-mode, the error is decreasing exponentially, where λ is a time constant type parameter. If λ is small, then the system response is slow but accurate. If it is big, the system response is fast but the system might chatter.

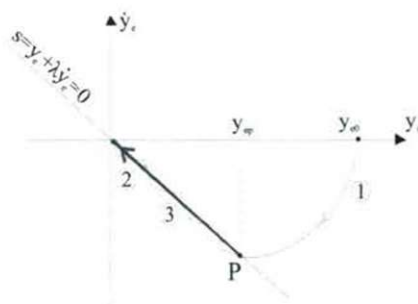


Figure 2. Sliding motion in the state space

Selection of the control law

In order to guarantee that the trajectory of the error vector e will translate from approaching phase to sliding phase, the control strategy must satisfy the sliding condition

$$s(\dot{e}, e) \cdot \dot{s}(\ddot{e}, \dot{e}) < 0 \quad (15)$$

This means that system trajectory should be forced to move toward the sliding surface. A proper control should be selected to satisfy the condition (15) in any time instant. Let us assume that the desired value is constant and according to (13) and (14) follows

$$\dot{s} = \dot{e} + \lambda \cdot \ddot{e} = -\dot{x} - \lambda \cdot \ddot{x} = -\dot{x} - \lambda \cdot f(x, \dot{x}, u) \quad (16)$$

If $s > 0$ or $s < 0$ the control law should be selected in a way, which ensures

$$-\dot{x} - \lambda \cdot f(x, \dot{x}, u) < 0 \quad \text{or} \quad -\dot{x} - \lambda \cdot f(x, \dot{x}, u) > 0 \quad (17)$$

The simplest control law that might lead to sliding-mode is the relay

$$u = \delta \cdot \text{sign}(s) \quad (18)$$

The relay-type controller does not ensure the existence of the sliding-mode for the whole state space, and relatively big value of δ is necessary, which might cause a chattering phenomenon. If the sliding-mode exists ($s=0$ and $\dot{s}=0$), then there is a continuous control, known as equivalent control u_{eq} which can hold the system on the sliding surface.

In practice, there is no perfect knowledge of the whole system and parameters, so, only \hat{u}_{eq} , the estimate of u_{eq} , can be calculated. Since \hat{u}_{eq} does not guarantee convergence to the switching surface, in general, a discontinuous term is usually added to \hat{u}_{eq} , thus,

$$u = \hat{u}_{eq} + \delta \cdot \text{sign}(s) \quad (19)$$

The role of the discontinuous term in the control law is to compensate the effect of the uncertain perturbations and bounded disturbance. The more knowledge of process is implied in the control law, the smaller discontinuous term is needed.

Chattering free implementation

Chattering is the main problem of sliding-mode control and chattering free implementation is the key step in design of a sliding-mode controller. A quite general solution is that the relay (which changes control value suddenly) is replaced by a saturation function. There is a boundary layer around the sliding surface where the control signal is changing continuously. If the system trajectory is close to the sliding surface and the control signal is small, then the system might stick before the goal. To avoid it a modified saturation function is proposed.

2. THE SERVOPNEUMATIC POSITIONING SYSTEM

The system is shown in Fig.3. and Fig.4. (details can be found in [33]). It consists of a double-acting pneumatic rodless cylinder (MECMAN 170 type) with bore of 32 mm, and a stroke of 500 mm, controlled by a five-way servo-distributor (FESTO MPYE-5-M5-010-B type).

A linear encoder (LINIMIK MSA 320 type) gives the position. Velocity and acceleration are obtained by numerical derivation. Pressure sensors (Motorola MPX5999D) are set in each chamber. The controller is implemented in PLC environment.

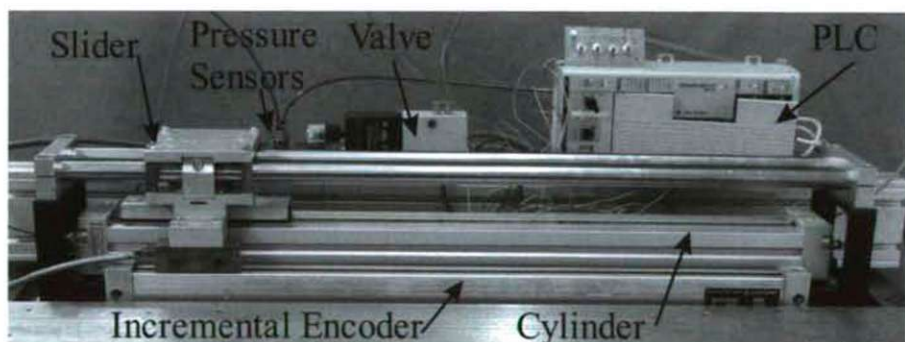


Figure 3. The experimental setup of servopneumatic positioning system

The control goal is to move the piston from any initial position to the target position. Using the sliding approach it is possible to minimize the positioning error.

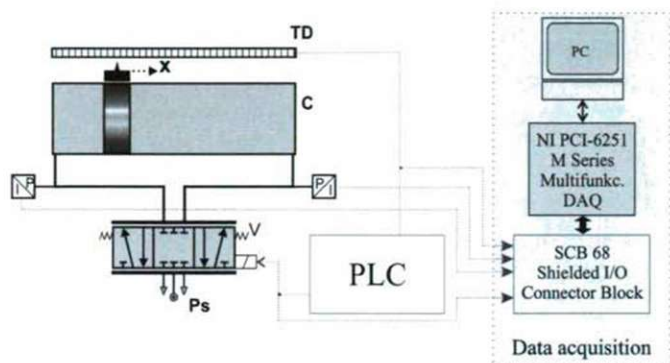


Figure 4. Configuration of pneumatic positioning system

The system pressure is set to be 5 bar, the sampling time is depend on the PLC program. In order to analyze the positioning control methods, a real-time data acquisition program was designed in LabVIEW to capture the system output data through the connector block to the NI PCI-6251 M Series Multifunction DAQ device.

A National Instruments data acquisition card (NI 6251/M) reads the signal, pressure sensors and incremental encoder into the PC. National Instruments LabVIEW will be used to collect the data imported through the DAQ card (Fig. 4.).

3. EXPERIMENTAL RESULT

The experiment is a sliding-mode control with classical relay control law. The transient responses of the piston position as well as control signal are shown in Fig. 5. The steady state position error of the system with PLC based relay type sliding-mode control is within ± 0.02 mm.

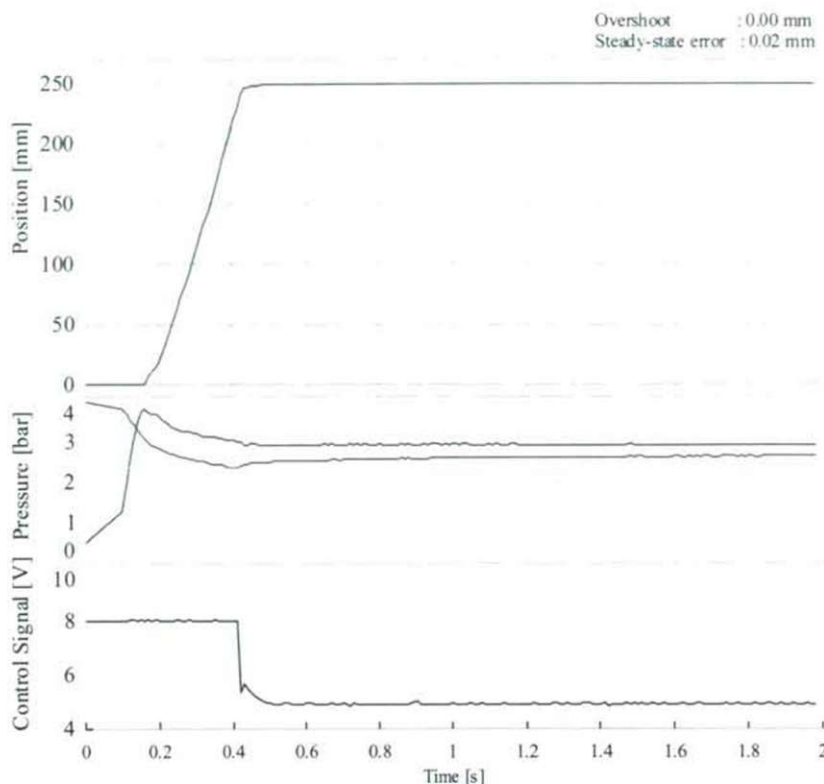


Figure 5. Piston position, air pressure and control signal transient responses with relay type SM controller

The accuracy of the system is limited by the applied position sensor.

4. CONCLUSIONS

This paper proved that pneumatic servo systems can be used for the accurate robust position control, not only for the movement between two hard stops. The experimental results showed that proposed sliding-mode controller gives fast response and good transient performance.

The final conclusion is that proposed sliding-mode controller with modified saturation function can eliminate chattering, which is the main problem in the case of sliding-mode control and can be used as a promising tool for accurate control of the servopneumatic systems.

Based on the laboratory measurements we can conclude that the PLC based sliding mode controller suitable and effective for the position control. The steady-state position error is within ± 0.02 mm and it is limited by position sensor.

Further works will be done on the BTL5-S101 type Micropulse Linear Transducer from Balluff with $1 \mu\text{m}$ resolution and we will be done with applying the input shaping method.

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THE ROLE OF FOREIGN CAPITAL AND MULTINATIONAL COMPANIES AND THEIR EFFECT ON ECONOMY IN HUNGARY

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ABSTRACT

Presence of the international companies, alien properties, and the foreign capital in Hungary is under a wide social debate. It is the foreign capital which established Hungary's long-range development and this capital will significantly influence it in the future, too. After the political transformation reintegration into the world economy, establishment of market economy and modernization of the economic structure realized by foreign investments implied an outstanding potential for further development.

However, by today the capital drawing ability of Eastern Europe, and Hungary has declined as a result of which adaption to the new situation, reversal of this trend, our ability to keep the capital, and giving the chance to companies in home property all are of stressed importance.

1. INTRODUCTION

In the post-socialist countries, among them in Hungary, too, the first foreign investors appeared on the scene at the end of the 80s. Closing up the Eastern block of Europe could be started by accepting the foreign capital, which is to say by the expansion of multinational companies. This process was considerably supported by globalization, on one hand, and economic policy of the potential capital receiving countries, on the other hand. This latter one can either significantly help or, within certain frames, can restrain the effects of transformation in world economy. In the following chapters I am aiming to examine and analyse the characteristic features of the foreign capital inflow coming to Hungary.

2. INFLUX OF FOREIGN FUNCTIONING CAPITAL FROM THE POLITICAL TRANSFORMATION TO THE END OF THE 90S

In our country, before the political transformation the term internationalization was restricted to the specific relationship with the CMEA-countries and the role of foreign investment was minimal.

However, the political transformation meant a real milestone since the earlier economic relations changed in their quality and almost unlimited opportunities were opened for the international companies to establish companies of production and service in Hungary¹.

¹ Lásd: SIMAI MIHÁLY: *A világgazdaság a XXI. század forgatagában* Akadémiai Kiadó Zrt. Budapest 2007. (a továbbiakban SIMAI 2007.) 317-325.

If we examine the 90s, it can be stated that German companies brought the most capital into our country, due to their significant participation in privatization of the energetic sector. Even the United States took its part from the greenfield investments. (General Electric, General Motors, Ford, Guardian Glass).

Besides them, Austrian, French, Dutch and Italian investors appeared on the scene, too.

At first, the foreign capital was typically concentrated on Budapest and its environs, and on the northern Transdanubian area. However, areas close to motorways, like northeast Hungary (TVK, Borsodchem, Alkaloida) and Gödöllő, Kecskemét² in the Eastern part of the country took their share, too.

Direct capital import is an important factor of integration into the developed market economies which greatly affects GDP, as well, since modern company management appears too, besides translation of the developed techniques and capital import. Multinational companies are efficient to get the external markets due to their existing relations. All these factors have an important part in that the country on the way of transition is able to achieve a relatively high sustainable pace of development even in the time span of one-two decades.

By 1997 or by the beginning of the increase the stock of functioning capital flowing into the Hungarian economy was 15,5 billion USD which calculating on the exchange rate of dollar in '97 meant 42% of the GDP. By this time Hungary had lost its leading position among the former Socialist countries, regarding the absolute extent of the direct capital import stock, but it still was in the leading position considering the total direct import per capita and direct capital import in proportion with GDP.

In the beginning more than a half of the capital import had been directed to the processing industry, but by 1997 this proportion had changed since it became the service sector to take away the bigger import capital, by this time its proportion was 59%.

It significantly influenced the pace of growth since export dynamics was considerably more intensive in processing industry than in the tertial sector. Today technical development is significant in the tertial sector, too, so even this field can influence long-range development. Also, it is worth considering that the pace of development is always bigger in a country on the way of transition than in the leading economy³.

3. INFLUX OF FOREIGN FUNCTIONING CAPITAL AFTER THE TURN OF THE MILLENNIUM

If I examine the process of the influx of functioning capital at a longer range, between 1990 and 2008, it can be stated that the stock of functioning foreign capital exceeds 57 billion EUR in our country.

The annual distribution of direct foreign capital investments between 2000 and 2008 is shown by the following diagram from which it can be read that the year 2007 was outstanding with its sum of 58.457 EUR. In 2008 decrease in capital stock was clearly due to the foreign

² Lásd: <http://www.hhrf.org/korunk/9811/11k27.htm>

³ Lásd: ERDŐS TIBOR: *Fenntartható gazdasági növekedés* Akadémiai Kiadó, Budapest 2003. 328-345.

disinvestment. The diagram shows that the growth is continuous up to 2007, the capital inflow increased by more than its double in the examined period.

The high proportion of German investment typical to the 90s stayed in Hungary in 2008, too, since this country accepted 23,7% from the total foreign capital investments. Examining the period between 2000 and 2008, it can be stated that the bigger part of capital investments comes from Europe, as this proportion was between 79-84% during the mentioned years.

The following diagram contains division (%) of the direct foreign capital investments coming to Hungary in 2008.

Stock of direct foreign capital investments in Hungary in million €

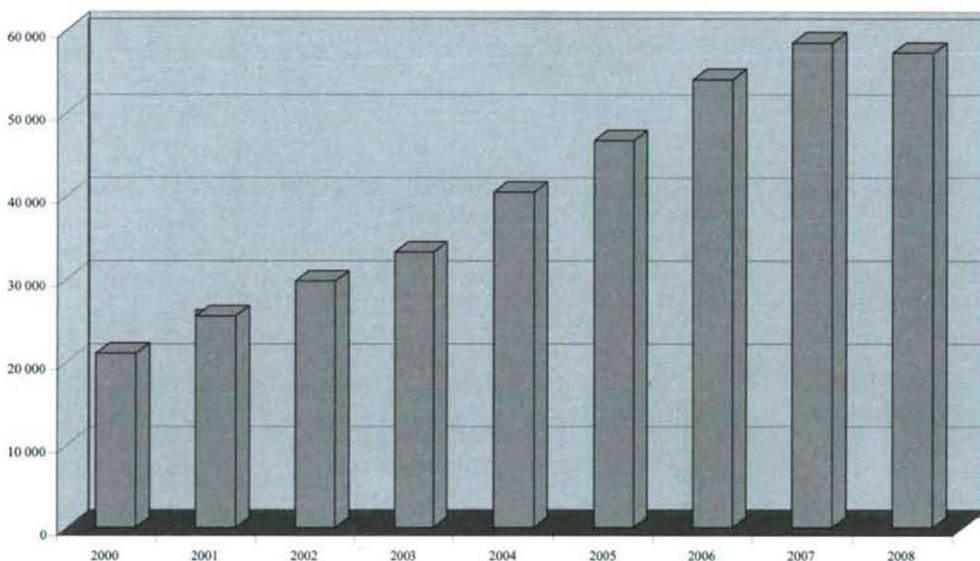


Figura 1: Changes in the stock of direct foreign capital investments from 2000 to 2008, my own data process – Source: MNB⁴

⁴http://www.mnb.hu/Statisztika/statisztikai-adatok-informaciok/adatok-idosorok/vii-kulkereskedelem/mnbhu_kozetlen_tokebef MNB A nem rezidensek magyarországi közvetlen tőkebefektetés (részvény, egyéb részesedés és újrabefektetett jövedelmek) állományának országokénti megoszlása

Direct capital investments in Hungary according to countries in 2008

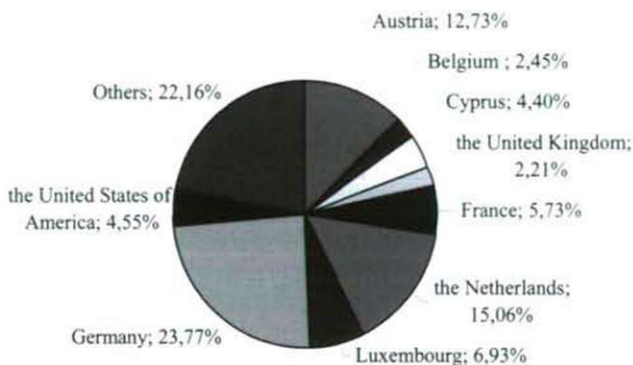


Diagram 2. Division of the direct foreign capital investments in 2008 according to the countries of origin- my own data process- Source: MNB⁵

Division of direct capital investments according to branches

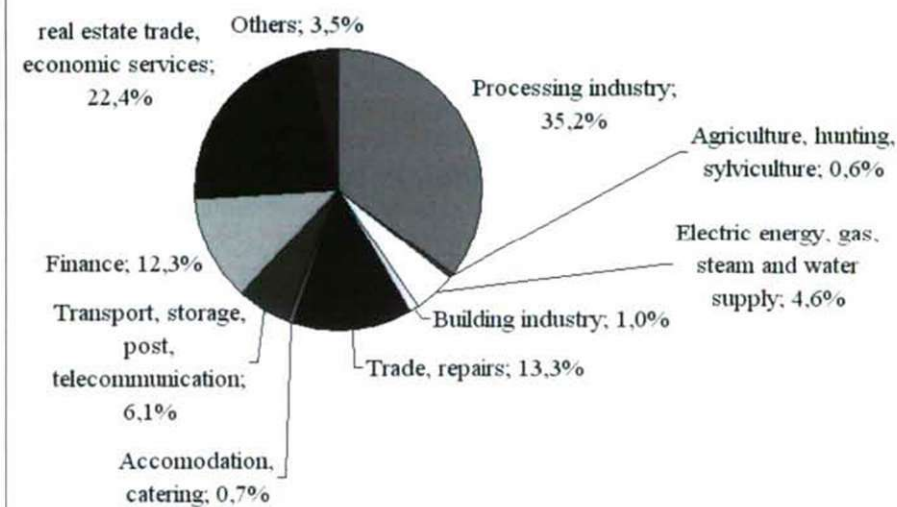


Diagram 3 Division of direct foreign capital investments in 2008 according to sectors – my own data process – Source: MNB

⁵http://www.mnb.hu/Statisztika/statisztikai-adatok-informaciok/adatok-idosorok/vii-kulkereskedelem/mnbhu_kozetlen_tokebef MNB: A nem rezidensek magyarországi közvetlen tőkebefektetés (részvény, egyéb részesedés és újrabefektetett jövedelmek) állományának ágazatonkénti megoszlása

It can be seen in Diagram 3 that besides the German capital, the Dutch (15,06%), the Austrian (12,73%), the Luxembourger (6,93%), the French (5,73%) and the American (4,55%) proportions are remarkable, too.

The tendency which was experienced at the turn of the millennium, too, remained in 2008 according to which more than a half of the inflowing foreign capital was accepted by service sectors.

It can be seen from the above diagram that 54,8% of the foreign capital was directed to the service sectors.⁶

4. EFFECTS OF THE PRESENCE OF MULTINATIONAL COMPANIES ON THE HUNGARIAN ECONOMY

In the 21st century multinational companies, banks, multilateral organizations and the European Union have an important role regarding internationalization.

In the book of Simai Mihály, published in 2007, we can read the following:

„Considering the importance of transnational countries and regarding „*the transnationality index*” calculated by the researchers of the UN Trade and Development Conference Hungary is in the seventh position among both the developed countries and within the borders of the EU, while *in the twelfth place* out of eighty countries if we consider the *whole world*. The basis of the transnationality index is the extent of capital property of international companies, the proportion of new value in BNT produced by them, and proportion of their employees in the whole number of workers.”⁷

Expansion of the multinational companies in Hungary is under continuous discussion.

Let's examine the effects more closely!

In the process of *reintegration of the Hungarian economy into the world economy* expansion of the foreign sector has become the most important factor since 90s. The internal effect of this process is also remarkable.

Companies in foreign possession have significantly *transformed the structure of the Hungarian industry*, export and import, proportion and direction of technical development and the quality of service sector.

We should not forget that the international companies considerably influence the *income of both the state and population and employment*.

It is evident that due to the above mentioned process *we depend on the effects of the processes in the international market* (let they be positive or negative), though it helps the Hungarian economy grow, we have to take the significant oscillations, and the possible consequences of the speculative operations into consideration.⁸

⁶ http://www.mnb.hu/Engine.aspx?page=mnbhu_statistikai_idosorok&ContentID=11130
MNB A nem rezidensek magyarországi közvetlen tőkebefektetés (részvény, egyéb részesedés és újrabefektetett jövedelmek) állományának ágazatonkénti megoszlása

⁷ see: SIMAI 2007. 395.

⁸ see: SIMAI 2007. 384-402.

The foreign greenfield industrial investments establish new workplaces, these companies produce mainly to export. Their most important representatives are Audi, Opel, Suzuki, Ford, Philips, Nokia, Sony etc.

There is a bigger professional and social criticism in connection with privatization of the energetic sector and financial institutions carried out by foreign investors. The first one can be explained with *rise in prices*, while the second one with the fact that Hungarian companies have *difficulties in getting bank loans* and that the *foreign control is increased* this way.

Multinational companies, hypermarket of food industry and trade attract customers from small and medium-sized shops in *home ownership* the process of which clearly results in *their impossibility of performance*.

In case of multinational companies *decisions* on development, the profit, investments are made in *the central office of the parent company*, so we can be winners and losers of these decisions. We can be winners if we can fulfil the function of regional „sub-centre” or with further home investments, but at the same time, sister companies in other countries can take away these possibilities from us, which means further risk.

Before the appearance of the foreign capital the home state companies lacked the capital which hindered competitive technical-technological investments. It is obvious that the international companies solved this problem with their own capital force or their credit of lower expenses, so the owners *could assure the financial and technical source* necessary to reorganize the given company.

According to home experiences, the multinational companies carried out a serious *reorganization* in the privatized companies. It involved sales and marketing departments, networks of sales from which they demanded a more customer-oriented operation more suitable for the requirements of market economy. Basically, two strategies were realized, the first one is transplantation of standards typical to the given company group and the second one is marketing and sales strategy appropriate for the local customs of consumption.

As for finance, it was typical that *a strong control* was executed by the person delegated by the owner which was accompanied with the deeper knowledge about the company and assessment of reserves. Besides, *modernization of financial information system* and *new structure of administrative systems* became typical.

Among expenses of several international companies we can find know-how, licences, fees of consulting, fees of management services by means of which, among others, even *tax optimization* can be realized within the company group.

The range of products in case of the newly purchased home companies transformed in order to fit into the strategy of the company group. Consequently, *transformation, enlargement and utilization of capacity* resulted in a more efficient operation, perhaps thus *outplacing production of small series*.

By *profile cleaning* certain service activities (maintenance, cleaning, catering, security service) were left out and they were ordered from external contractors (outsourcing).

In the field of *research-development* capacity is submitted to the interests of the entire company group which also means *reorganization*, reduction or even building a new research base. The so-called regional divisions of research and development are getting more and more widespread.

Multinational companies generally practise a centralized policy of purchase price reduction of which, due to the order of great volume, results in a significant cost advantage. As a result, unfortunately, *the local suppliers of background industry*, which serve only the home company having a limited capacity, *are replaced* and the proportion of import will increase in this field. Thus, for example, the former suppliers of Lehel Fridge Factory, Tungsram and

Telephone Factory suffered a serious loss in market. Besides, *while determining the suppliers quality, price and reliability in transport* are of determinant importance, thus only competitive companies can fulfil these requirements. However, these latter ones might serve sister companies in other countries, too.

In management level the control of the parent company is strong, home managers have smaller independence than in case of companies in Hungarian possession.

International companies employ *young, more qualified labour force* who can adapt the new knowledge in a more flexible way and can suffer more burden than their older colleagues. Therefore companies in foreign possession tend to *pay more* for their employees, though *productivity of these employees* compensates the higher labour force expenses.

In Hungary *the knowledge transfer* realized by the multinational companies formed a human resource in the Hungarian labour market which is really creative, productive and competitive. Besides, the modern knowledge of management has become widespread. Knowledge of a foreign language is indispensable in this environment, and knowledge of organization has become well-known, too.

Regarding the balance of foreign trade, it can be observed that *at the beginning of the foreign capital investments* it declines, since suppliers of the parent company take more part, later it can be compensated by the export of home suppliers. In case of industrial technologies investments are realized mainly from import, so developments of this kind worsen the balance. However, it can be counterpoised by the export residue due to them. In case of foreign capital investments directed to obtain the home market, import can be emphasized in the fields of car-assembly, production of telephone centre and packaging technology.

The current account improves due to the influx of foreign capital (investments, developments), however, it declines due to the profit transfer – namely profit allocation in foreign currency. Besides paying dividend, other *techniques of income reduction* are used, basically for tax optimization.

In several sectors – e.g. building industry, trade, food industry and sectors of energy and public utilities- *concentration* of great size is realized by the foreign capital which was induced by the bigger share in market and *optimal factory size*.

Besides, *increase in competition* can be observed in some branches, since competitive spirit has become implanted in Hungary, too, which on one hand, makes the home companies competitive, and on the other hand, competition is in the interest of customers, as well, for example, in the field of financial sector.

Foreign managers and their families in Hungary live lives of consumers of significant income. To satisfy their needs *the international characteristics has entered our culture* which is expressed in cultural programmes, expansion of the international media and special services.

5. FUTURE OF MULTINATIONAL COMPANIES IN OUR COUNTRY

Thinking of the functioning capital I have the picture „there are always more round pegs than round holes” in my mind. In the 90s our country could invite foreign capital with the *cheap labour force* and *government subsidies*, which is typical to periphery countries. However, after the period of privatization dynamics of FDI-inflow seems to decrease so we have to *change strategy regarding the other countries functioning in periphery*.

Withdrawals can affect the home economy very seriously, we have to think of the example of IBM or firms which did not and do not intend to establish any relations with the Hungarian businesses, they just have products coming from foreign suppliers assembled which they at once transport to other foreign markets. Firms without roots like these generally rent both the large workshop and a significant part of the labour force, so within few weeks they can easily change premises.

We have to give chance to the activities which produce higher added value and which prefer home suppliers and qualified labour force, mainly research and development should have key importance.

It might protect us from withdrawals, though nothing can be sure in this case, since *profit-orientation* is the most important thing for strategic decision-makers of international companies. Service and logistic centres could mean a real breakout for our country, though today it implies a huge competition.

Besides rootless international companies, we have to mention the other pole, as well, because there are companies which carry out R+D activity in our country, like, for example, General Electric, Sanofi Chinoin, Nokia, Siemens, Audi, Knorr-Bremse, Flextronics, Michelin, Unilever etc.⁹

In case of international companies in high-tech industry, while making decision on their investments in Hungary *know-how in the industry* was one of the influencing factors. It is an even bigger advance that in their Hungarian premises centres of development and testing were established, going beyond the category of place of production. An excellent example for it the subsidiary company of ZF in Eger chose the University of Miskolc and the Technical University of Budapest as its partners. In this case the firm directs the researches and the research results can be utilized at once in the field of technology development which reacts to the export ability of our country and to the increase in economy. I can hardly image *a better win-win relation*.¹⁰

6. SUMMARY

During the examination of this subject I could conclude that it is absolutely necessary to improve the capital attracting ability of Hungary from the aspect of her future development.

For this I thought important to underline the following things:

- *Activities of higher added value* should have more attention.
- *Switch over to services* can create a new situation since it can change the way of thinking about the premises. Thus higher qualifications and knowledge of language can play more important roles.
- Influx of the foreign capital into the food processing industry can be realized with success only when *the necessary service background is established*, too.
- *Infrastructure of traffic and telecommunication* should be developed even more.
- *It is necessary to become specialized in new fields, in activities which need labour force of high qualification*, for example we can aim at location of service, financial and administrative centres within the company groups to our country.

⁹ See: IVICZ MIHÁLY- KATONA KLÁRA – SCHLETT ANDRÁS: Vonzó-e Magyarország a működő tőke számára

In: BOTOS KATALIN: *Pénzügyek a globalizációban* JATEPress Szeged 2004. 58-67.

¹⁰ See: http://www.gtm.hu/cikk.php?cikk_id=735

- It is necessary to increase *the efficiency of subventions*. Besides, it is advisable to pay attention to regional development if we want prevent companies from leaving our country after that the subventions have been finished.
- Corruption has to be forced back.
- We should pay more attention to the soft factors of capital attraction. It is necessary to consider what qualitative and quantitative conditions a given area has for example, in the fields of *life quality, education and culture*.

As a result, Hungary can not only obtain capital import of long-range but also continuous knowledge transfer.

Besides, it is necessary to minimalizethe risk coming from our international dependence.

Closing up home companies means a huge challenge but with a strategically well-planned, well-organized system of subsidies these companies can become real, serious *suppliers* or even *competitors* of international companies, or *significant performers of home market* not only in Hungarian but *in international aspect, too*.

The stressed question of today's Hungarian economy is how we can utilize *the human capital* for the interest of companies both in foreign and home possession, so that *the employee, the management* can be satisfied both professionally and financially, so that *the budget* can be satisfied by means of taxes, and this way indirectly even *the Hungarian society can be satisfied*. I am aware of that not every international company has left stories of success in Hungary, that is why it is the government's responsibility to minimize this risk by means of that, for example, foreign companies should be motivated to stay and to use Hungarian suppliers. I honestly imagine a future where *in the public conscious* the term multinational company does not evoke negative feelings but rather *confidence, chances for development, an example to follow, development of the home economy and cultural diversity*.

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NEEDED ACTIONS IN BUSINESS LIFE ON PREVENTION OF MONEY LAUNDERING AND TERRORISM

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ABSTARCT

The actuality of the subject derives from the Seledt Committee on the Evaluation of Anti Money Laundering Measures aided by the Financial Action Task Force. The reason of the program is to give aides to those countries which wore not FATF members as money laundering is the most profit yielding business on the world with it's 2800 milliard USD turnover. This organization controls Hungary by supervising the law and overall actions giving a so called Progress Report about the achievements.

Anti-money laundering (AML) is a term mainly used in the financial and legal industries to describe the legal controls that require financial institutions and other regulated entities to prevent or report money laundering activities. Anti-money laundering guidelines came into prominence globally after the September 11, 2001 attacks and the subsequent enactment of the USA PATRIOT Act.

Today, most financial institutions globally, and many non-financial institutions, are required to identify and report transactions of a suspicious nature to the financial intelligence unit in the respective country. For example, a bank must perform due diligence by verifying a customer's identity and monitor transactions for suspicious activity. To do this, many financial institutions utilize the services of special software, and use the services of companies such as C6 to gather information about high risk individuals and organizations. United States federal law for example related to money laundering is implemented under the Bank Secrecy Act as amended by anti-money laundering acts up to the present. Many people have confused Anti-Money Laundering (AML) with Anti-Terrorist Financing (ATF). Under the Bank Secrecy Act of USA, Money Laundering and Terrorist Financing are classified when financial institutions file Suspicious Activity Reports (SAR) to Financial Crimes Enforcement (FinCEN) which is a US government agency. To effectively implement AML and ATF measures, The US government encourages financial institutions to work together for AML and ATF purposes in accordance with Section 314(b) of the USA PATRIOT Act. However, since financial institutions are required by law to protect the privacy of their clients, section 314(b) cooperation has not been generally adopted by financial institutions. To overcome this obstacle, the United Crimes Elimination Network (UCEN) has been established by AML and ATF professionals to achieve this global cooperation goal in compliance with the privacy laws of most countries.

Different countries, depending on the activity, demand different actions. For example; in the US a deposit of US\$10,000 or more requires a CTR (Currency Transaction Report) , in Europe it is EUR 15,000, and in Switzerland it is CHF 25,000 in Hungary it is 3,600 thHUF requires full identity control. In some countries there is no CTR requirement. Suspicion of ML activity in the US requires the submission of a SAR, while in Switzerland a SAR will only get filed if that activity can be proved. As a result, thousands of SARs are filed daily in the US, while in Switzerland the rate is much lower.

FATF: Financial Action Task Force against Money Laundering

Formed in 1989 by the G-7 countries, the Financial Action Task Force on Money Laundering (FATF) is an intergovernmental body whose purpose is to develop and promote an international response to combat money laundering. In October of 2001, FATF expanded its mission to include combating the financing of terrorism. FATF is a policy-making body, which brings together legal, financial and law enforcement experts to achieve national legislation and regulatory AML and CFT reforms. Currently, its membership consists of 31 countries and territories and two regional organizations. In addition, FATF works in collaboration with a number of international bodies and organizations. These entities have observer status with FATF, which does not entitle them to vote, however permits full participation in plenary sessions and working groups. FATF's three primary functions with regard to money laundering are:

i. Monitoring members' progress in implementing anti-money laundering measures ii. Reviewing and reporting on laundering trends, techniques and countermeasures, and iii. Promoting the adoption and implementation of FATF anti-money laundering standards global The Financial Action Task Force on Money Laundering (FATF), also known by its French name Groupe d'action financière sur le blanchiment de capitaux (GAFI), is an inter-governmental body founded in 1989 by the G7. The purpose of the FATF is to develop policies to combat money laundering and terrorist financing. The FATF Secretariat is housed at the headquarters of the OECD in Paris. FATF Associate Members include

The FATF currently comprises 34 member jurisdictions and 2 regional organisations, representing most major financial centres in all parts of the globe. – Argentina, Australia ,Austria, Belgium, Brazil, Canada, China, Denmark, European Commission, Finland, France, Germany, Greece, Iceland, India, Ireland, Italy, Japan, Netherlands, Luxembourg, Mexico, New Zealand, Norway, Portugal, Russian Federation, Singapore, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom,United States.

The Financial Action Task Force (FATF) is an inter-governmental body whose purpose is the development and promotion of policies, both at national and international levels, to combat money laundering and terrorist financing. The Task Force is therefore a "policy-making body" which works to generate the necessary political will to bring about national legislative and regulatory reforms in these areas.

Since its creation the FATF has spearheaded the effort to adopt and implement measures designed to counter the use of the financial system by criminals. It established a series of Recommendations in 1990, revised in 1996 and in 2003 to ensure that they remain up to date and relevant to the evolving threat of money laundering, that set out the basic framework for anti-money laundering efforts and are intended to be of universal application.

The FATF monitors members' progress in implementing necessary measures, reviews money laundering and terrorist financing techniques and counter-measures, and promotes the adoption and implementation of appropriate measures globally. In performing these activities, the FATF collaborates with other international bodies involved in combating money laundering and the financing of terrorism..

History of the FATF

In response to mounting concern over money laundering, the Financial Action Task Force on Money Laundering (FATF) was established by the G-7 Summit that was held in Paris in 1989. Recognising the threat posed to the banking system and to financial institutions, the G-7 Heads of State or Government and President of the European Commission convened the Task Force from the G-7 member States, the European Commission and eight other countries.

The Task Force was given the responsibility of examining money laundering techniques and trends, reviewing the action which had already been taken at a national or international level, and setting out the measures that still needed to be taken to combat money laundering. In April 1990, less than one year after its creation, the FATF issued a report containing a set of *Forty Recommendations*, which provide a comprehensive plan of action needed to fight against money laundering.

In 2001, the development of standards in the fight against terrorist financing was added to the mission of the FATF. In October 2001 the FATF issued the *Eight Special Recommendations* to deal with the issue of terrorist financing. The continued evolution of money laundering techniques led the FATF to revise the FATF standards comprehensively in June 2003. In October 2004 the FATF published a Ninth Special Recommendations, further strengthening the agreed international standards for combating money laundering and terrorist financing - the *40+9 Recommendations*.

Background on the MONEYVAL (Formerly PC-R-EV)

In 2002, the PC-R-EV formally changed its name to MONEYVAL. MONEYVAL was established in September 1997 by the Committee of Ministers of the Council of Europe to conduct self and mutual assessment exercises of the anti-money laundering measures in place in Council of Europe member states, which are not members of the Financial Action Task Force * (FATF). The effort includes encouraging jurisdictions to improve their anti-money laundering measures in keeping with the FATF Forty + 9 Recommendations and to enhance international co-operation. Currently 28 Council of Europe member States are evaluated by MONEYVAL. In 2006 the Committee of Ministers accepted the application of the State of Israel to join MONEYVAL's terms of reference and Israel has since been evaluated by MONEYVAL. MONEYVAL also engages in a regular typologies exercise focused on the methods and trends of money laundering activity.

MONEYVAL takes into account the practices and procedures of the FATF in its work. MONEYVAL is a sub-committee of the European Committee on Crime Problems of the Council of Europe (CDPC). Each of its member countries is entitled to appoint three experts to MONEYVAL. These individuals are selected based on their expertise in legal issues related to national and international anti-money laundering instruments, supervision of financial institutions, and law enforcement matters. There are thrice-yearly Plenary meetings of the Committee at which the national experts consider and adopt draft mutual evaluation reports and follow up reports of evaluated members of members. Additionally, the MONEYVAL membership also includes experts from the past and current Presidency of the FATF and four scientific experts appointed by the Secretary General.

When MONEYVAL (then called PC-R-EV) was formed in 1997, a document containing the terms of reference for the Committee was agreed at the same time. The Terms of Reference have since been amended to extend the mandate of the Committee until 31 December 2010. The amended Terms of Reference also permit FATF member countries to participate as observers in the work of the Committee.

Following the events of 11 September 2001, MONEYVAL expanded its mandate to include countering terrorist financing. MONEYVAL became an Associate Member of the FATF in 2006.

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MYCOBIOTA AND FUMONISIN CONTAMINATION IN DRIED FRUITS OF DIFFERENT ORIGIN

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ABSTRACT

Fumonisin are carcinogenic mycotoxins which were originally identified in *Fusarium verticillioides*. According to recent findings, fumonisins are also produced by some black *Aspergillus* species including *Aspergillus niger* and *A. awamori*. Aspergilli are able to produce fumonisins in high quantities on agar media with low water activities. Data on the occurrence and role of this species in fumonisin contamination of agricultural products with high sugar content are needed to clarify the importance of *A. niger* in human health. The mycobiota and fumonisin contamination of various dried fruit samples collected from different countries were examined to clarify the role of black Aspergilli in fumonisin contamination of such products. All except two of the examined raisin samples were contaminated with black Aspergilli. Species assignment of the isolates was carried out using sequence analysis of part of the calmodulin gene. The range of fumonisin isomers present in the raisin samples, and produced by *A. niger* and *A. awamori* isolates collected from dried vine fruits was also examined using reversed-phase high-performance liquid chromatography/electrospray ionization – ion trap mass spectrometry. Among the *A. niger*/*A. awamori* isolates identified, 67% produced fumonisins. The isolates produced several fumonisin isomers also present in the dried vine fruit samples, including fumonisins B₁₋₄, 3-epi-FB₃, 3-epi-FB₄, iso-FB₁, and two iso-FB₂₋₃ forms. Most of these isomers have previously only been identified in *Fusarium* species. The average fumonisin content of the 7 dried vine fruit samples which were found to be contaminated by potential fumonisin producing black Aspergilli was 7.22 mg kg⁻¹. Our data indicate that *A. niger* and *A. awamori* are responsible for fumonisin contamination of dried vine fruits worldwide. The observed levels of contamination are alarming and pose a new threat for food safety. Preliminary data also indicate that fumonisin contamination of other dried fruits including figs and dates, and that of onions are also caused primarily by black *Aspergillus* species. Further work is in progress to examine the role of black Aspergilli in fumonisin and ochratoxin contamination of agricultural products.

1. INTRODUCTION

Fumonisin are carcinogenic mycotoxins which were originally identified in *Fusarium verticillioides* (teleomorph *Gibberella moniliformis*). Fumonisin are mycotoxins produced by several species of the genus *Fusarium*, including *Fusarium proliferatum*, *F. subglutinans*, *F. oxysporum* and *F. globosum* (3, 10)(Table 1). Fumonisin B₁ is predominant in most Fusaria, FB₂ and FB₃ usually account for up to 15-25% and 3-8%, respectively, while FB₄ is normally present in insignificant amounts (Fig. 1). Regarding the toxicity of fumonisins, high levels of fumonisin contamination in home-grown maize were found to be associated with high prevalence of human esophageal cancer in several parts of the world including Transkei region in South Africa, LinXian province in China, Northern Italy, Mazandaran and Isfahan provinces in Iran, Southeastern USA, India, Kenya, Zimbabwe and Brazil (12). Fumonisin

have also been shown to be involved in leucoencephalomalacia in horses, pulmonary edema in pigs, and liver cancer and neural tube defects in experimental rodents (12).

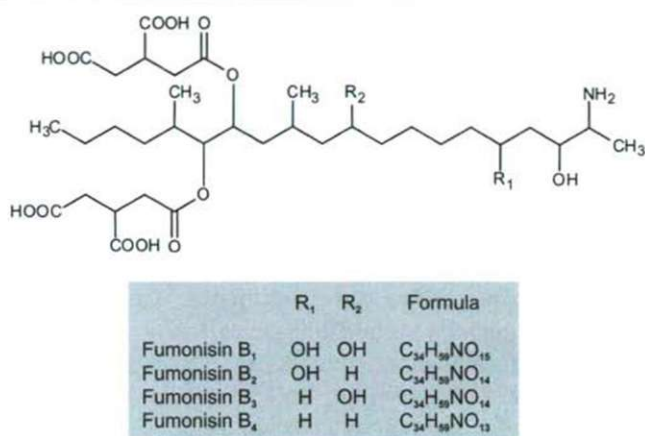


Figure 1. Chemical structures of the main fumonisin isomers

Table 1. Fungi able to produce fumonisins (7, 10, 14)

<p>Fusarium species Section <i>Liseola</i>: <i>F. verticillioides</i>, <i>F. proliferatum</i>, <i>F. fujikuroi</i>, <i>F. sacchari</i>, <i>F. subglutinans</i> (?), <i>F. anthropilum</i>, <i>F. globosum</i>, <i>F. thapsinum</i> Section <i>Dlaminia</i>: <i>F. nygamai</i>, <i>F. dlamini</i>, <i>F. napiforme</i> (?), <i>F. pseudonygamai</i>, <i>F. andiyazi</i> Section <i>Elegans</i>: <i>F. oxysporum</i> Section <i>Arthrosporiella</i>: <i>F. polyphialidicum</i></p>
<p>Aspergillus species <i>A. niger</i>, <i>A. awamori</i></p>
<p>Tolypocladium species <i>T. inflatum</i>, <i>T. cylindrosporium</i>, <i>T. geodes</i></p>

Table 2. Fumonisin production by various species on different media (2, 7)

Media	<i>A. niger/A. awamori</i>	<i>F. verticillioides</i>	<i>T. inflatum</i>
Dichloran 18% glycerol agar (DG18)	++	-	++
Czapek yeast autolysate agar + 5% NaCl (CYAS)	+++	-	-
Czapek yeast autolysate agar + 20% sucrose (CY20S)	+++	-	-
Yeast extract sucrose agar (YES)	+++	-	+++
Malt extract agar (MEA)	-	+++	++

Potato carrot agar (PCA)	-	+	+
Potato dextrose agar (PDA)	-	+++	+++
Oatmeal agar (OAT)	-	+++	-
V8-juice agar with antibiotics (V8)	+	++	++

Recent findings indicate that species unrelated to *Fusaria* are also able to produce fumonisins. In a recent study, Pel et al. (8) have identified a putative gene cluster for fumonisin biosynthesis in the phylogenetically very distantly related fungus *Aspergillus niger*, and fumonisin production has also been proved for several *A. niger* isolates came from culture collections, coffee beans, grapes and raisins (2, 6, 14). Another fumonisin producing species, *Aspergillus awamori* has recently been found to represent a phylogenetic species closely related to *A. niger* based on a multilocus sequence approach and AFLP analysis (Perrone et al., submitted). Besides, recently Mogensen et al. (7) have also observed fumonisin production in *Tolypocladium* species. Most of these reports claim that *A. niger* and *Tolypocladium* species produce only fumonisins B₂ and B₄. While *F. verticillioides* produces fumonisins on agar media based on plant extracts such as barley malt, oat, rice, potatoes, and carrots, *A. niger* is able to produce fumonisins in high quantities on agar media with a low water activity (2). Several agricultural products fit this criterion, including dried vine fruits (including raisins, sultanas, currants), dates and figs.

We examined the mycobiota and fumonisin contamination of various dried fruit (raisin, sultana, fig and date) samples collected from different countries to clarify the role of black *Aspergilli* in fumonisin contamination of such products. We also examined the range of fumonisin isomers present in the samples, and those produced by fungal isolates collected from dried vine fruits using reversed-phase high-performance liquid chromatography/electrospray ionization – ion trap mass spectrometry (RP-HPLC/ESI-ITMS).

2. MATERIALS AND METHODS

2.1. Dried fruit samples and fungal isolates

Altogether 22 dried vine fruit, fig and date samples were collected from various parts of the world. The samples were surface sterilized using 96% ethanol by immersion for 5 min, and placed on malt extract and dichloran-rose bengal medium (5). The plates were incubated at 25°C for 7 days, and black *Aspergilli* growing on these plates were purified and identified by classical taxonomic methods (9, 11).

2.2. Genotypic analysis

The fungal cultures used for the molecular studies were cultivated and DNA was extracted as described previously (14). Sequence analyses of the partial calmodulin gene were set up as described previously (4). Phylogenetic analysis of the sequences was performed using MEGA version 4 (13) as described previously (14).

2.3. Extraction and analysis of fumonisins

Fumonisins were extracted from 1 g of the samples with MeOH/H₂O (3/1, v/v). Fumonisins were extracted from the fungal cultures according to Frisvad et al. (2), with minor

modifications (14). The extracts were analysed by a hyphenated technique (RP-HPLC/ESI-ITMS) as described previously (1, 14).

3. RESULTS AND DISCUSSION

3.1. Occurrence of black *Aspergilli* in dried fruit samples

Black *Aspergilli* have been identified in 84.6% of the dried vine fruit samples, in 4 of the 5 examined fig samples, and in all 4 date samples (Fig. 2). Species assignment was carried out using sequence analysis of part of the calmodulin gene fragment of the isolates. Potential fumonisin producing *A. niger* or *A. awamori* isolates have been identified in 7 of the raisin samples, in 3 of the fig samples, and in only one of the date samples (14; data not shown).

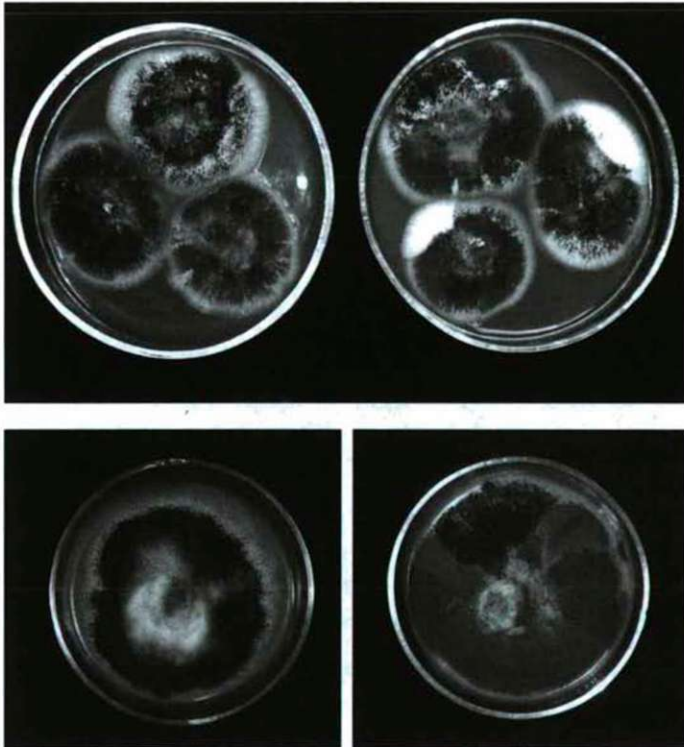


Figure 2. Mycobiota of a raisin (top 2 plates), a fig (bottom left) and a date sample (bottom right)

3.2. Detection of fumonisins in dried fruit samples

RP-HPLC/ESI-ITMS analysis of the dried fruit samples have been carried out to examine the amount and distribution of fumonisin isomers in the samples. Several fumonisin isomers were detected in all the samples, including fumonisins B₁₋₄, 3-epi isomers of FB₃ and FB₄, iso-FB₁, iso-FB_{2,3}, FB₅ and iso-FB₅ (14; Fig. 3). The detection of the same isomers in the dried fruit samples and in the fungal cultures indicates that *A. niger* and *A. awamori* are probably responsible for fumonisin contamination of dried fruits including raisins and figs worldwide. The observed levels of contamination are alarming and pose a new threat for food safety.

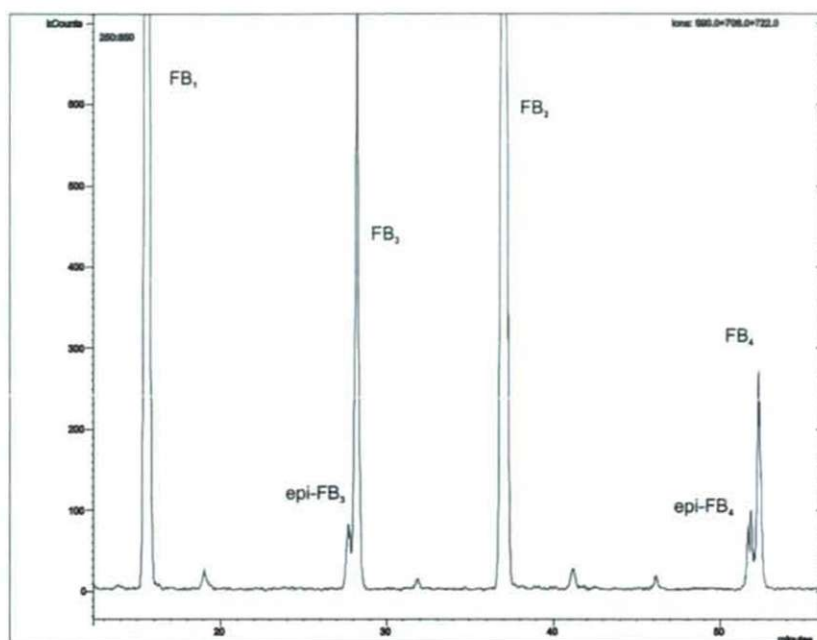


Figure 3. RP-HPLC/ESI-ITMS EIC chromatogram of the extract of a raisin sample

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NEWER INVESTIGATIONS ON THE APPLICATION OF PHYSICAL METHODS IN THE FOODSTUFFS' QUALIFICATION

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ABSTRACT

The Lambert-Beer law relating to the absorption of optical emission allows the quantitative and qualitative examination of food products, semi-finished products and raw materials whose production can be followed optically. This paper examines the possibilities of food engineering quality analyses with this physical method, the results of the locally developed computerized spectrum analysis, and the restrictions of the applicability of this method, with special emphasis on confectionery colouring substances.

1. INTRODUCTION

An ever increasing tasks related to the qualification of food products are arising as food engineering develops. Attention has already been paid to determination of the energy content of nutrients. Examinations are now being made of those elements which are present in only small amounts, only but which are of importance because their presence in living organisms is essential, since they are biologically active.

Apart from the lengthy and labour-intensive chemical procedures, there is a need for the development of physical methods which ensure the relatively rapid and simple determination of the qualification parameters of food products and satisfy the prescribed microbiological and preservative requirements. These aspects have drawn attention to colouring substances and spices, which have been studied at our Faculty for several decades. We have developed a personal computer-supported absorption spectrum analysis method, which we have primarily employed to determine the surface colour and the colouring substance content of granulated products (e.g. ground paprika) [1-3], to qualify the degree of ripeness of raw paprika [4] and to examine the physical and microbiological characteristics of the products [5;6]. We have paid particular attention to identifying the relation between the quantitative development of colouring substances added to food products and the surface colours [7].

In the past few years, the examination of colouring substances has received increasing attention, since there is a generally accepted trend that the colouring of basic food products is not purposeful. However, the colouring effect also affects the flavour of the products, and consumer conservatism demands the presence of the familiar colours. Efforts to decrease the use of artificial colouring substances to a minimum are global. Under particular circumstances, absorption spectroscopy can serve as the basis of the development of a system which allows the quantitative determination and qualitative detection of colouring substances. The present paper introduces the method of spectrophotometric examination of confectionery colouring substances, and discusses the limitations of the developed method.

2. MATERIALS AND METHODS

Spectrum analysis is based on the Lambert-Beer law relating to the absorption of optical emission, which states that the intensity of a monochromatic and parallel beam of light decreases exponentially with the distance (d) covered in the medium. The common logarithm of the quotient of the amount of light entering the medium and the reduced amount emitted is called the extinction (E) or optical density. When the light absorption is due to only one homogeneous constituent with molar concentration (c), the extinction will be

$$E(\lambda) = \varepsilon(\lambda) c d,$$

where $\varepsilon(\lambda)$ is the molar extinction coefficient. The wavelength function of the above formula is called the absorption spectrum.

Various authors have proved [8;9] that, under given conditions, the extinction of an m -component solution mixture measured at certain wavelengths can be expressed by summing the extinctions of the constituents measured at the same wavelength:

$$E(\lambda_i) = \sum_{k=1}^m \varepsilon_k(\lambda_i) c_k d.$$

According to this relationship, it is possible to quantify the constituents of an m -component solution mixture of known molar extinction coefficient but unknown concentration c . To achieve this, a linear system of equations is needed, consisting of m equations and produced with m measurements at different wavelengths, provided that the equations are linearly independent. The spectra of the solutions are extended as far as possible in order to diminish the effects of relative measurement errors occurring at certain wavelengths ($i > m$).

During our examinations, we used distilled water solutions (30 mg/1000 cm³) of the granulated colouring substances indigocarmine (blue), quinoline yellow (yellow) and neococcine (red). The absorption spectra of the model solutions were recorded with a UVIKON 930 spectrophotometer at each nm within the wavelength interval 350-650 nm. The spectrophotometer saves the data on disk in text format (ASCII), and these data are processed by the method of least squares (IBM PC AT/STATGRAPHICS). Verification of the conclusions drawn from the measurements and calculated results was based on mathematical statistics. Acidification of solutions was carried out with citric acid, while an alkaline reaction was achieved with the use of 0.1M NaOH solution. Later, we shall deal with the examination of the conditions of application, and also the spectrum-altering factors (pH, concentration of colouring substances, sugar content and duration of storage).

3. RESULTS

We first, checked the applicability of the method by the use of model solutions, analysing colouring substances in known mixing proportions. The results are demonstrated in Table I and Figure 1.

Table I – Computer-supported evaluation of neococcine and quinoline yellow solution mixtures

Measured value		Calculated value		Difference in %	
Neococcine (%)	Quinoline yellow (%)	Neococcine (%)	Quinoline yellow (%)	Neococcine (%)	Quinoline yellow (%)
20	80	19.34	80.21	-3.3	0.26
40	60	38.46	60.98	-3.85	1.63
60	40	58.96	41.72	-1.73	4.3
80	20	79.22	20.38	-0.98	1.9

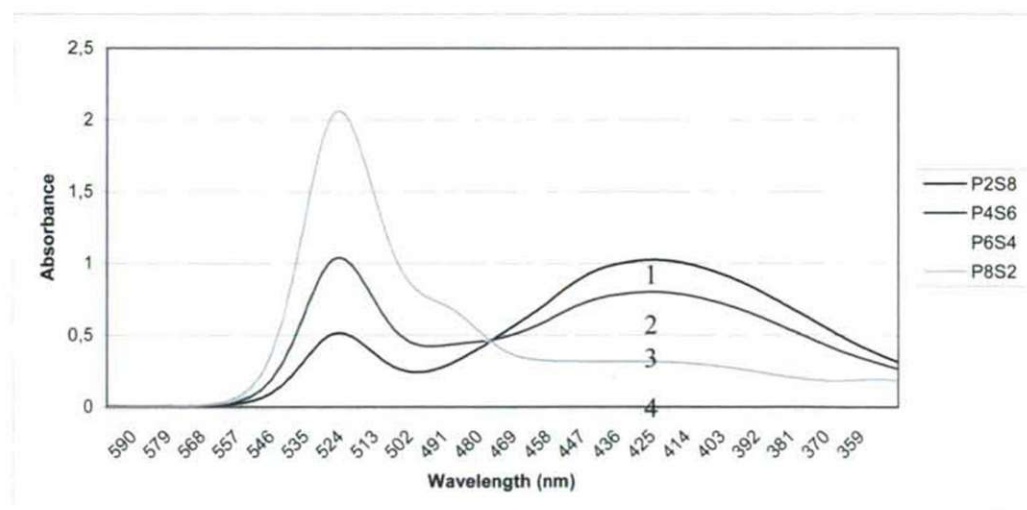


Figure 1 – Spectra of neococcine and quinoline yellow solution mixtures

Next, we examined the spectrum-influencing effects of the pH (Fig. 2), the concentration of the colouring substance (Fig. 3), the sugar content.

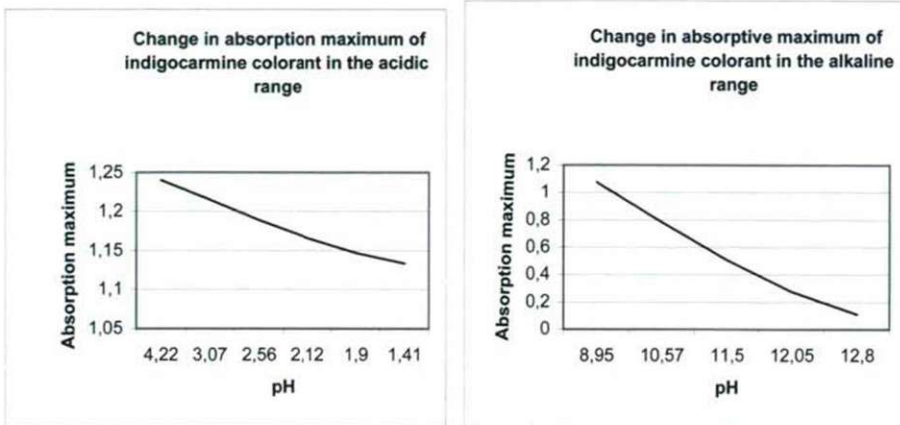


Figure 2 – Absorbance vs. pH

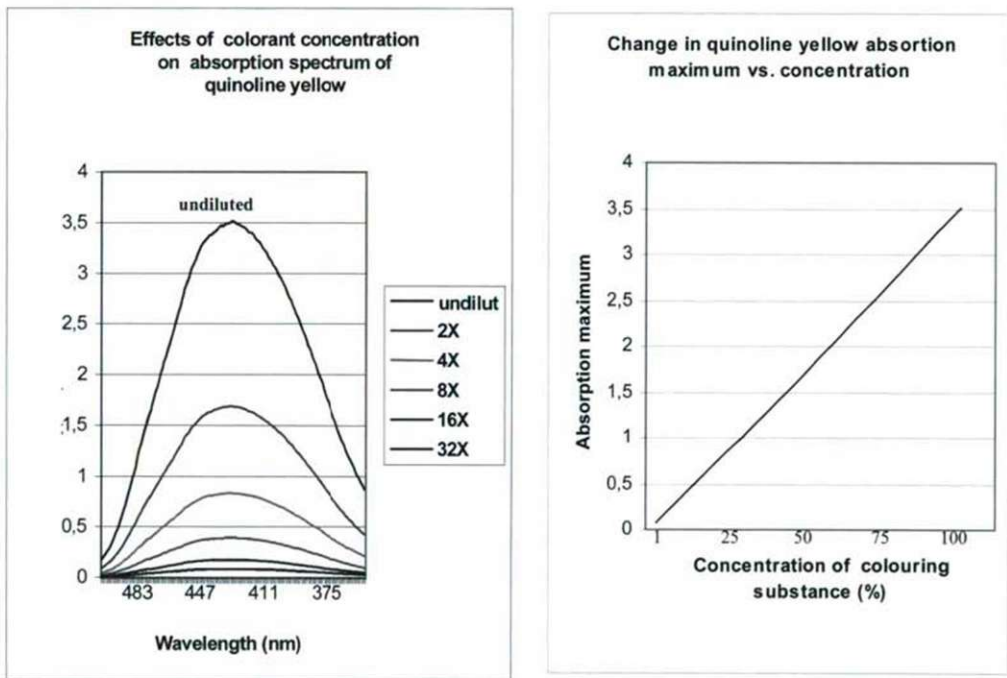


Figure 3 – Effects of concentration of colorant on absorption spectrum

4. DISCUSSION AND CONCLUSIONS

Our absorption spectrum analysis method is suitable for the examination and qualitative classification of the colouring substance contents of raw materials, semi-finished and finished products whose production can be followed optically. The application of the method may be

restricted by the fact that it can be used to examine only those substances which undergo no qualitative or quantitative changes during solution preparation. The present work examined of factors that can exert considerable effects on the operating conditions. Our findings were as follows:

- The computer-supported procedure is applicable to model solutions. The percentage differences between the measured and calculated values were within a margin of error of 5%.
- As concerns the effects of the pH on the spectrum (Fig. 2), the absorption maxima decreased in both acidic and alkaline media. This may be due to the instability of the colouring substances, because the colour changes of the solutions were clearly visible to the naked eye. However, it must also be noted that these extremely high pH values do not occur in food engineering.
- By varying the concentrations of the colouring substances, we examined the validity of the Lambert-Beer law, which is applicable only to dilute solutions, with monochromatic radiation and one energy state. As anticipated, the maximum absorbance varied linearly (Fig. 3).
- Variation of the amount of sugar affected the shape of the spectrum only slightly. No significant change occurred in the absorption maxima, i.e. the sugar content was not a determining factor at the examined concentrations up to of 0.5%.

We plan to continue our research with the analysis of new spectrum-altering effects, and study of the relation between the quantity of colouring substance applied and the visually observed colour effect.

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PERITEC TECHNOLOGY TO REDUCE FUSARIUM TOXIN CONTAMINATION IN THE MILLING TECHNOLOGY

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ABSTRACT

The fungi causing the infection and mycotoxins production are concentrated in the bran of the grain, thus the intensive surface cleaning, the so-called debranning operation could allow the reduction of contamination in the milling technology. The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing.

We carried out our experiments using a naturally contaminated wheat lot. We modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine by SATAKE. Applying different treatment times we varied the rate of debranning.

As for DON (deoxinivalenol) toxin contamination, a continuous decrease can be found by increasing the rate of debranning. The total flour obtained during grinding the unpolished wheat contains 0.25 mg/kg toxin on average, which decreases to 0.11 mg/kg if we apply the highest, 40 sec polishing.

Figure 4 shows the DON toxin content of all the obtained fractions. The toxin contamination of the wheat grains and the grinding fractions gradually decreased as a result of debranning. Very high toxin content of the removed parts of the husk indicates that toxin is concentrated in the outer husk layers. Although the DON content of the original wheat sample was relatively low (0.74 mg/kg), the DON content of the removed materials was about 4 mg/kg, which exceeds all statutory limits.

During our work we focused mainly on the toxin contamination of the grains and their milling products, as well as on other characteristics that are important with regard to milling processing.

As a result of debranning, the toxin content of the grinding fractions decreased, which justifies that that PeriTec method is suitable for the reduction of toxin contamination.

On the basis of the experimental results, the optimum peeling was the peeling which resulted in a weight loss of about 6%, the toxin content significantly decreased (from 1,59 mg/kg to 0,94 mg/kg).

1. INTRODUCTION

Nowadays, more and more attention is paid to mycotoxin contamination in the food safety considerations of wheat, as an essential nutrient raw material, in particular to the toxins produced by fusaria (Szeitzné, 2009; Téren et al., 1990). During our experiments we dealt with the laboratory modelling of a new milling surface treatment called PeriTec technology (Figure 1.) to find out to what extent this method can reduce toxin contamination (Gold, 2005).

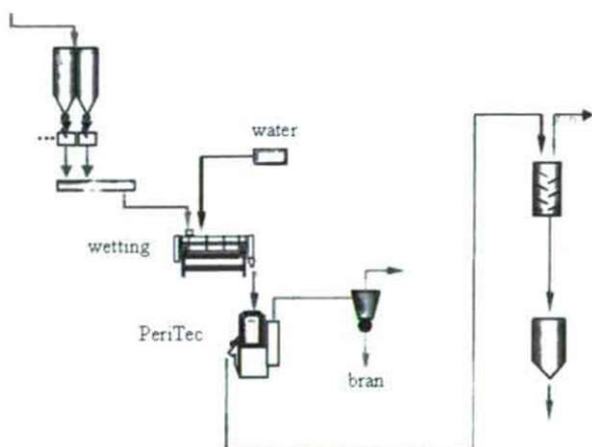


Figure 1. Flowsheet of the PeriTec technology

The fungi causing the infection and mycotoxin production are concentrated in the bran of the grain, thus the intensive surface cleaning, the so-called debranning operation could allow the reduction of contamination in the milling technology. The essence of the PeriTec technology - originally developed by SATAKE, a Japanese company, to clean rice - is that it gradually removes the bran layers of the grain by mechanical means before further processing.

We carried out our experiments using a naturally contaminated wheat lot. We modelled the PeriTec technology with a laboratory size, batch-operating, horizontal debranning machine made by SATAKE. Applying different treatment times we varied the rate of debranning.

We studied how the physical parameters of wheat grain developed (kernel size, kernel hardness, ash content) as well as the rate of grain fracture. After peeling we ground the wheat samples in laboratory mills. We determined DON toxin content of all the resulting fractions with competitive ELISA method.

2. MATERIALS AND METHODS

We carried out our experiments using a wheat lot from Cereal Research, Szeged, naturally contaminated with fusaria.

We modelled the PeriTec technology with a laboratory size, batch-operating horizontal debranning machine by SATAKE (Figure 2.).

The main part of the equipment is a cylindrical working space delimited by a perforated plate. In this working space/area there is a horizontal-spindle, corundum-covered grinding wheel rotating. The operation of the machine is batch-type; 200g of wheat can be treated at a time. We inject the samples into the treatment area through the inlet. The rate of polishing can be altered by changing the treatment time applied. After the debranning operation we open the latch put/located at the bottom of the working space and the kernels fall into the central container, while the removed parts of the hull get into the two lateral chambers.

After conditioning to a moisture content of 15%, the samples were subjected to different levels of rubbing applying 10, 20 and 40 sec operation times.

We studied the development of the physical parameters of the wheat grains, as well as the rate of grain breakage. We determined the ash content of the samples according based on MSZ (Hungarian Standard) 6367/15-84. We used a Perten SKCS 4100-type instrument to measure kernel hardness.

Kernel length, width and thickness were determined with a digital calliper using 100 kernels per sample. We measured the rate of broken kernels using a 50g sample manually sorted and separated.

After polishing the wheat samples were ground using a Quadrumat Senior type laboratory mill made by Brabender. During milling there were four fractions: 1. flour, 2. flour, fine bran and coarse bran.

We determined the DON toxin content of the base material and of all the fractions obtained during polishing and grinding with R-Biopharm RIDASCREEN FAST DON competitive ELISA test.



Figure 2. SATAKE machine

3. RESULTS AND DISCUSSION

The development of the physical parameters of wheat as a result of peeling can be seen from Table 1.

Table 1. Development of the measured characteristics of wheat as a result of debranning

	width (mm)	length (mm)	thickness (mm)	kernel hardness HI	broken grains (%)
unpolished wheat grains	3,25	6,64	2,86	70,49	2,32
10s polished wheat grains	3,22	6,53	2,72	71,77	4,01
20s polished wheat grains	3,24	6,53	2,69	69,59	5,12
40s polished wheat grains	3,13	6,38	2,55	70,85	9,28

From the specific grain dimensions thickness decreased to the highest degree as a result of rubbing. This thickness decrease may mean that the ventral furrow becomes shallow and thus

the quantity of the contamination stuck in it also decreases. The kernel hardness index did not change significantly, however, the rate of broken grains in the lot increased significantly as a result of the strong mechanical impact applied during the operation.

Figure 3 shows the quantitative ratio of the fractions obtained during debranning and the subsequent grinding.

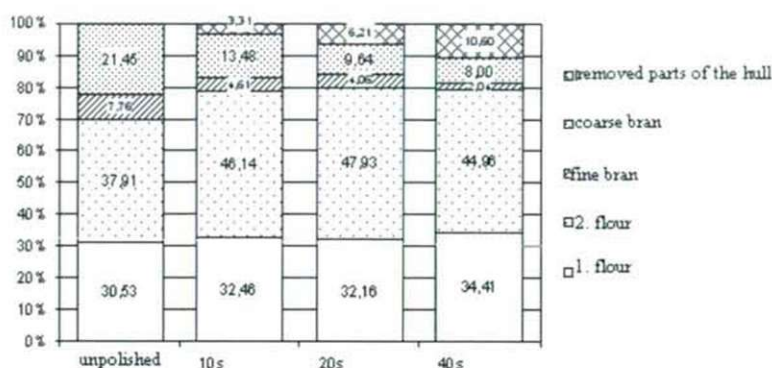


Figure 3. Quantitative ratio of the obtained fractions

The flour yield increased significantly with the application of the peeling operation, and the higher and higher rate of debranning resulted in the reduction of by-product (brans) rates obtained through grinding.

Figure 4 shows the total flour characteristics obtained during milling.

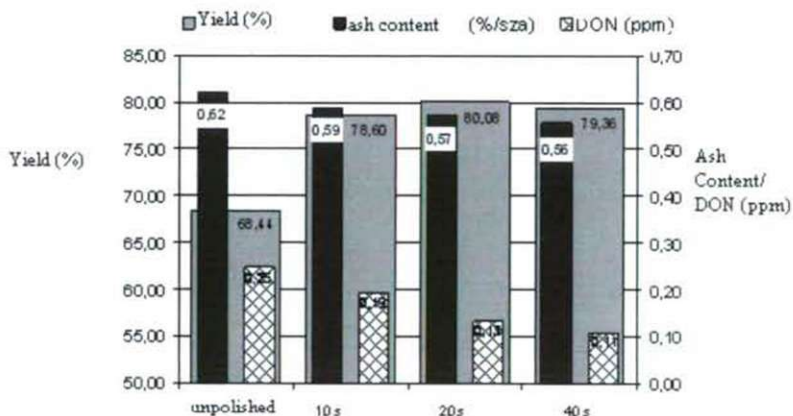


Figure 4. Rate of yield, ash content and toxin contamination of total flour

The flour yield increased, the value of the ash content – used to characterize the hull content of flour – decreased, which means a better flour quality in milling industry, and also the increase of the rate of white flour obtainable as a result of this technology. The 20 sec polishing operation resulted in the best flour yield.

As for DON toxin contamination, a continuous decrease can be found by increasing the rate of debranning. The total flour obtained during grinding the unpolished wheat contains 0.25 mg/kg toxin on average, which decreases to 0.11 mg/kg if we apply the highest, 40 sec polishing.

Figure 5 shows the DON toxin content of all the obtained fractions. The toxin contamination of the wheat grains and the grinding fractions gradually decreased as a result of debranning. Very high toxin content of the removed parts of the husk indicates that toxins are concentrated in the outer husk layers. Although the DON content of the original wheat sample was relatively low (0.74 mg/kg), the DON content of the removed materials was about 4 mg/kg, which exceeds all the hygienic limits.

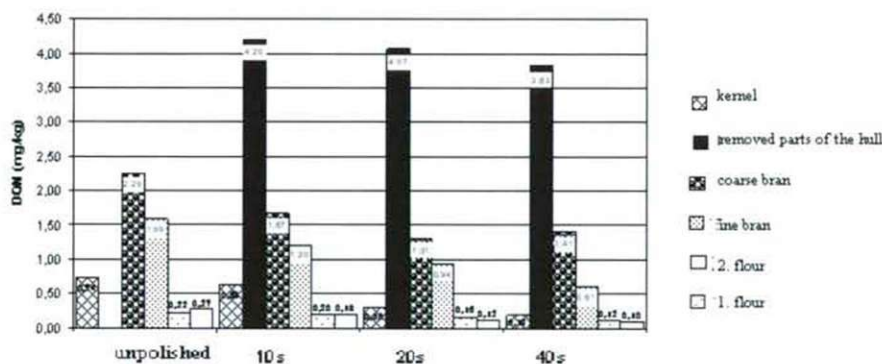


Figure 5. DON toxin content of the debranning and grinding fractions

During our work we focused mainly on the toxin contamination of the grains and their milling products, as well as on other characteristics that are important with regard to milling processing.

4. CONCLUSIONS

As a result of debranning, the toxin content of the grinding fractions decreased, which justifies that PeriTec method is suitable for the reduction of toxin contamination.

On the basis of the experimental results, the optimum peeling was the peeling which resulted in a weight loss of about 6%:

- the toxin content significantly decreased (from 1,59 mg/kg to 0,94 mg/kg),
- the flour yield increased (from 70 % to 80 %),
- the rate of grain fracture remained within an acceptable level.

Despite the fact that the toxin content of the experimental wheat sample was rather low, 0,74 mg/kg, we got quite high values of toxin contamination, about 4 mg/kg, in the removed bran, which significantly exceeds the allowed rate. This result draws special attention to the importance of the surface cleaning of crops before milling and the significance of the debranning technology studied.

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MULTIFUNCTIONAL UTILIZATION OF AGRICULTURAL LAND FOR BIONERGY PRODUCTION IN CONTEXT OF ECONOMY'S FOOD SATISFACTION LEVEL

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ABSTRACT

The main role of agriculture production in economy is to produce food commodities in order to ensure the food safety. In this context agriculture ensures the production function.

The European Union in context of The European model of multifunctional agriculture declares the multifunctional agriculture land utilization. The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for non-food bioenergy production. From the viewpoint of production input, agricultural land is the main production input for food and also non-food crop commodities. There are different approaches from domestic and foreign authors about food versus non-food energy agricultural land utilization. The main discussed fact is the limited character of agricultural land. Already in ideas of classic economist the land has been considered as limited production source.

The main goal of the article is to determine the potentially available agriculture land for energy crops cultivation in context of multifunctional agricultural land utilization at required food sufficient level in Slovak economy. The multiple regression model is applied in order to model the agriculture land area available for non-food bioenergy production at different food satisfaction levels. The model is used to determine the available potential of cereal cultivated most productive agricultural land, which is primary utilized for main food production and secondary according to model scenarios could be potentially available for non-food biomass production. Cereals are the main food commodities in and also are considered to be one of the main food commodities cultivated as energy commodities in conditions of Slovak Republic suitable for biofuels production. We assume: a) primary with food agricultural land utilization - especially most productive land for main food commodities cultivation and b) secondary with potential alternative non-food biomass cultivation on surplus of agricultural land, after reaching the required food satisfaction level of economy.

In context of the Model of multifunctional agriculture we consider with two main factors limiting the availability of biomass sources from agriculture – the food satisfaction level of the economy and the multifunctional utilization of agricultural land as the main production factor of energy non-food biomass cultivation. According to The Agrarian and food policy of Slovak Republic the food satisfaction level is at minimum level of 90 %.

1. INTRODUCTION

Several programs deal with future position of agriculture sector assumes wider range of function for agriculture sector as its primary food production function. According to foreign and domestic studies the significant will be the position of the agricultural sector as a producer of renewable bioenergy sources. Renewable energy sources as a part of energy mix are considered to be the one of the basic pillar of sustainable economy.

These energy sources can gain strength at strategic level also in Slovak Republic, because of the Slovak economics' high level of energy dependency and vulnerability on imported fossil fuels. And also because of the availability of production potential of agricultural land (Bohunická and Židek 2005, Pepich 2006.).

Slovak Republic as a member of European Union deals with the question of renewable energy resources at national level. And also commit to expand utilization of bioenergy sources and increase of energy efficiency at national level.

The European Union in context of The European model of multifunctional agriculture declares the multifunctional agriculture land utilization. The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for non-food bioenergy production. Biomass production is the one of the six main land function declared in context of multifunctional and intersectional land meaning. According to The Land government of Slovak Republic (2001) agriculture biomass as the one of the renewable energy resources from agriculture is divided into three basic groups:

- Biomass for heating – straw, wood waste biomass
- Biomass for biogas – animal or crop sources, waste from food industry
- Liquid biofuels – crops for MERO production

According to FAO Studies (2006) support of the biofuels could be the opportunity for development of countries with considerable agricultural resources. Halliday (2007) emphasizes, that the development of biofuels is suppose to be the main factor causes increase in prices of agricultural commodities. The conclusion is the knock-on effect on food prices all over the world. Jonk (2007) and European Biomass Industry Association – EUBIA (2007) allege in studies that the potential of biofuels is low and limited because of the limited agricultural land for “fuels commodities” cultivation. A key uncertainty according to IEA (2007) is the availability of sufficient land resources for large-scale expansion of the cultivation of biofuel crops, given the intense competition with conventional agricultural products for arable land. Competition will favor those crops most profitable for farmers, accounting for such factors as growing region, farming practice, and soil type. According to authors, crops for non-food energy utilization would be cultivated primarily on lands situated in:

- marginal areas and areas contaminated with emissions (Váňa, 2003)
- degraded areas and also the available land can be gained by increasing of agriculture productivity (Bindraban and Cojnin, 2007)
- areas where the cultivation of food commodities was stopped because of economic reasons (Piczalka, 2007)
- Also there is a possibility to utilize the most productive agriculture land especially for alternative traditional food commodities cultivation, utilization of secondary commodities and waste (Jamříška and Surovčík, 2006)

The main goal of the article is to determine the potentially available agriculture land area for energy biomass production in context of multifunctional agricultural land utilization at required food sufficient level for Slovak economy. The partial goal is to give an overview of multifunctional agriculture land utilization from the viewpoint of food and non-food bioenergy crops cultivation. The multiple regression model is applied in order to model the agriculture land area available for food or non-food bioenergy utilization at different food sufficient levels. The model is used to determine the available potential of cereal cultivated most productive agricultural land, which is primary utilized for main food production and secondary according to model scenarios could be potentially available for energy biomass production.

2. MULTIFUNCTIONAL AGRICULTURE LAND UTILIZATION FOR FOOD AND NON-FOOD BIOENERGY CROPS CULTIVATION

The one of the alternative multifunctional agriculture land utilization is the alternative land utilization for food and non-food bioenergy crops cultivation. From this viewpoint agricultural land is the main production input for food and also non-food energy crop commodities. The production input – the area of agricultural land is limited. The basic principle of the multifunctional agricultural model, which is also the strategic base of The Slovak Agrarian and Food policy, is to ensure the food safety. In order to ensure the food safety is necessary utilize the part of agricultural land only for strategic direct food production utilization. On condition that the economy's food sufficient level is ensured, there is a place for other than food agricultural land utilization.

In context of the Model of multifunctional agriculture we consider with two main factors limiting the availability of energy crops sources from agriculture:

- a) the food sufficient level of the economy and
- b) the multifunctional utilization of agricultural land as the main production factor of energy biomass cultivation.

Energy biomass commodities cultivated for specific energy reasons in context of food security can be divided into two groups:

- food energy biomass crops base on traditional food commodities
- non-food energy biomass crops – non-food energy alternatives of traditional food commodities and other specific energy commodities

The traditional food commodities - cereals, maize and rape are commodities especially considered being the energy crops with considerable share cultivated on agricultural area suitable for biofuels production in condition of Slovakia. These food commodities belong to basic strategic food commodities with a significant long term share on utilized agricultural land.

In order to fulfill the goals based on The Biofuels Directive, these food energy commodities should have to be utilized in context of food security because of their food importance.

According to domestic and foreign authors and specialist in this field of problematic:

- Energy biomass commodities belong to category of food agricultural commodities can be cultivated without considerable restrictions on agricultural land.
- And as we have mentioned in part of this article - Introduction there is also the possibility to utilize the most productive agriculture land especially for alternatives of traditional food commodities cultivation, utilization of secondary commodities and waste.

Figure 1 display, total energy utilized agricultural land area divided into two categories of energy crops in year 2007.

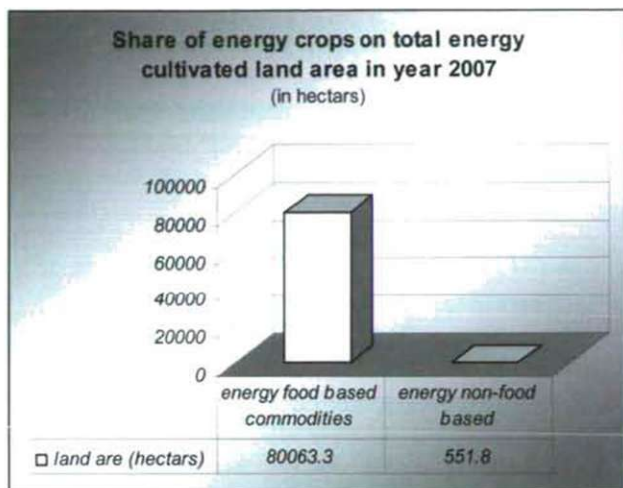


Figure 1. Share of food and non-food energy crops on total energy cultivated land area

Source: APA (2008), own calculation

The total energy utilized agricultural land area was approx. 80,6 thousand hectares in year 2007.

- The significant 99.2% share on total energy utilized agricultural area had the food base energy commodities. The highest share on total energy utilized land area and also the most significant share in category of food energy commodities had the rape with 86 % share on total energy land area (cultivated on 69.9 thousand hectares of total energy cultivated area), followed by the maize with 12% share on total energy area (cultivated on 9.9 thousand hectares of total energy cultivated area). Other food base energy commodities including also cereals had less than 1% share on total energy cultivated land area.
- The share of the specific non-food energy crops (energy grasses, poplars, willows, and others) on total energy utilized land area was very low relatively less than 1% (cultivated on 551.28 hectares of total energy cultivated area). The share of individual non-food energy crops on total energy cultivated area was less than 1%.

2.1 Modeling of available potential of cereals cultivated on most productive agricultural land for energy utilization

The question is: *Are there potentially available land areas – especially the most productive agricultural land area for non-food energy utilization?*

- *In order to model availability of the most productive land area for energy utilization the land area of cereals were chosen as the land area represented the most productive agricultural land area*
- *There are some facts about cereals:*
 - are cultivated on most productive agricultural land area and have character of intensive cultivated crop.

- in context of food security are the traditional main food commodities.
 - are considered to be one of the traditional food commodities cultivated as energy crops in conditions of Slovak Republic suitable for biofuels production.
 - The Agrarian and Food policy of Slovak Republic is based on principle of high food sufficiency level of cereals production.
 - There is also the possibility to utilize the most productive agriculture land especially for alternatives of traditional food commodities cultivation (energy cereals) rather than other specific energy commodities.
 - According to Figure 1, the share of cereals as a food base energy commodities are not significant (less than 1% share on total energy cultivated area) on total energy cultivated area - non-food utilization of cereals in domestic consumption is low
- *In consequences of utilization of agricultural land area restrictions we assume:*
- a) primary with food agricultural land utilization - especially most productive land for traditional basic food commodities cultivation important for food security and
 - b) secondary with potential alternative food or non-food energy biomass cultivation on surplus of agricultural land, after ensuring the required food satisfaction level of economy.
- *The food security restriction expressed by the required food satisfaction level -* According to The Agrarian and Food policy of Slovak Republic the food satisfaction level is at minimum 90 % level of covering the domestic consumption from domestic production

The multiple linear regression model for cereals cultivated most productive agricultural land area:

Model 1

$$Y_{\text{food satisfaction level of economy}} = -56.003 + 22.836 * \text{yields} + 0.0001 * \text{land area}$$

Coefficient of determination R square = 0,734 (73.4 %), Significance F=0,0026 (F< 0,01)

The scenarios are based on different levels of cereals yields in order to model available agricultural land area for secondary non-food energy utilization.

- *Scenario A:* is based on the average level of cereals yields 5.2 t.ha^{-1} in years 1985-1989. These yields represent the highest level of cereals yields have been reached in cereal cultivation in Slovak Republic.
- *Scenario B:* is based on and represent very low level of cereals yields at level of 2.7 t.ha^{-1} in year 2000. The level of cereals yields was low particularly because of unfavorable climatic conditions
- *Scenario C:* is based on level of the highest estimated cereal yields at level of 4.5 t.ha^{-1} in year 2010
- *Scenario D:* is based on level of the lowest estimated cereal yields at level of 2.5 t.ha^{-1} in year 2010.



Table 1. The potentially available agricultural land area for non-food energy utilization according to different scenarios of cereals yields

Food satisfaction level of economy (%)	Available agricultural land area according to different scenarios of cereals yields (hectars)			
	Scenario A	Scenario B	Scenario C	Scenario D
70	487472	-81144,4	327620	-129100
80	387472	-181144,4	227620	-229100
90	287472	-281144,4	127620	-329100
100	187472	-381144,4	27620	-429100
110	87472	-481144,4	-72380	-529100
120	-12528	-581144,4	-172380	-629100
130	-112528	-681144,4	-272380	-729100

Source: own calculations

According to modeling scenarios shown in Table 1, there are potentially available agricultural most productive land areas for non-food utilization only in cases of Scenarios A and C at the minimum of 90% food satisfaction level of Slovak economy. This potentially available land area could be secondary utilized for energy plants cultivation.

Note, in both scenarios A and C the estimated cereals yields are at the highest level. As less the level of food satisfaction is required in economy there is the higher available land potential for non food energy utilization.

In case of Scenarios B and D the most productive agricultural land areas for another than primary food utilization are not available. From another point of view in these scenarios non food utilization of most productive agricultural land would be available only in case of the competition with food production and food security.

3. CONCLUSIONS

One of the main discussed facts about food versus non-food energy agricultural land utilization is the limited character of basic production input the agricultural land. Our approach to multifunctional agricultural land utilization respects several restrictions cause by multifunctional principle. Primary should have to be assumed with food agricultural land utilization - especially most productive land for main food commodities cultivation and secondary with potential alternative non-food biomass cultivation on surplus of agricultural land, after reaching the required food satisfaction level of the economy.

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