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CONTENTS

	PAGE
Elisabeth T. KOVÁCS: Definition, benefits, processing and examination of functional foods	1
Zsuzsa, H. HORVÁTH: Change of colour of different particle size Paprika Grist during storage	12
E. FORGÁCS, J. CSANÁDI, C. HODÚR, G. SZABÓ: New safety element for dairy technology 19	
MIKLOS Imre Zsolt - CIOATĂ Vasile George - MIKLOS Imre - KISS Imre: Protection systems of the titling mechanisms at the rolling trains	26
János GYEVIKI - Attila CSISZÁR: Pneumatic positioning in practice	36
Balázs P. SZABÓ, Antal VÉHA, Ernő GYIMES: Different methods for determining kernel hardness	42
CIOATĂ Vasile George - KISS Imre - MIKLOS Imre Zsolt: The influence of the technological parameters about the mechanical characteristics of the pieces obtained through die-forging in semi-liquid state.....	46
György MÉSZÁROS: Application of an ultrasound technique in the mechanical washing of plastic boxes and crates in the food industry	55
János GYEVIKI - Attila CSISZÁR: Sliding mode control in pneumatic positioning	62
Gabriella KECZER: Managing change in hungarian higher education: key risks and their handling	69
Ferenc SZABÓ: Conflict of short-term and long-term interests related to projects concerning environmental protection	75
László GULYÁS- Enikő TURCSÁNYI: Method of individual selection interview.....	82

DEFINITION, BENEFITS, PROCESSING AND EXAMINATION OF FUNCTIONAL FOODS

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(Pannon University, Agricultural Science Mosonmagyaróvár, 23th March 1999)

ABSTRACT

In generally, a functional food can be defined as any food that has a positive impact on an individual, health, physical performance or state of mind as well as its normal nutritional values. The Japanese Ministry of Health and Welfare has identified 12 very broad-based classes of ingredients, which they consider to be health enhancing. The are dietary fibre, oligosaccharides, sugar alcohol's, aminoacids, peptides and proteins, glycosides, alcohol, isoprenoids and vitamins, cholins, lactic acid bacteria, minerals, polyunsaturated fatty acids and others (e.g. phytochemicals and antioxidants). As consider, amaranth, quinoa and pea seed all some of the attributes of functional foods. These seeds fulfil the requirements for functional foods in many ways. The prolamin type protein content of this seeds low, therefore these seeds are suitable in the diet of people suffering from celiac disease, and emulsifiers are required to form the dough structure. In the presence of emulsifier an emulsifier-carbohydrate-protein-lipid complex can be expected. The rate of the individual interactions depends on the components of the given sample. It was examined the developed pasta products from point of interactions and the quality of products.

Functional foods, designer foods, pharmafoods and nutraceuticals are synonyms for foods that can prevent and treat diseases. In generally, a functional food can be defined as any food that has a positive impact on an individual' health, physical performance or state of mind as well as its normal nutritional values. The Japanese have highlighted three conditions that which define a functional food:

- ☞ It is a food (that is not a capsule, tablet or powder) which derived from naturally occurring ingredients.
- ☞ It can and should be consumed as part of the daily diet.
- ☞ It has a particular function when ingested, serving to regulate a particular body process, such as: enhancement of the biological defence mechanisms; prevention of a specific disease; recovery from a specific disease; control of physical and /or mental conditions; slowing the ageing process.

The idea of health-filled foods is of course, not new. The modern message probably took root in the soil of the classical nutrition studies in the 1950's and "back to the nature" revolution in the 1960's. The message was to produce processed and packaged food, which retained its nutritional quality, and appeared and tasted as close to natural as possible. In the sixties, medicine and food producers entered their first unlikely partnership.

Today, the concepts of nutrition, natural foods, minimal addition of additives or merge into a modern field of new and challenging scientific investigation. Not only do food ingredients in proper combinations actually offer potential or actual benefits in preventing or treating special conditions or diseases, but these food ingredients can occur naturally or can be produced by biological technologies such as genetic engineering.

Diet is believed to play an important role in the for major disease of our society, for example: cardiovascular (hearth and artery) disease, cancer, hypertension and obesity. Hearth disease and cancer together account for 70% of all deaths, although the exact degree to which diet is important in the prevention of these diseases is not known. A commonly accepted estimate among experts is that at least 1/3 of the cancer cases can be attributed to diet and perhaps 1/2 of the cases of hearth and artery diseases and hypertension also related to diet. The major food components associated with cardiovascular diseases and cancer are: fats, particularly too much saturates fat and the under consumption of dietary fibre from vegetables and fruits.

In the 1980's, the potential medical benefits of different food ingredients such as calcium, fibre and fish oil was all substantiated. Today various ingredients are being studied for their role in preventing or treating various chronic diseases and also for their far-reaching benefits in slowing the ageing process and affecting mood and performance. Recent examples include the use of fish oil supplements and antioxidants to reduce the damage caused by arteriosclerosis.

The Japanese Ministry of Health and Welfare has identified 12 very broad-based classes of ingredients, which they consider to be health enhancing. The are dietary fibre, oligosaccharides, sugar alcohol's, aminoacids, peptides and proteins, glycosides, alcohol, isoprenoids and vitamins, cholins, lactic acid bacteria, minerals, polyunsaturated fatty acids and others (e.g. phytochemicals and antioxidants).

These ingredients appear in a full menu of food products ranging from breakfast cereals to salad dressing.

EXAMPLES OF FUNCTIONAL FOODS

Milk products. Since 1908, when Eléie Metchnikoff (Nobel Prize laureate) suggested that consumption of milk fermented with lactobacilli would prolong one's life, there has been an interest in the potential health benefits associated with these organisms. Potential health benefits include: improved lactose digestion, reduction of serum cholesterol, tumour inhibiting effects, immune system stimulation, prevention of constipation, generation of group B vitamin, production of bacteriocins and inactivation some toxic compounds. Besides the traditional kefir and koumiss, the new products include among others: several yoghurt: Natural Light Yoghurt, OH BA Yoghurt.

Japan has been a pioneer in the area of functional foods and has already established for approving functional foods, granting such products individual health claims for specific health needs on approved and sufficient research data.

The others are: Pf 21 (from ASAHI BEER COMPANY) protein rich sport drinks that contains collagen; pasta rich in natural dietary fibre; snack rich in fibre (from Nissin Food products); sausage: Oligo Harmony - pork sausage with added oligosaccharides; Fibre Harmony - pork sausage with wheat fibre; Calcium Harmony - pork sausage with added egg shell calcium. The first functional foods in cereal products was YOSA^R. YOSA^R is a

fermented oat brain snack . It was registered and introduced on the market in Finland 1995. Yosa^R is a vellie: a cereal based snack type pudding fermented after cooking with probiotic bacteria and flavoured. It is stored and served cool, ready to eat like a snack or dessert.

As consider, amaranth, quinoa and pea seed all some of the attributes of functional foods.

FUNCTIONAL FOODS FROM PSEUDO-CEREALS

Amaranth is a pseudo-cereal plant originating from Central and South American Indians. The most common varieties are: *Amarantus cruentus*, *Amarantus hypochondriacs*, *Amarantus caudatus* and *Amarantus edulis*.

The protein content of amaranth is 16 - 20 %, the protein components are albumin and globulin 66%, prolamin 0,70% and gluten 28,5%. Its biological value 75. Starch content is between 50 -70% of which amylopectin can be almost 80 - 100 %. Its oil and fat content is approximately 8 %. Its oil content is rich in vitamin E and its Ca, K, P as well as Mg and Fe content is relatively high.

Amaranth seeds fulfil the requirements for functional foods in many ways. The prolamin type protein content of amaranth is low, therefore these seeds are suitable in the diet of people suffering from celiac disease, and emulsifiers are required to form the dough structure. In the presence of emulsifier an emulsifier-carbohydrate-protein-lipid complex can be expected. The rate of the individual interactions depends on the components of the given sample.

MATERIAL AND PREPARATION OF DOUGH SAMPLES

Amaranth flour and quinoa flour with rice flour (in a ratio 1:1) after extrusion was used in the study, which carried out in University of Vienna. The emulsifiers are presented in Table 1.

Table 1. Type of emulsifiers applied

Name		Company	Type
Amidan 250B	A	Grindsted, Denmark	>90 % saturated and unsaturated mono-and diacylglycerols
Dimodan PM	D		
Multec SSL	S	Beldem Food Ingredients, Belgium	Sodium stearyl-2-lactylate
Multec Data	B	Beldem Food Ingredients, Belgium	Mono-and diacylglycerols tartaric acid ester
Epikuron 130-P	E	Lucas Meyer, Germany	Lecithin Lecithin + Lysolecithin
VP-6108-10	V		

PREPARATION OF DOUGH SAMPLES

The amount of flour and water was counted for 40% moisture content in the model systems. The optimal amount of emulsifiers has 1 - 1,2% (calculated on a flour mass basis). Suspension was made from the emulsifier and water. The temperature of suspension was increased 97 °C. It was stirred for 15 minutes in the mixer. Fine and small pieces of dough were prepared by dough processing machine pressed through teflon matrix. The dough was dried at 39 °C and 87 % relative humidity for 24 hours.

METHODS

- ☞ Method of wet content, carbohydrate, protein according to Karácsonyi (1970)
- ☞ Method of cooking test was made according to Karácsonyi (1972, cooking time, wet volume, the amount of water uptake, cooking loss.
The water : dough = 1 :1, tap water pH= 6,80 , electric cooker).
- ☞ Sensory assessment was carried out according to Hungarian Standard methods (1986).
- ☞ Iodine binding capacity was measured according to Conde Petit (1992)
- ☞ Electrophoreses were made according to Kovács (1998, PS 2000 instrument, 110 V, 45 mA, 110 min)
- ☞ Mini gels were used and stained for protein and carbohydrate according to Nedelkovits (1975).
- ☞ Protein fractions were separated according to Barba de la Rosa (1992)

RESULTS AND DISCUSSION

The results of the model systems were evaluated with mathematical statistical method at P = 5% level. The amaranth pasta properties can you see on the **Figure1**. Good quality dough with excellent sensory assessment was obtained from amaranth flour with 1,2 % monoglycerid type emulsifiers, while applying lecithin type emulsifiers, the dough structure was less good : consistency value is worsening and the cooking loss is growing. Monoglycerid type emulsifiers result 60-80 % complexing rate, which suggest the presence of emulsifier - amylose interaction in the structure, while in the lecithin type of emulsifier there are hardly any components suitable for complex forming. The interaction is only between protein and emulsifiers.

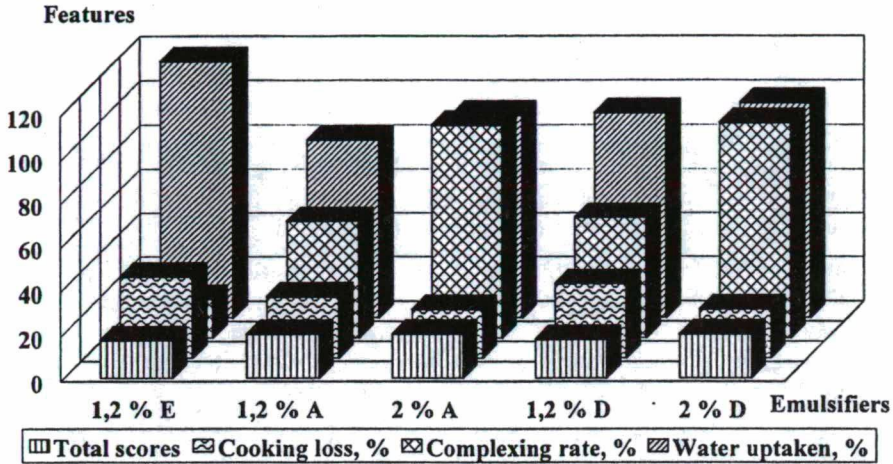


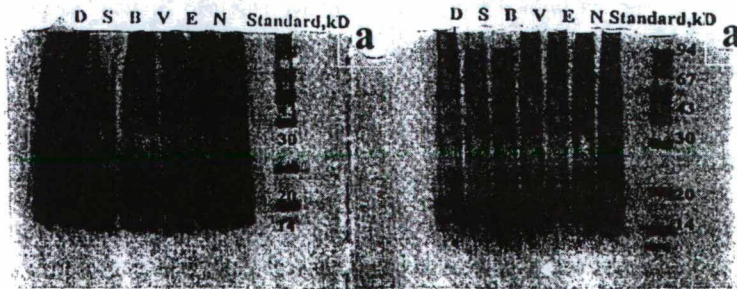
Figure 1. Characteristics features of amaranth pasta products made with different type of emulsifiers

The molecular weight distribution can you see on the 2. Figure. Albumin and globulin fractions : 10, 22-24, 21-32, 36-38 and small number of molecular weight region under 58-60 kDa were obtained from native amaranth flour. When we applied emulsifiers the amount of albumin and globulin fractions diminished and there was a discrepancy in the distribution of fractions.

At Amidan 250 B there were only in the region of 13 kDa and a small of 20 kDa fractions. The emulsifiers Dimodan PM 1,2 and 2 % (D1 and D2) were applied fractions under 10 kDa and a small 22-24 and 38 kDa remained. There are capable only of forming electrostatic and H-bridge interactions. The Epikuron 130-P emulsifier type of lecithin, in this case the interaction has mainly a hydrophobic character: the subunits under 10 kDa and 22-24 kDa remained and the fraction 36-38 kDa was increased.

Albumin and Globulin

Glutenin



Standard = Standard protein mixture (Pharmacia, Sweden), E = Epikuron 130 P, V = VP-618-10, B = Multec Data, S = Multec SSL, D= Dimodan PM, N = no emulsifier

Figure 2. Electropherogram of soluble protein fractions made from amaranth flour with different emulsifier

We managed to demonstrate significant changes in glutelin fraction of amaranths pasta products. In natural amaranth flour protein fraction under 13 kDa was observable, but fractions 22-27, 34-37, 54-57 and 68 kDa were dominant. When we applied monoglycerols type emulsifiers (Amidan 250 B and Dimodan PM) the amount of sharply different pattern diminished, aggregation occurred. The low molecular weight protein subunits vanished and different type of change caused by lecithin takes place: the fraction in between 10-37 kDa or due to aggregation, it remain at the starting point. If the separated protein (gel slab) is stained for carbohydrate, it can be seen to contain carbohydrate in different degree.

In albumin and globulin fraction the 13 kDa fraction on the influence of glucoprotein, emulsifiers only interactions under 20 kDa contain carbohydrate active components. Every subunit of active glutenin fraction contains a carbohydrate active component. In the monoglyceride type emulsifiers fractions 10 -34 kDa region are active, but in the Epikuron 130-P emulsifier under 13 kDa or fraction remains at the starting point.

Based on the results of electrophoretic studies it can be stated clearly that these interactions depend on the type of emulsifier. All used emulsifiers had an effect on the molecular weight distribution of protein fractions.

FUNCTIONAL FOODS FROM PEA

Pea seeds are rich in the components of functional foods and they do not contain substances causing celiac disease.

The protein content of peas is 16-25 %. The components of protein are albumin, legumin and vicillin. Its biological value is 64. It is a wellknown fact, all starches, including those from peas and other legumes are composed of two types of molecules, amylose and amylopectin. The starch content is 50 %, the amylose content is 40%. Pea seeds have a high level of dietary fibre, 19 %. The fat content is 0,8-1,3 %. It is high in oleic and linoleic acid, which is essential for human nutrition. The most important vitamins in pea seeds are thiamine, riboflavin, niacin, vitamin B₆, folic acid and β -carotene. The mineral and trace mineral composition is good: P, K, Na, Ca, Mg, Zn, Cu and Fe. Pea seeds do not contain gluten protein (gluten free) therefore emulsifiers are required to form the dough structure.

The emulsifiers interact with the proteins, carbohydrates and lipids. The proteins establish hydrophobic hydrophilic and hydrogen-bridge interactions with emulsifiers. In this way help to form a flexible network in the leguminous basic dough. The emulsifier - carbohydrate interaction can be a complex forming with amylose or a hydrogen-bridge with the amylopectin.

When developing new products, it is important to study the texture: sensory properties, rheological and mechanical properties, macro-, micro- and submicroscopic structure as well as the chemical composition. From this point of view it is important the forming of interaction between emulsifiers and the components of raw material.

We produced dough in model systems from different varieties of pea flour and type of emulsifiers. The optimal amount of emulsifiers 1 % (as calculated on flour mass).

In these systems we can imagine on protein-emulsifier, protein-carbohydrate and protein-lipid interactions occurring respectively. The results can be seen on **Figure 3**, **Figure 4** and **Figure 5**.

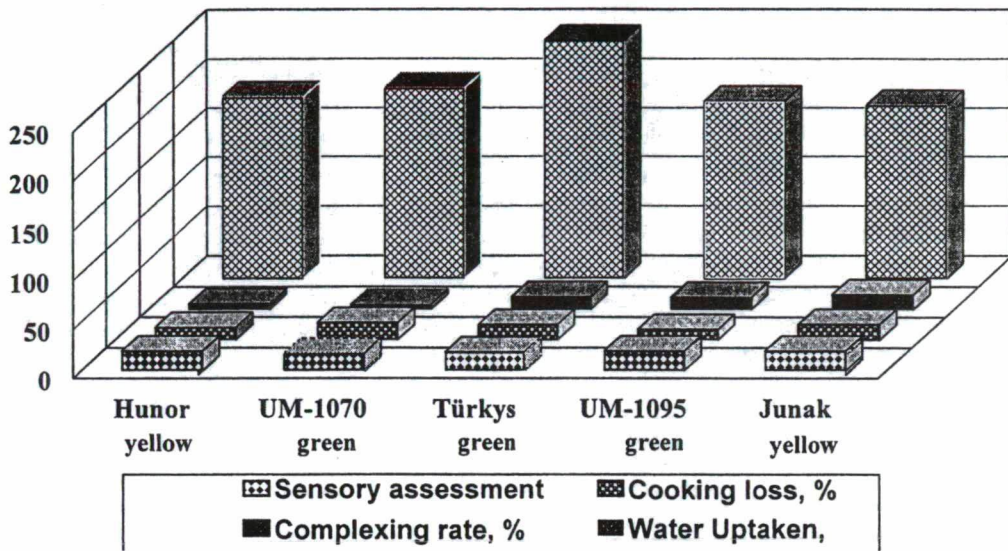


Figure 3. Cooking properties of pea basis dough made with lecithin emulsifier

The flours of pea varieties differ from one other in respect of their protein and amylose content. Pasta was made from HUNOR, UM 1093 and TÜRKYS pea varieties with different type of emulsifiers exhibited poor sensory properties, but the quality of the dough was first class. These pasta products had a high water uptake and low cooking loss. From the point of view of sensory assessment resulted in the UM-1095 and JUNAP pea varieties the best results. In these systems the structure was very good: the water uptake reasons able enough and the cooking loss low.

Monoglycerid type of emulsifiers Dimodan PM resulted in 69-91 % complexing rate which suggested the presence of amylose-emulsifier interaction in the structure. The amount of complexing rate was according to amylose content of the samples. But there are interactions between emulsifiers and proteins too.

In the presence of Epikuron 130 P the protein-emulsifier interaction has an important role in the forming of structure. In lecithin type of emulsifiers there are hardly any components suitable for complex forming. The complexity rate was very low 5-15 %.

The emulsifier VP-618-10 contains lysolecithin also, so the complexing rate is lower, than 48-66 %. In this system both protein-emulsifier interaction, emulsifier-carbohydrate complex were established.

The results of the electrophoretic examination can be see on the figure 6. On the basis of electrophoretic pattern of salt soluble fraction we can see that in the presence of monoglycerid and lysolecithin a similar change in molecular weight distribution took place: the fractions processing molecular weight under 25 kDa decreased, that between 43-67 kDa was detected in mainly two patterns and the amount of fractions over 80 kDa did not change. In the presence

of emulsifier lecithin, the fractions of 30, 55 and 60 kDa aggregated. The number of fractions was reduced, but the amount of fractions increased.

On the basis of electrophoretic pattern stained for carbohydrate, we observe new results. In the native samples of pea salt soluble proteins we observe active carbohydrate subunits of 43-60 kDa. The emulsifier aggregated the low molecular weight fraction into the protein network. In the presence of emulsifiers type of monoglycerid and lysolecithin we found carbohydrate active components in 30, 50 and 60 kDa molecularweight region, in the presence of lecithin we found this fraction in 40-60 kDa molecular weight region.

We were able to show the emulsifier-lipid-carbohydrate-protein complex. In the native samples and in the presence of emulsifiers the protein fractions of 30 kDa contained lipid fraction, but in the presence of lecithin the lipid fraction in 40-80 kDa was detected. The emulsifier lecithin could establish hydrophobe interaction and the molecularweight of this fractions was between 40-70 kDa. In this emulsifier we could not detect lipid fraction in the low molecular weight region. The lipid complex was connected in all pea varieties to the 40-80 kDa protein fractions in the presence of emulsifier lecithin.

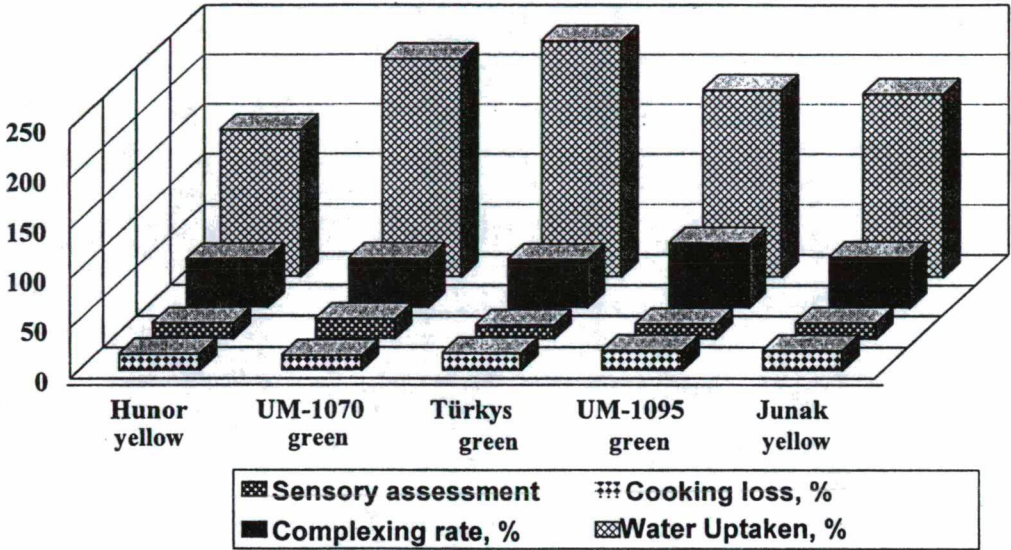


Figure 4. Cooking properties of pea basis dough made with lecithin and lysolecithin emulsifiers

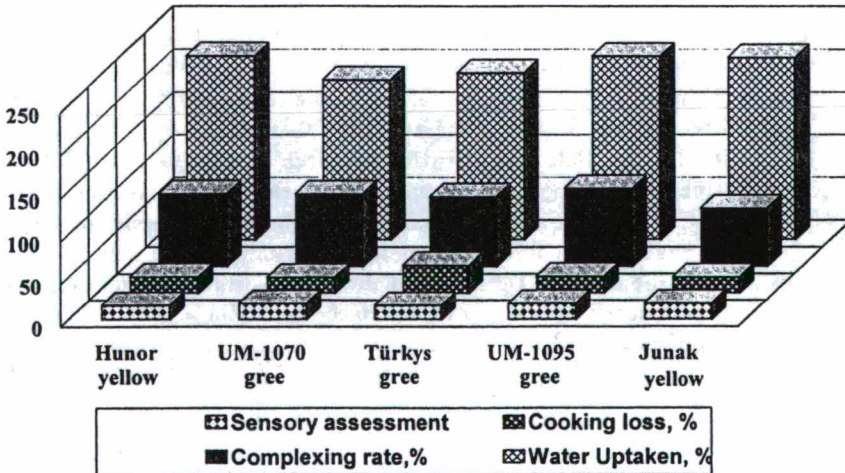
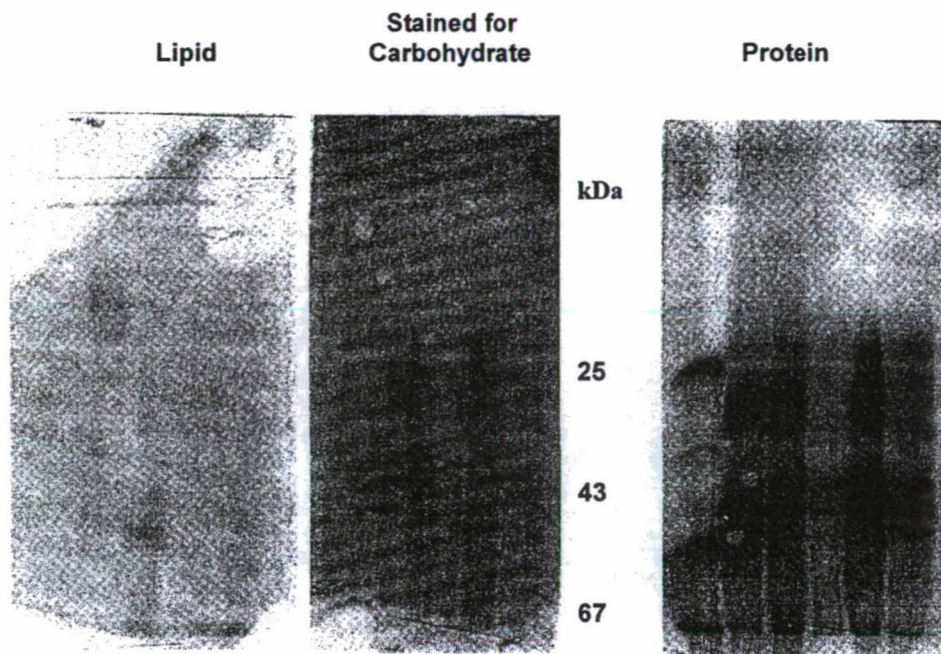


Figure 5. Cooking properties of pea basis dough made with mono- and diacylglycerols emulsifiers



S N A D E V V E D A N S N A D E V

Figure 6. Electrophoretic pattern of Junak pea variety

S: Standard (Pharmacia Sweden, Mw= 25, 43, 67 kDa), N = Native,
A: Amidan 250B, D = Dimodan PM, E7 Epicuron 130 P , V = VP-618-10

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CHANGE OF COLOUR OF DIFFERENT PARTICLE SIZE PAPRIKA GRIST DURING STORAGE

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ABSTRACT

The colour characteristics of paprika grists with different particle size were analysed. The CIE L*, a*, b* system was used for colour characterization, measured with a Minolta CR-300 instrument. The colour of grists was measured after milling and 6 months later. The colour of paprika grist becomes less saturated and more yellow during storage independent of particle size of its. The colour coordinates were measured after milling and 6 months later have a linear correlation.

1. INTRODUCTION

Paprika is a spice plant, which is grown and consumed in the biggest quantity in Hungary. The quality of paprika grist is mainly determined by its colouring power and the visually perceptible colour of the colouring substance in it. The colouring power of paprika is determined by its colour agent content, but the visually colour of paprika is dependent on its other characteristics. The effect of particle size, moisture content, and oil content is well known in the industrial practise. The relation between colour agent content and colour coordinates was investigated (Nieto-Sandova et al. 1999), but there is not a common formula to give the relationship between colour characteristics and pigment content. So, to guarantee the suitable colour of end-product paprika grist is the most problematical step of its producing. The instrumental colour measuring system is not used in industrial practise.

We can find a lot of papers, that deal with constituents that have effects on the change of colour agent content, such as technological factors (Márkus et al. 1999, Varon et al. 2000, Landron de Guevara et al. 2002), ripening factors (Gomez et al. 1998, Márkus et al. 1998), and storage conditions (Landron de Guevara et al.2002). There are less papers that treat with the change of colour using instrumental colour measuring. (Kispéter et al. 2003, Varon et al. 2000, Qingchun-Chen et al. 1999, Navarro et al. 1993, Huszka et al., 1991, Halaszné et al.,1998, C.Hodúr et al., 2000).

In this paper first we prove the empirical fact that the colour agent content doesn't define the colour of paprika grist squarely used colour characteristics measured by instrument. After that we investigate how the storage effects on the colour coordinates of paprika grist with different particle size.

2. MATERIALS AND METHODS

2.1. The measurement of colour agent content and colour coordinates

To investigate the colour agent content and colour of paprika together, we measured 200 different quality paprika powders. The samples were made from Hungarian, Brazilian and South-African primary commodity. The average of particle size of grist were between 245-255 μm . We determined the colour using the CIE 1976 L^* , a^* , b^* colour system measured by MINOLTA CR-300 tristimulus colorimeter. We applied to define the difference between two colour point the value ΔE^*_{ab} colour difference: (Lukács, 1982)

$$\Delta E^*_{ab} = \left((L_1^* - L_2^*)^2 + (a_1^* - a_2^*)^2 + (b_1^* - b_2^*)^2 \right)^{\frac{1}{2}} \quad (1)$$

The relationship between ΔE^*_{ab} and visual sensing in case of paprika grist presented in Table 1.

*Table 1. The relationship between ΔE^*_{ab} and sensible colour difference*

ΔE^*_{ab}	Visual sensing
$\Delta E^*_{ab} \leq 1.5$ or $(1.5 < \Delta E^*_{ab} \leq 2.5$ and $ \Delta L^* , \Delta a^* , \Delta b^* < 1.5$)	No difference.
$1.5 < \Delta E^*_{ab} \leq 2.5$	A hardly perceptible difference.
$2.5 < \Delta E^*_{ab}$	A definitely perceptible

We used to give the colour agent content of paprika grist the ASTA unit. The colour agent content of paprika grist was measured in Laboratory of Szegedi Paprika Co., according to MSZ 9681-5:2002.

2.2. The measurement of colour of paprika grist with different particle size

We examined 8 types of paprika with different quality from Hungary, Brasilia and South-Africa:

- ✓ 3 South-African samples
- ✓ 1 Brazilian sample
- ✓ 4 Hungarian samples

The samples were taken after milling on hammer mill and from the end-product paprika grist as well.

First we screened the samples taken after milling on hammer mill to the following particle size fractions.

Particle size fraction: 630-1000 μm

0-630 μm → 125-250 μm
 250-315 μm
 315-400 μm
 400-500 μm
 500-630 μm

The grist doesn't have grains less than 125 μ . The average particle size of samples taken from the end-product paprika grist was between 240 and 255 μm . After screening the colour of different particle size fraction of paprika grist and of the end-product was measured. We made

measurements after milling and 6 months later, because the guaranteed time of paprika grist is 6 months. The samples were stored in dark place, its temperature was 23 °C on average.

We determined the colour using the CIE 1976 L^* , a^* , b^* colour system measured by MINOLTA CR-300 tristimulus colorimeter too. We applied to define the difference between two colour points with ΔE^*_{ab} colour difference value (1), ΔH^*_{ab} hue difference, defined by (2), and ΔC^*_{ab} chroma difference, defined by (3) (Lukács,1982).

$$\Delta H^*_{ab} = \text{sign}(a_1^* \cdot b_2^* - a_2^* \cdot b_1^*) \cdot \left((\Delta E^*_{ab})^2 - (\Delta L^*)^2 - (\Delta C^*_{ab})^2 \right)^{\frac{1}{2}} \quad (2)$$

$$\Delta C^*_{ab} = \left((a_1^*)^2 + (b_1^*)^2 \right)^{\frac{1}{2}} - \left((a_2^*)^2 + (b_2^*)^2 \right)^{\frac{1}{2}} \quad (3)$$

3. RESULTS AND DISCUSSION

3.1. Analysing of colour agent content and colour coordinate values

We investigated if the colour agent content of paprika grist determines its colour squarely. Therefore we classified the samples based on their colour agent content. We composed 13 classes. After then we calculated the colour difference of samples that are in the same colour content class. Next we categorized the calculated ΔE^*_a values to three class as based on Table 1. and made frequency histogram. The results are presented in Figure 1.

It seems good, that the frequencies of colour difference values that are higher than 2,5 are more than 59% in all colour agent content classes, namely the colour of samples, that have similar colour agent content, are different in 59 percent. So we can state, that the colour agent content of paprika grist doesn't define their colour squarely.

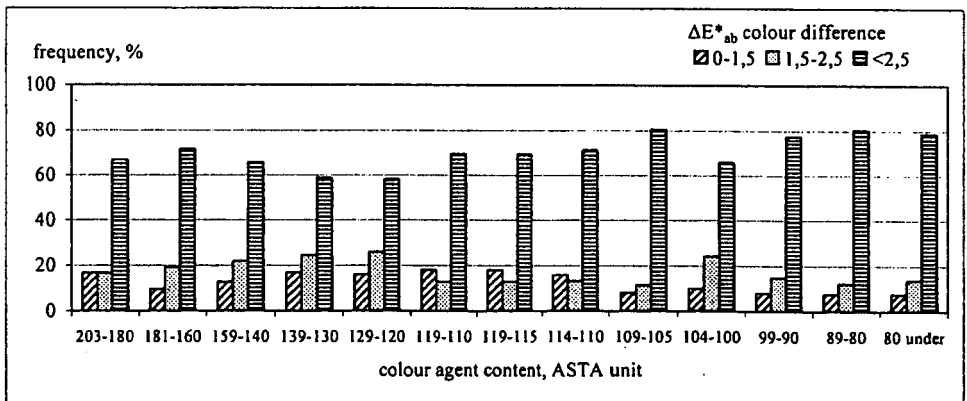


Figure 1. The frequency histogram of different colour difference values in case of different colour agent content classes

3.2. Effect of storage on colour coordinates

To evaluate the colour coordinate values measured after milling and 6 months later, we calculated averages and standard deviation of data were measured on samples with same

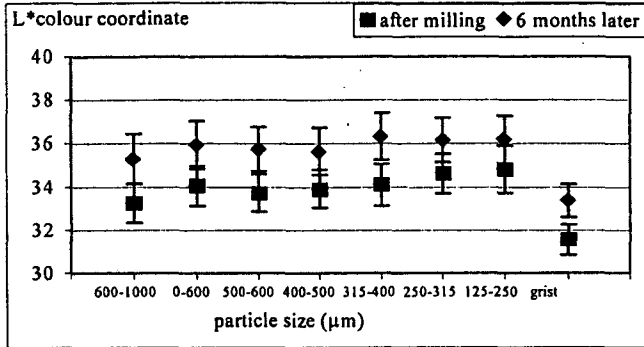


Figure 2. Effect of storage on L* lightness coordinates in case of paprika grist with different particle size(average ± confidence interval)

particle size. The values are presented in Figure 3. We marked average values with confidence interval that appertains to 95% confidence level. We plotted the averages of values measured after milling and 6 months following in the same diagram. We can appoint that the L* (lightness) coordinate went up, and the a* (redness) dropped independent of particle size. The change of a* coordinate of end-product paprika powder was lower, in the other cases the variation of redness coordinates were averagely 3 units. The L* increased on average with 2 units. The b* (yellowness) changed significantly only in case of end-product (grist).

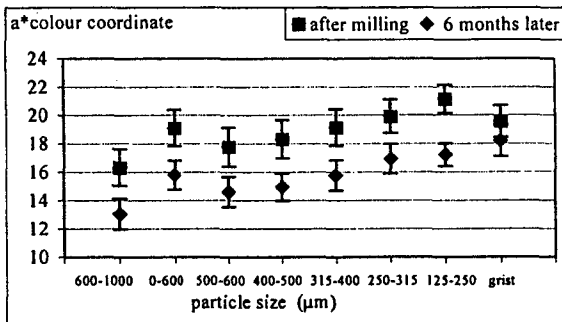


Figure 3. Effect of storage on a* redness coordinates in case of paprika grist with different particle size(average ± confidence interval)

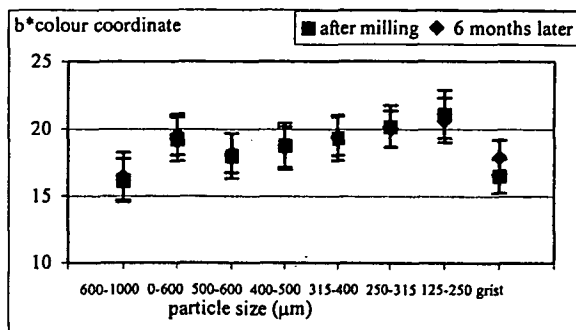


Figure 4. Effect of storage on b* yellowness coordinates in case of paprika grist with different particle size(average \pm confidence interval)

Table 2. The averagely change of colour characteristics in course of storage

	ΔL^*	ΔE^*_{ab}	ΔC^*_{ab}	ΔH^*_{ab}
Average	-1,88	3,90	1,77	2,45
Standard deviation	0,84	1,19	1,50	1,01

Table 2. shows the averages of fluctuation of colour difference, of hue difference and of chroma difference values with standard deviations. We can see, that the colour difference higher, than 3, so the variation is well sensible. The positive value of ΔC^*_{ab} points, that the colour of paprika grist becomes less saturated. By reason of hue difference we can say, that the colour of paprika turn into more yellow.

Next we searched connection between data were measured after milling and 6 months following using regression analysis. We represent the result in Figure 3. The values measured 6 months following are illustrated depend on values measured at first. We marked the regression lines and R^2 values in the figure.

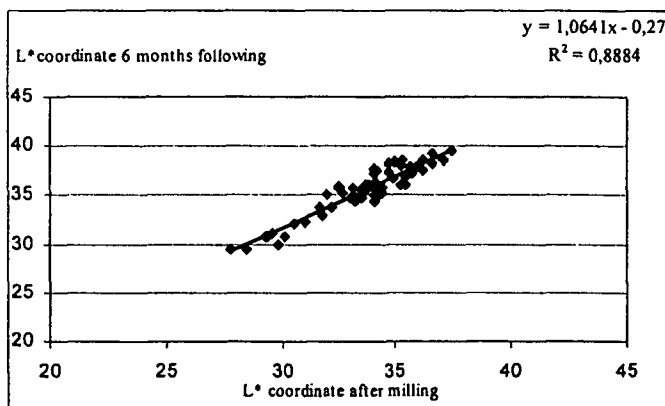


Figure 5. The relationship of lightness coordinates were measured after milling and 6 months later

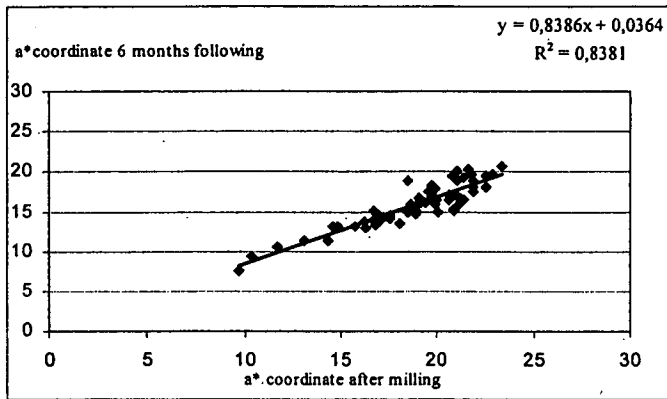


Figure 6. The relationship of redness coordinates were measured after milling and 6 months later

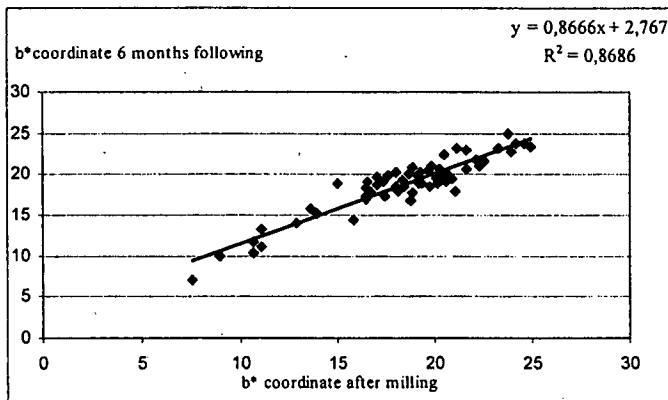


Figure 6. The relationship of yellowness coordinates were measured after milling and 6 months later

We can establish, that the values measured first and in the second time have linear connection in case of all colour coordinates, R^2 values are higher than 0,83. So the change of colour coordinates in 6 months is appraisable using this formula.

CONCLUSION

- ✓ The colour agent content of paprika grist doesn't define its colour squarely, the colour of samples, that have similar colour agent content is different in 59 percent.
- ✓ The lightness (L^*) coordinate rises, the redness (a^*) coordinate drops in course of storage, independent of particle size of grist, so its colour becomes lighter. The b^* (yellowness) changed significantly only in case of the end-product.
- ✓ The colour of paprika grist becomes less saturated and more yellow during storage independent of particle size of grist.

- ✓ The colour coordinates were measured after milling and 6 months later have linear connection. In case of L^* coordinate $R^2=0,8884$, in case of a^* coordinate $R^2=0,8381$, in case of b^* coordinate $R^2=0,8686$.

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NEW SAFETY ELEMENT FOR DAIRY TECHNOLOGY

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ABSTRACT

The strict instructions for heat-treating of raw milk are contained in Codex Alimentarius Hungaricus, 92/46, 92/380 EU Directives and 1/2003 (I.08) FVM-ESzCsM decree. Most of the applied equipments for heat-treating of raw milk have no flow direction valve, which should guarantee the heat-treating of milk by directives in all cases.

The goal of the project: to develop a safety flow-diversion valve for small and medium dairy firms in order these firms will be able to satisfy the EU directions, in this way, their products can take part in the Eu dairy market as well

Developed flow-diversion valve fitted small pipe diameter has double valve seat and leakage system.

The main advantage of developed valve is the follows: the raw milk or failure heat-treated milk doesn't able to flow into the regenerative sections of equipment in the case of the failure of gaskets, even more it shows the gasket failure with leakage.

Using equipments with developed valve cancel a main critical point from the Quality Management System. Innovated valve is quickly installable with standard binder items.

The flow-diversion safety valve, which was developed by Zootechnika Ltd. and University of Szeged, sponsored by EU and Hungarian National Program GVOP 3.1.1-2004-05-0275/3.0. has a Qualification from Bundesanstalt für Milchforschung Institution Kiel n:KI-S 5/04.

ÖSSZEFOGLALÓ

A nyers tej hőkezelésére vonatkozó, érvényben lévő szigorú előírásokat a Magyar Élelmiszerkönyv, a 92/46 EGK, a 92/380/EWG irányelv és az 1/2003. (I.8.) FVM-ESzCsM rendelet tartalmazza. A jelenleg alkalmazott kisüzemi pasztörök többsége nem rendelkezik olyan rendszerű biztonsági átváltó szeleppel, amely minden esetben biztosítaná a nyers tej előírás szerű hőkezelését.

A projekt célja: Olyan biztonsági szelepet előállítsa, amelynek használatával az említett előírásokat a hazai kis-, és középüzemek kifogástalanul teljesíteni tudják így termékeik is helyet kaphatnak az EU piacán.

A kis csőátmérőkre kifejlesztett irányváltószelep kettős szeleplékű, szivárgás-ellenőrzött (leakage) rendszerű.

A kifejlesztett irányváltó szelep fő előnye: a nem kellően hőkezelt nyerstej tömítéshiba esetén sem kerülhet vissza a regeneratív és hűtőszakaszokba, illetve az esetleges tömítéshibát szivárgással is jelzi. A szeleppel szerelt pasztörök a minőségbiztosítási rendszerből kiiktatnak egy kritikus pontot. A szelep a szabványos csökötésekbe gyorsan és probléma nélkül szerelhető.

A Zootechnika KFT és a Szegedi Tudományegyetemen által fejlesztett és az EU valamint a Gazdasági Versenyképesség Operatív Program (GVOP 3.1.1-2004-05-0275/3.0.) támogatásával elkészült szelep a Kiel-i Bundesanstalt für Milchforschung Intézetől EU minősítéssel rendelkezik n:KI-S 5/04.

INTRODUCTION

Our joining the EU on 1st May 2004 means possibilities and challenges as well as the so-called globalization. Simultaneously we have to note reluctantly that the legal and official prescriptions and regulations may become inconsiderate tools of market competitions sometimes. Naturally these are destined for the protection of customers, but unready producers as market persons can be affected like a bolt from the blue by the demands of prescriptions or regulations indicated perhaps by competitors on the market - as some precedents have happened so far. However, such products can be found on the market of the Union after some years of tolerance, which suit in every respect the very severe conditions created in connection of the production and marketing of foods.

For home milk processing plants such a new challenge is to ensure warranted safe heat treatment of raw milk in such a manner which excludes any kind of possible forms of after-infection. In addition suitability of applied procedure must be verified. The achievement of this is not realizable in most home creamery without technical development, innovation and investment.

PRECEDENTS

Judiciary background

New sanitary prescriptions related production and marketing of raw and heat-treated milk as well as milk products were established in the **Communiqué of the Council of European Communities** (Directive 92/46, 1992).

The Appendix B and chapter V of this directive deals with the special requirements for licensing of heat-treating and processing institutions and describes that:

"... heat treating and processing institutions must possess at least:

- (f) a heat treating equipment approved or permitted by authorities responsible, which is equipped with:

- temperature controller,

- recording thermometer,

- automatic safety device, which prevent the insufficient heating,

- suitable safety system, which prevents mixing of pasteurized or sterilized milk and milk heated insufficiently,

- automatic data recorder to the safety system mentioned in the preceding item

..."

For instance, pneumatic reversing valves built-in behind holding section of pasteurizer are destined for the fulfillment of above recommendation. According to experiences of hygienic controls, valves of such function are absent in the system in several places. If there are some, this does not satisfy demands on exclusion of all possibilities for reinfection, or they are cut out. But such valves have not existed so far for small-scale devices and for small tube diameters.

Effect of operation of the diversion valve on pasteurization

The task of reversing valve is to secure the stream of milk in alternative bifurcating directions from heating or holding sections of the pasteurizer. The aim of this operation is to prevent the flow of milk of inadequate quality in return tract of the pasteurizer where thermal energy of hot milk is used for preheating the incoming cold milk. Because an intensive heat

exchange also takes place in this tract, hot milk quickly cools to such temperature that system infecting microbes can cause spoilage by getting into the milk destined for packing or following use.

Valves are usually controlled with automation using signals of temperature sensor and their automatic change occurs by remote control. Most of all operation of such valves is worked out by means of compressed air.

Critical conditions of valve operation:

- Accuracy of temperature signal coming in the controller,
- Accuracy and reliability of control program in the built-in system,
- Adequacy and authenticity of operating air and/or mechanic elements,
- Suitable flow conditions inside the valve.

In the best, case reversing valve is used during heating up of the system, at the end of pasteurization and by washing, respectively. Its operation is inevitable in these steps of production to prevent after-infections or mixing of the milk with other materials (e.g. washing solutions).

After-infection is the most dangerous problem during heating up of the system, because milk does not achieve its required germicidal effect yet, so return tracts can be considerably infected. Infection can be resulted, when some kinds of defects arise in the operation or tightness of the valve. A continuous leaking is frequent resulting from packing defects in the case of valves without leakage control. This is the most dangerous defect, because it is hidden and both outputs of the system are infected. Very significant germ propagation can occur in the stagnant milk in the tract out of use which may threaten other systems later. Infection of the return line of the milk is the most dangerous problem during heating up, because in this case infection occurs under slow flow velocity. There are such tracts in the pasteurizer where stagnant and slowly escaping milk may cause deposits, which can be removed by subsequent high flow velocity only after longer time.

Automatic reversal of suitable heat treated milk into the return tract will sooner or later wash away the infective flora from the system. In fact infection will be diluted so much that it will not cause further trouble. Milk of expected good quality will continuously be infected by centers originating from heating until required dilution is produced. Milk quantity necessary for dilution is very difficult to be estimated, therefore solution can be attained only by application of leakage controlled valves. Their application excludes infection of returning milk. Packing defect is indicated simultaneously by milk leaking from the valve in a distinctly visible. So defect can be removed quickly and safe pasteurization can be continued.

Unfortunately leakage controlled valves are used typically in pasteurizers of high-efficiency, such valves are rarely found in machines of low- and medium-efficiency.

We have developed leakage controlled flow diversion safety valves (LFDV) with double valve seat presented below, to satisfy above requirements in pasteurizers of low-efficiency.

RESULTS AND DISCUSSION

Powers and pressures necessary for perfect closing of valve disks and seats in valve constructed were determined on the basis of registered data in the first step. In starting position valve disk and seat (1, 2) are closed, pressure necessary for closing is provided by spring force. There are two springs (R_1 , R_2) in the valve. In starting position spring R_2 keeps the valve closed, while spring R_1 works against it. Spring forces were determined from tables:

$$R_1 \rightarrow D=16[\text{mm}], d=2[\text{mm}], L_o=52 \quad \underline{F_1=198 [\text{N}]}$$

$$R_2 \rightarrow D=34[\text{mm}], d=4[\text{mm}], L_o=54 \quad \underline{F_1=523 [\text{N}]}$$

Determination of acting pressure on closing surface A1 (ring "O"):

$$A_1 = \frac{(D_2 - D_1)^2 \pi}{4} = \frac{(40\text{mm} - 39\text{mm})^2 \pi}{4} = 0.78\text{mm}^2$$

Pressure:

$$P_1 = \frac{F_2 - F_1}{A_1} = \frac{523 - 198}{0.78\text{mm}^2} = 416\text{kPa} \cong 4.16\text{bar}$$

Determination of velocities

$$\text{Flow cross section: } A = \frac{d^2 \pi}{4} [\text{m}^2]$$

$$d = 20 [\text{mm}] = 0,02 [\text{m}] \rightarrow A = \frac{0,02^2 \pi}{4} A = 0,000314 [\text{m}^2]$$

Liquid flow (from instrument reading): $Q = A \times v [\text{dm}^3/\text{h}]$.

$$\text{Velocity: } v = \frac{Q}{A \times 1000 \times 3600} \left[\frac{\text{m}}{\text{s}} \right]$$

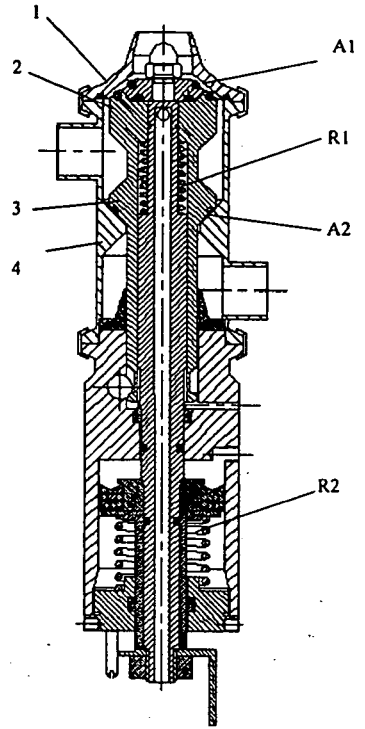


Figure 1. The cutaway view of valve

After change the valve is closed at the bottom, an air pressure of 6 bars adds to spring force, so a force R_1 + force originating from air pressure works against R_2 . (Figure 1.)

Pressures and liquid velocities in the valve were modeled with computer program. Velocity values evolving in LFDV is plotted in the left-hand figure. Liquid pressure values are illustrated in the right-hand side and in the middle figures, respectively.

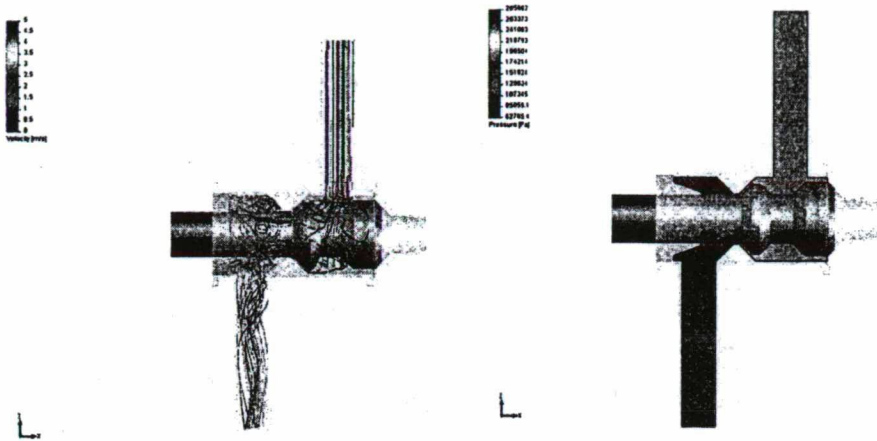


Figure 2. Changing of the flow velocity and pressure in the valve

Diagram of differences between input and output liquid pressures can be seen on the 3rd Figure.

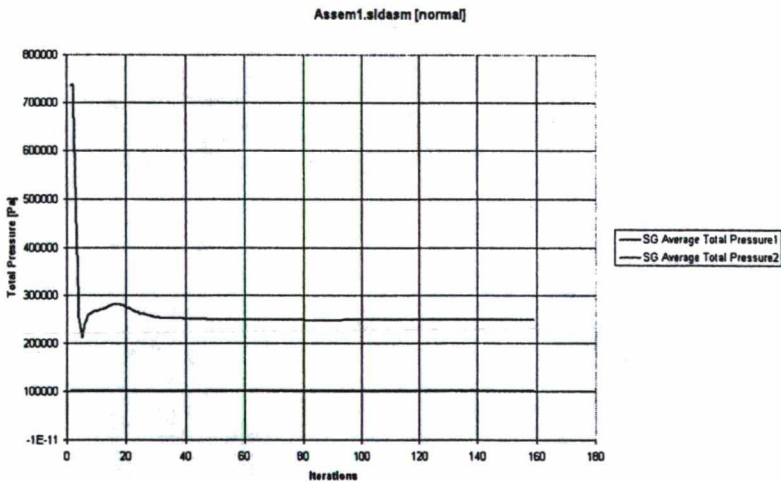


Figure 3. Difference of liquid pressure at the inlet and outlet of valve

Projected valve on the basis of calculations and modeling was found as required.

After production of the valve we had to perform actual tests, from which it could turn out whether the LFDV worked according to prescriptions and projecting.

Test measurements 1.

Detailed measuring results are not presented here because of extent limits.

Evaluation of tests

Measurements were performed at liquid temperature of 15 °C (in the present case water was used as liquid), at revolution of 2950 min⁻¹ and at gradually increased pressures.

At higher working pressures leakages occurred during tests. The valve did not close perfectly and liquid appeared in both discharge holes, since tract were opened into each other. This defect could be developed because of low force of spring R2. In addition other leakage problems aroused, too.

Cause of defect

-Problem of imperfect closing originated from spring force in the cylinder, which was insufficient to switch the valve completely at higher liquid pressure, the two liquid tracks were only opened into each other.

-Contact surfaces between valve disk and seat were formed at an inappropriate angle. As a result, rings "O" were damaged and leakage defects appeared.

-Double valve seat was dislocated because of its insufficient guidance, which caused further leakage problems.

Elimination of defect

-One extra boring M was fabricated in the cylinder. Its inner sizes were transformed for solving the two-way air input and with that spring force could be helped pneumatically. So working cylinder of double operation was practically applied instead of a cylinder with single operation, working pneumatically with spring operation. Because of cylinder alteration its head had to be modified, too. Distance pieces in the cylinder had to be substituted with one on which two O rings could be mounted (double packing) for producing pneumatic guidance back and forth.

- Angles of contact surfaces between valve disk and seats were also for more stable bearing and packing.

-Valve seats in valve case were transformed so that they could guide the double valve disk.

Assembly drawing of modified valve is presented in the following figure.

Test measurements 2.

Elimination of defect

-A slot for a slip ring had to be formed in the cylinder to eliminate metallic contact between double valve disk and cylinder surfaces.

-Modification of angles of contact surfaces between valve disk and valve seats was continued for even more stable bearing and packing.

-Lower pipe junction on the valve case had to be located 1-2 mm deeper, so liquid could completely leave the valve. Slots for ring "O" had to

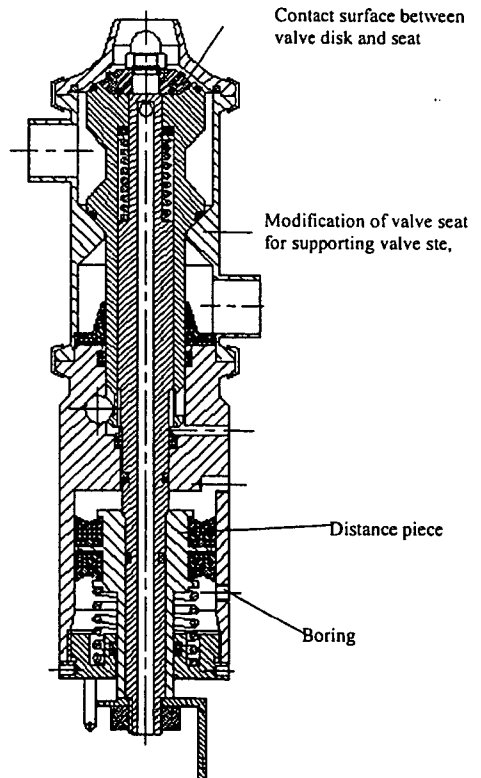


Figure 4. The cutaway view of the modified valve

be formed radial, by its means rings "O" would be seated more precise into the slot ensuring better packing and preventing impurities from penetrating under the ring.

Test measurements 3.

New measurements were performed at 15, 75 and 90 °C liquid temperatures and at 2950 min⁻¹ pump revolution after elimination of defects. The performed modifications enabled the development of a valve operating satisfactorily on the basis of measurements.

CONCLUSIONS

EU directive regarding to safe heat treating of milk demands building such machine parts in present pasteurizers which can guarantee food safety excluding the after-infection. Provisionally such safety valves are available only in constructions produced for equipments of high-efficiency and for great tube diameters. Operation of reversing valve prepared according to our plans was investigated in a test equipment.

Measurements were performed in several series in the test equipment projected and built for this purpose. Liquid pressure was gradually increased at constant pump revolution of 2950 min⁻¹ and at 15, 75 and 90 °C temperatures. At the bench valve operating factory-like was modeled with several repetitions and alternations of valve position.

Liquid flow was developed with pump in the pipe line of 20 mm diameter in test measurements. Liquid streamed from the tank through volume flow meter to LFDV then back to the tank. Pressure, temperature and liquid flow was continuously measured. Measuring results were recorded with recorder for subsequent detailed analysis and evaluation.

On the basis of measurements performed after defect corrections and valve modifications it can be established that operation of LFDV meets the expectations. Pressure of the liquid streaming in it does not fluctuate and its velocity remains within prescribed values. The valve changes quickly, perfectly and in a leak-proof way. It is verified with EU qualification KI-S 5/04 by Bundesanstalt für Milchwirtschaft in Kiel, which is at our disposal.

On the basis of our results the project realized with the aid obtained in the scope of European Project is deemed to be successful. The developed safety valve is recommended to home and foreign small-scale plants for purchase and installation.

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PROTECTION SYSTEMS OF THE TITLTING MECHANISMS AT THE ROLLING TRAINS

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ABSTRACT

To the tilting mechanisms with hook from the rolling trains because of stuck of the hook in the way with rolls, appear additional loads in the tilting mechanisms elements, who can lead to destruction. For the protection of the mechanism, the connecting rod is fitted with a safety bolt, which shall tear through destruction in the moment of the additional load. The present work proposes the substitution of the bolt of destruction with a device, of type system of index, who give in the moment of the additional load, and he shall come back in the natural position to next cinematic cycle of the mechanism in the condition of ending the additional load, respectively the design and the experimental study in conditions of exploitation for different variants of the device.

KEYWORDS

rolling trains, tilting mechanisms, experimental study, processing results

1. INTRODUCTION

The paper presents the study of the tilting mechanism with hook, from the rolling train blooming 1000. To this mechanism, because of an wrong operation, it can happened, on one side, when the hooks are going down, they jabbed in the bloom, and at the other side when the hooks are going up, they can hung on the way with rolls of rolling train. This thing can bring destruction of the component elements by reason of additional load.

In the case of the tilting mechanism from the blooming 1000 mm, the main connecting rod is fitted with a section of minimum resistance, materialized with two safety bolts, which is brake up in the moment of the appearance of the additional load. The connecting rod's cross-section is presented in FIGURE 1.

The protection of the tilting mechanism with safety bolts is convenient at the first sight, only that she presents some disadvantages. Thus, in the moment of bolt break, by the reason of accidental additional loads, must interrupt the process of lamination on period time, in which time the broken bolt is taking and put another new one. This operation is difficult, due to the difficult intake to the section with bolts.

The object of this paper is a protective solution of the tilting mechanism from the rolling trains, lock limiter automatic force type. For design this, is necessary to know the value of the force from the connecting rod of the tilting mechanism. The blooms tilting mechanism work with shocks and therefore, the state of efforts from his elements can't be determinate just when the dynamic coefficient is known very well. To have a real situation, is accepted the experimental method (with tensometrical stamps).

After the measurements is obtained the maximum values of the force from the connecting rod of the mechanism in the next conditions:

- 97800 N, to working in empty;
- 475000 N, to working in charge;
- 1350000 N, to break of the bolts.

2. DESCRIPTION AND WORKING OF THE LOCK LIMITER AUTOMATIC FORCE

The authors proposed two variants of lock limiter automatic force, with tapered blocking bodies and with balls. The schematic sketches of the two variants are presented in FIGURE 2 (a, b).

The press force Q from the compression spring (4), is calibrated depending on maximum force of regime from connecting rod. In the moment when force F from connecting rod exceeded a certain pre-value, the blocking bodies (3) will be pushed in outside of the transversal seats, compressing the springs until these gets away from the two tapered bores. After additional load is ending, the compression springs shall push backward the blocking bodies in the tapered bores from connecting rod. Thus the mid-section of the connecting rod is displaced by the exterior one, permitting the end of solicitation, achieving thus the enclosing the lock limiter automatic force to the next kinematic cycle.

Taking in consideration that the critical force from connecting rod (the spring press force) are very big and because the space where the spring is placed is limited (for a little deformation), is recommended compression ring-shaped type springs to use, who satisfy the conditions below.

3. CALCULATION AND DESIGN OF LOCK LIMITER AUTOMATIC OF FORCE .

a) For the case of the tapered blocking bodies is noted with F the force from connecting rod where the lock is breaking up, lock presented in FIGURE 2. The force is in equal mode distributed on each pairs of blocking bodies. On each blocking bodies, will be act the half from the critical force, F/2. The scheme of load of a blocking body is presented in FIGURE 3.

With the notations from FIGURE 3 between the distributed force, F/2 and force P who pushes the blocking body in the tapered bore, the following relation can be writing:

$$P = \frac{F}{4 \cdot (\sin \alpha + \mu \cdot \cos \alpha)} \quad (1)$$

Forces who acts on the blocking bodies (FIGURE 4) will be: P, respectively μP , spring press force Q and N_1, N_2 (the reactions of slideway) respectively F_1 and F_2 the frictional forces in the slideway. From the equilibrium condition of the forces, results the relation of the force P depending on Q and the geometrical sizes of the tapered blocking body.

$$P = \frac{Q}{\left[\cos \alpha - \mu \cdot \sin \alpha \left(1 + \frac{2 \cdot b}{l} - \frac{\mu \cdot a}{l} \right) \right]} \quad (2)$$

Next, the problem is to choose the optimal value of the angle α of tapered body of lock, respectively to determinate the limit value to avoiding the stuck phenomenon in the tapered bore of the connecting rod, in working conditions.

The stacking of the blocking body in the tapered bore from connecting rod is produced when the denominator of the relation (2) is null, respectively force P tend to infinite. Taking count of these specifications and the fact that the angle α can't have negative values, the domain in which can take values the angle α is:

$$0 < \alpha < \arctg \frac{1}{\mu \cdot \left(1 + \frac{2 \cdot b}{l} - \frac{\mu \cdot a}{l} \right)} \quad (3)$$

From the relations (1) and (2) is determined the value of the spring press force, Q:

$$Q = \frac{F \cdot \left[\cos \alpha - \mu \cdot \left(1 + \frac{2 \cdot b}{l} - \frac{\mu \cdot a}{l} \right) \cdot \sin \alpha \right]}{4(\sin \alpha + \mu \cdot \cos \alpha)} \quad (4)$$

or $Q = K \cdot F$

$$K = \frac{\cos \alpha - \mu \cdot \left(1 + \frac{2 \cdot b}{l} - \frac{\mu \cdot a}{l} \right) \cdot \sin \alpha}{4 \cdot (\sin \alpha + \mu \cdot \cos \alpha)} \quad (5)$$

For $F = F_{\max} \Rightarrow Q = Q_{\max}$

The lock limiter automatic force was modeled in the Mechanical Desktop program, the rendered image of this is presented in FIGURE 5.

The relations (1)...(5) were solved with a calculation program, who permits to know the maximum values of angle α , α_{\max} , where appear the stuck of the blocking body in connecting rod, and Q spring press force, for different values of friction coefficient μ (different pairs of materials), respectively the geometrical sizes of the tapered blocking body.

Keeping the geometric sizes constant, for different values of friction coefficient between the tapered blocking body material and the connecting rod material, are obtained differently limits values for the angle of the blocking body.

For the real case analyzed of the tilting mechanism, admitting $\mu = 0.15$, will be result the maximum angle where appear the danger of stacking lock:

$$\alpha_{\max} = 78.68 \text{ [degree]}$$

For the covering the estimation who was made in calculations, this value is reduced with a safety factor 1.3, resulting:

$$\alpha_{\text{lim}} = \frac{78,68}{1,3} = 60[\text{deg ree}]$$

b) For the case of limiter lock of force with balls (FIGURE 2) it can considered the same conditions of load as in case of the tapered blocking bodies. The calculation scheme is presented in FIGURE 6.

From the condition of equilibrium is determined the spring press force:

$$F_{\text{Iarc}} = \frac{F_{\max}}{2} \left[(1 - \mu_0^2) \cdot \text{tg}\alpha - 2 \cdot \mu_0 \right] \quad (6)$$

4. EXPERIMENTAL TRIALS

The experimental trials were made for the variant case with tapered blocking bodies. Because the main connecting rod of the tilting mechanism has big length (2480 mm), for the experimental trials, it was considered just a portion from connecting rod, respectively the portion, on which is assembled lock limiter automatic of force. Lock limiter automatic of force is presented in FIGURE 7. The experimental trials on lock limiter automatic of force with tapered blocking bodies has been made on the universal machine of tried to stretch and pressure, presented in FIGURE 8.

From the experimental trials results that the lock is broken on values between 50200 and 50750 daN of the force from connecting rod, near value of the one obtained by calculation (53010 daN).

The pairs of values *force – displacement of connecting rod*, read on measure equipment of the machine of tried was estimated through interpolation with Lagrange polynomial.

The estimation with the Lagrange method of interpolation consists in determination a polynomial of this form:

$$P_n(x) = L_0(x) \cdot y_0 + L_1(x) \cdot y_1 + \dots + L_n(x) \cdot y_n \quad (7)$$

where: The coefficients $L_i(x)$ - polynoms of n degree named Lagrange polynoms. The value of n represents a number of pairs of values $(x_0, y_0), (x_n, y_n)$, read on the measure equipment of the machine of tried to stretch and pressure.

The shape of Lagrange polynom is:

$$L_i(x) = \frac{(x - x_0) \cdot (x - x_1) \cdot \dots \cdot (x - x_{i-1}) \cdot (x - x_{i+1}) \cdot \dots \cdot (x - x_n)}{(x_i - x_0) \cdot (x_i - x_1) \cdot \dots \cdot (x_i - x_{i-1}) \cdot (x_i - x_{i+1}) \cdot \dots \cdot (x_i - x_n)} \quad (8)$$

To the final, the interpolation polynom have the following form:

$$P_n(x) = \sum_{i=0}^n a_i \cdot x^{n-1} = a_0 \cdot x^n + a_1 \cdot x^{n-1} + \dots + a_{n-1} \cdot x + a_n \quad (9)$$

For the 76 read pairs of values (*force - displacement*), result a interpolation polynom of the 76 degree. The interpolation was made with a program write in Matlab, and the graphic representation of the estimation polynom is presented in FIGURE 9.

5. CONCLUSION

After the experimental trials the conclusion is that lock limiter automatic of force works correct, and he brakes up in to a value of force near to the one obtained through calculation.

The blocking bodies don't present deformation because of contact solicitation, respectively no element of wear. In these conditions the blocking bodies are still in good shape of working.

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FIGURES

FIGURE 1. THE CROSS-SECTION OF THE CONNECTING ROD

- 1- destruction bolt;
- 2, 3 - the elements of the connecting rod;
- 4 – threaded toppers

FIGURE 2.a. LOCK LIMITER AUTOMATIC FORCE (variants a)

- 1, 2 - connecting rod;
- 3 – blocking body;
- 4 - spring of pressure;
- 5 - threaded topper

FIGURE 2.b. LOCK LIMITER AUTOMATIC FORCE (variants b)

FIGURE 3. THE SCHEME OF LOAD PAIRS OF LOCKS

FIGURE 4. FORCES WHO ACT ON A LOCK

FIGURE 5.a. DESIGN OF LOCK WITH TAPERED BLOCKING BODIES

FIGURE 5.b. DESIGN OF LOCK WITH BALLS

FIGURE 6. THE CALCULATION SCHEME OF LOCK WITH BALLS

FIGURE 7. LOCK LIMITER AUTOMATIC OF FORCE

FIGURE 8. EXPERIMENTAL TRIAL

FIGURE 9. THE VARIATION OF THE FORCE FROM CONNECTING ROD

- o Recording data; __ Estimated chart

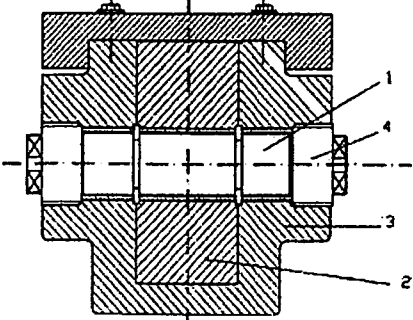


Figure 1.

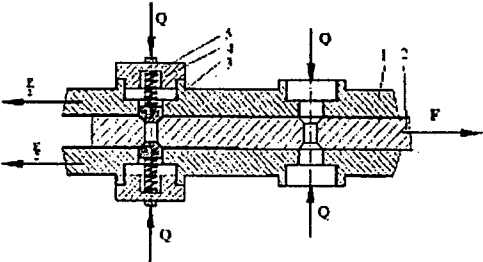


Figure 2/a

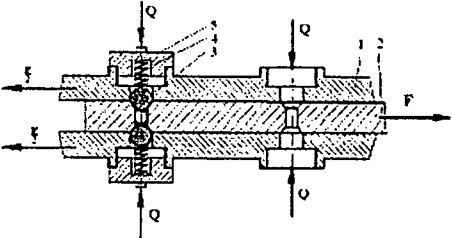


Figure 2/b

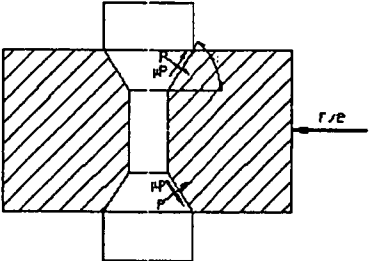


Figure 3.

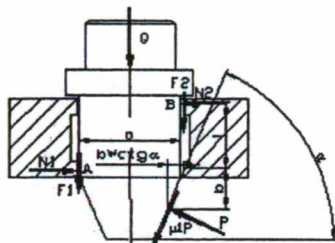


Figure 4.

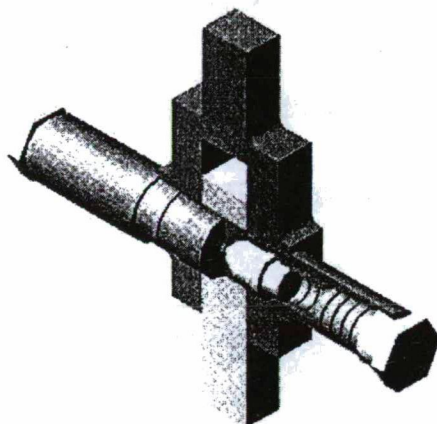


Figure 5/a

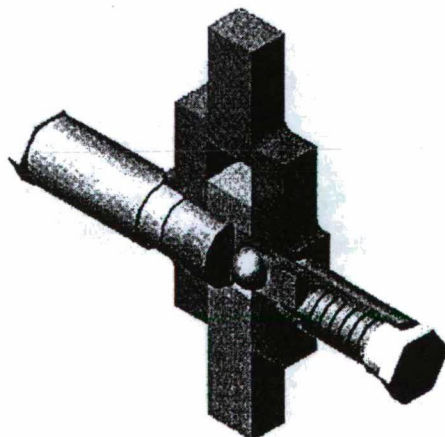


Figure 5/b

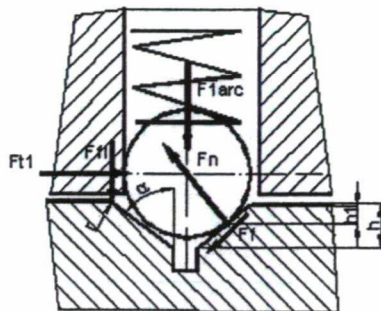


Figure 6.

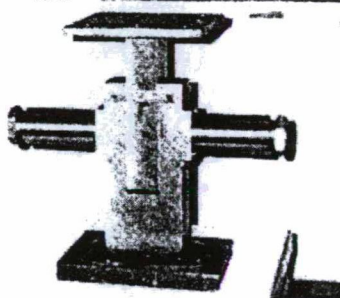


Figure 7.

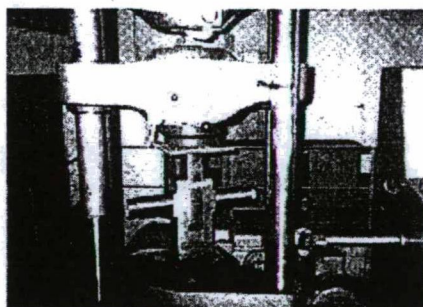


Figure 8.

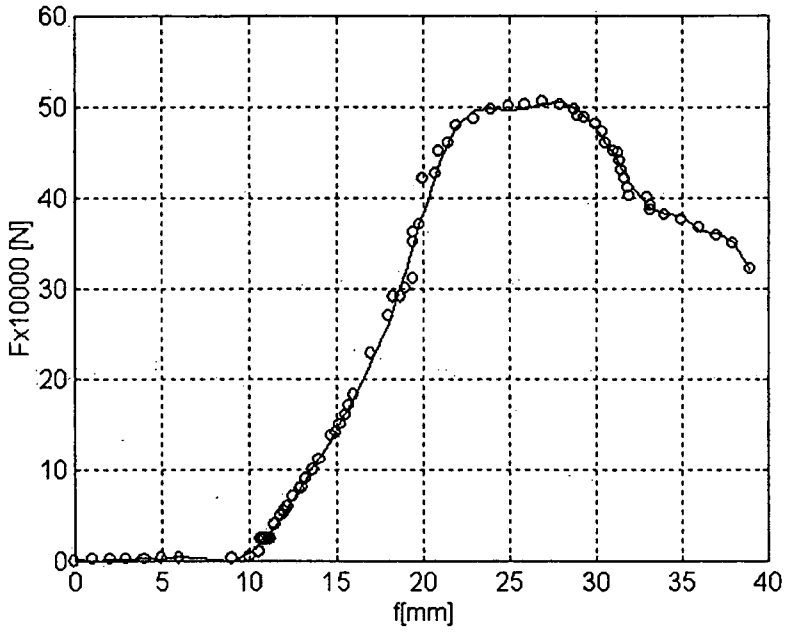


Figure 9.

PNEUMATIC POSITIONING IN PRACTICE

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ABSTRACT





In recent years considerable investigation has been devoted to the pneumatic positioning. Several methods are applied to control these positioning systems. Due to the fact that DSP owns the advantage of low cost, high speed and calculation performance, it has been widely applied. The main contribution of this paper is a design of a robust sliding mode controller implemented on DSP system. The effectiveness of the proposed control schemes is demonstrated by some simulated and experimental results.

Keywords: Sliding mode control, DSP, chattering, pneumatic system.

1. INTRODUCTION

Increased industrial demands on quality and performance over a wide range of operating regions have led to a significant interest in the area of pneumatic linear actuators and motion control systems that combine high speed with high accuracy, repeatability, and reliability. The goal of this project is to create a flexible laboratory test stand capable to perform in various hardware configurations all necessary tests and measurements included our research program.

The following requirements for the system have been met:

-  the system should be built basing on industry equipment,
-  the system should fulfil all requirements imposed by the research program,
-  the system should be universal and easy to use,
-  except testing of the pneumatic positioning system, the system should be used as a laboratory subject for students.

Changing loads, contaminated air supplies, cylinder orientation, long strokes, bore sizes, and cylinder sticktion are just a few of the challenges that have contributed to the negativity associated with servopneumatics.

Because on control difficulties, caused by the high nonlinearity of pneumatic systems, a robust control method must be applied. There are two main classical directions in the field of robust control. One is the H infinite control for linear systems, and the other is the sliding mode control for nonlinear systems. Another solution is to employ the advanced nonlinear control strategies developed in recent years (soft computing) [10][11].

The variable structure control with sliding mode strategy was first proposed by a group of Soviet scientists [1][2] in 1950's. It has been proven as an effective and robust control methodology and applied in many practical applications [3]. Sliding mode control (SMC) has been traditionally recognized as a high gain control technique with outstanding

robustness features for both stabilization and tracking problems. 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”. A great deal of energy was invested in empirical techniques to reduce chattering.

2. DESCRIPTION OF THE TEST SYSTEM

The test equipment

The system is shown in Fig.1. (details can be found in [9]). 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-5-1/8 HF-010B tip.). A linear encoder (LINIMIK MSA 320 tip.) gives the position. Velocity and acceleration are obtained by numerical derivation. Pressure sensors (Motorola MPX5999D) are set in each chamber. Because on control difficulties caused by the high nonlinearity of pneumatic systems a nonlinear control method must be applied. So we will deal with robust control and a DSP based sliding mode control was designed. The block diagram of the system is shown in Fig. 2.

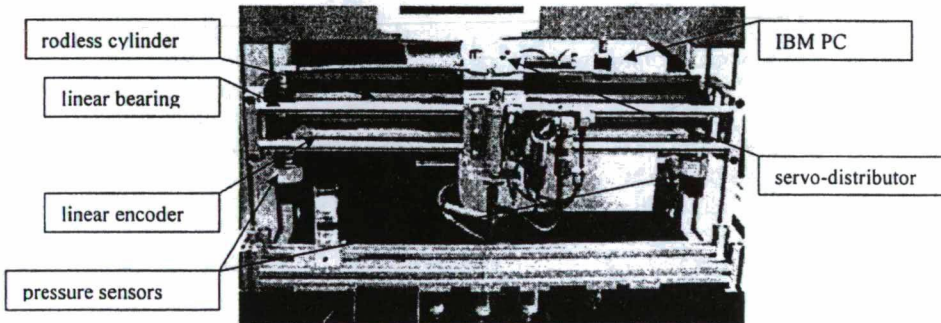


Fig. 1. The test equipment

The control system

DSPs are designed for signal processing and have hardware optimizations which are directly applicable to digital control. Some of these desirable features are short instruction cycle duration, pipelining to achieve one instruction per cycle, and one cycle hardware multipliers. With integration increasing and die sizes dropping, peripherals such as encoder interfaces, PWM generators, multiple synchronous A/Ds, and more are available on the same chip with the DSP. Other functions associated with high-end applications (and expense), such as real-time interpolated sinusoidal encoders, resolvers, and other transducers, can be done in software. This can mean that low-cost encoders/transducers may be used to produce very high resolutions.

Several DSP based controllers have been proposed within the last several years [1][2][5].

In our investigation we have used the „eZdsp™ for TMS320LF2407” DSP target board from Spectrum Digital. 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 errors. A simplified functional block diagram of the control module is shown in Fig. 3.

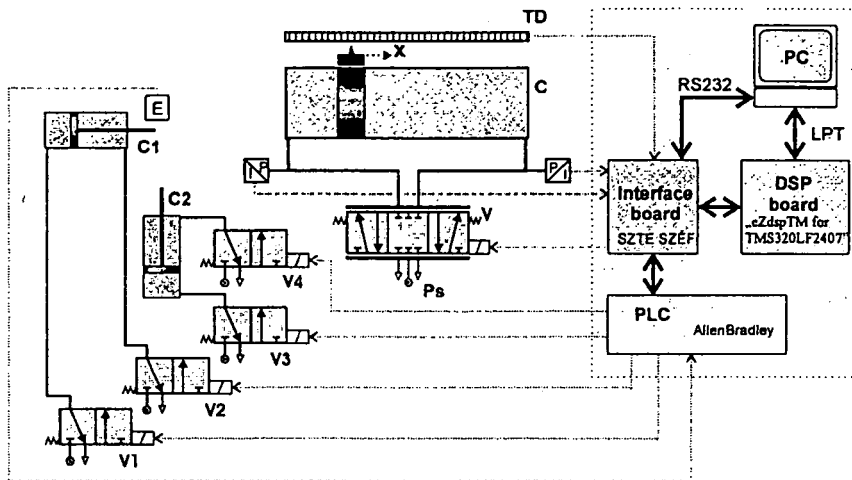


Fig. 2. The block diagram of the system

The TMS320LF2407 devices use an advanced Harvard architecture that maximizes processing power by maintaining two separate memory bus structures — program and data — for full-speed execution. This multiple bus structure allows data and instructions to be read simultaneously. Instructions support data transfers between program memory and data memory. This architecture permits coefficients that are stored in program memory to be read in RAM, thereby eliminating the need for a separate coefficient ROM. This coupled with a four-deep pipeline, allows the LF2407 devices to execute most instructions in a single cycle. See the functional block diagram of the 2407 DSP CPU for more information in Fig. 3.

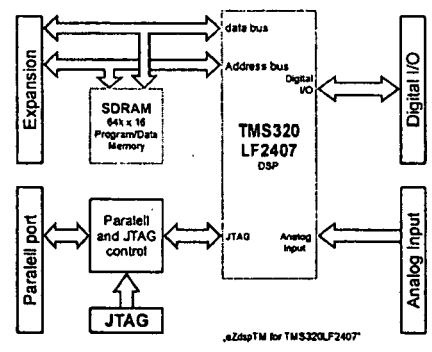


Fig. 3. Functional block diagram of the 2407 DSP CPU

Hardware Features

- ☐ TMS320LF2407 Digital Signal Processor operating at 40 Mhz from Texas Instruments
- ☐ Communications to host PC via parallel port for debug and communications
- ☐ 64K words of zero wait state memory (32K program, 32K data)
- ☐ Embedded IEEE 1149.1 JTAG scan controller
- ☐ Expansion connectors for custom user logic (data, address, I/O)
- ☐ Compatible with eZdsp wire wrap prototype card
- ☐ Compatible with DMC Motor Controllers

Software Features

- ☐ Compatible with "C2000 Code Composer" from Texas Instruments
- ☐ Compatible with SDFlash programming utility from Spectrum Digital

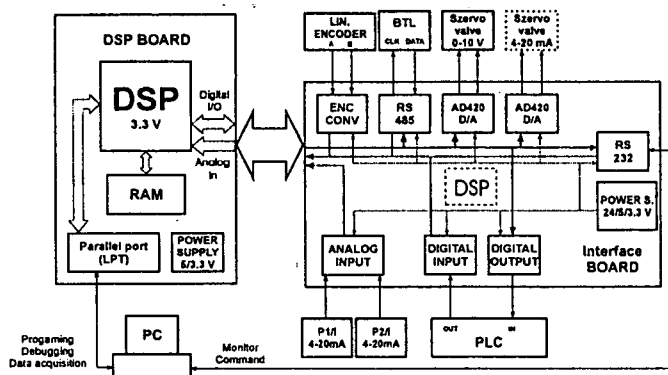


Fig. 4. „eZdsp™ for TMS320LF2407” DSP target board and Interface board

In order to analyze the positioning methods a real-time data acquisition program was designed for a PC to capture the system output data through the communication interface between the PC and the DSP controller. The control program is in the DSP program memory. So the DSP controller can operate independently. In our experiments, we use D/A channel for control and incremental encoder channel for position measurements.

For flexibility, the design includes an extra interface board to fit I/O ports, to support both of the two main types of position encoder and providing two analog outputs for the servovalves and serial communications link to a host computer (Fig. 4.). In this application, the second board can be plugged. The two boards contain a DSP controller TMS320LF240 and its oscillator, a JTAG and an RS232 link and the necessary inputs and outputs.

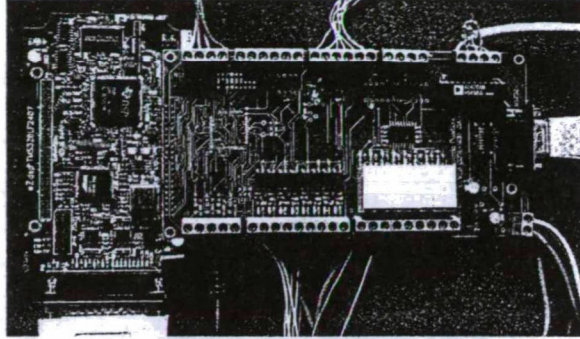


Fig. 5. Top View of „eZdsp™ for TMS320LF2407” DSP target board and Interface board

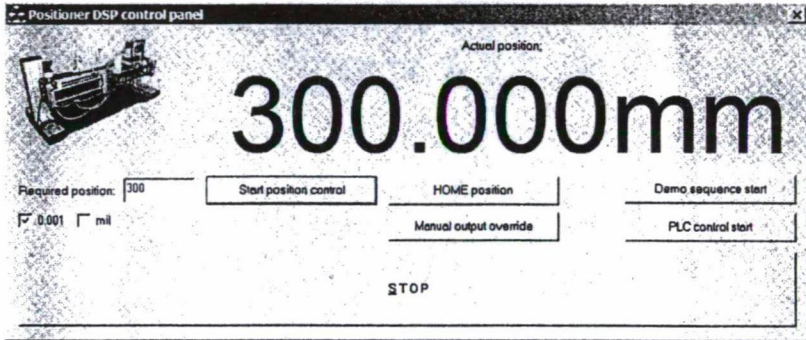


Fig. 6. The controller operating window

and it is robust to variations of system parameters and external disturbances, and they do not require accurate modeling. Further works we have done with applying the BTL5-S101 type Micropulse Linear Transducer with 1 μm resolution from Balluff.

3. EXPERIMENTAL RESULT

Based on the laboratory measurements we can conclude that the DSP based sliding mode controllers suitable and effective for the position control. The steady-state position error is within ± 0.01 mm (Fig.4.). The robustness of the proposed SMC is also tested on the vertical position cylinder with mass load disturbances.

The experimental results indicate that the proposed sliding mode controller gives also fast response, good transient performance and it is robust to variations of system parameters and external disturbances, and they do not require accurate modeling.

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DIFFERENT METHODS FOR DETERMINING KERNEL HARDNESS

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SUMMARY

Kernel hardness is one of the most important characteristic. In our investigation we used two methods to measuring kernel hardness. The dynamic method was Perten Single Kernel Characterization System (SKCS) 4100 device, the static test was the Lloyd 1000 R Material Testing Machines. The aim of this research was the investigation of the kernel hardness and our aim to compare these two methods.

INTRODUCTION

The kernel hardness is a genetic factor (well inherited factor). It determines conditioning parameters, flour yield, quality, starch damage, water absorption capacity etc. Kernel hardness controls by friabilin protein and it depends on the relation between protein matrix and starch granules. The friabilin presents in high concentration in soft grain varieties and low concentration in hard grain varieties (Békési, 2001). The flour which is made from hard winter wheat varieties are better than the flour which is made from soft winter wheat varieties. Such indicators are flour yield and flour particle size since the adhesion between the starch granules and proteins of hard varieties is so strong in the milling process that starch granules fragment rather than get released from the protein matrix as they do in soft wheat varieties.

OBJECTIVES

The aim of this research was the investigation of the kernel hardness. We use two methods (Perten SKCS 4100 and Lloyd 1000 R) and the aim is to demonstrate the relationship among these results. The aim is to demonstrate a dynamic and a static test. The endospermium structure was examined by mechanical breaking force. We used Hungarian varieties of Szegedi Gabonatermesztési Kutató Kht. (Cereal Research NPC, Szeged) as samples. There were six soft grain varieties and six hard grain varieties, which were labeled with code number.

MEASUREMENT METHODS

The Perten SKCS 4100 instrument (figure 1.) can test 300 kernels in 3 minutes on the average and report the following data: kernel hardness (hardness index, %), moisture, thousand kernel weight and kernel size.

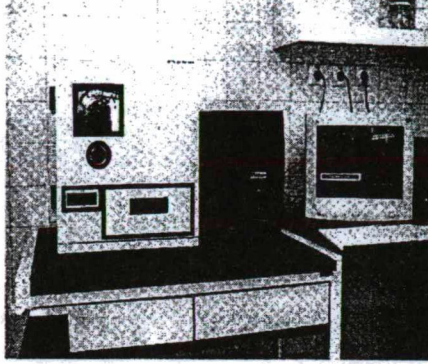


Figure 1. Perten SKCS 4100 instrument

LLOYD 1000 R Material Testing Machines (figure 2.): We scraped the grain, the surface on the side of the beard and the germ and this machine presses the kernels with the compressor head of Lloyd 1000 R testing machine of 1000 N force, and by reading the force – displacement curve (figure 3.). From this graph we read the breaking force, the incline and the break work. We examine the grain in standing position.

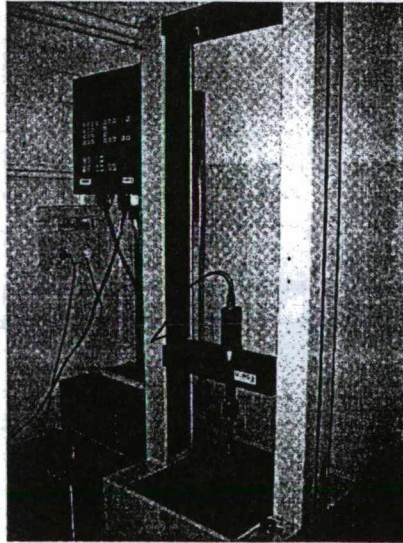


Figure 2. LLOYD 1000R Material Testing Machines

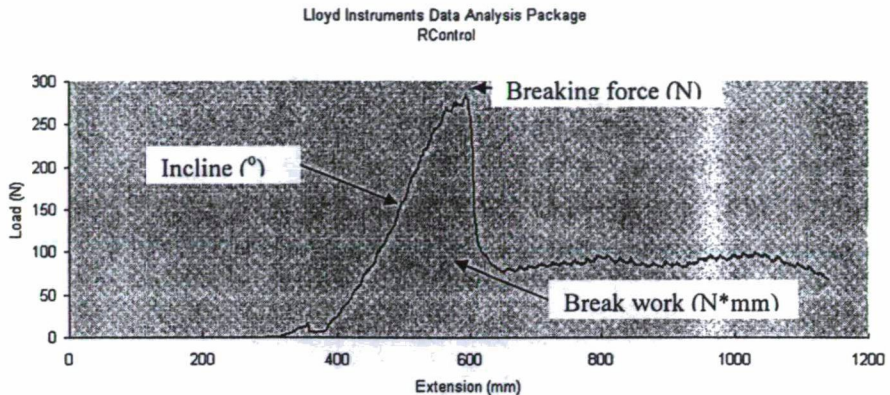


Figure 3. Load (N) – extension (mm) graph

RESULTS

The results of Perten SKCS 4100 and Lloyd 1000 R (table 1.).

Table 1. Test results

Code:	Incline (°):	Breaking force (N):	Break work (N*mm):	SKCS 4100 (HI):	Hardness grade:
311	50.93	246.84	28.98	39	S O F T
320	56.15	288.60	33.25	40	
321	55.88	293.39	33.12	24	
322	52.70	285.85	35.65	45	
325	49.00	268.13	33.42	46	
331	47.71	246.21	29.58	38	
374	59.58	365.18	52.40	71	H A R D
376	60.34	407.88	61.81	72	
378	60.21	400.98	62.19	85	
379	62.24	421.97	61.91	77	
389	53.79	312.45	44.78	80	
307	61.79	394.79	61.43	91	

We use twin correlation to determine the relationship among the results. The SKCS 4100 compartmentalize the results in two groups. Under 50 is soft grain (the hardness index was between 24-46). Above 50 is hard grain (the hardness index was between 71-91). The correlation between hardness index and the static test was significant ($r=0,7-0,9$), for example: hardness index – breaking force $r=0,829$ (figure 4.); hardness index – break work $r=0,902$. As a result, the Lloyd 1000 R machine can sort the winter wheat in two groups (soft, hard).

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THE INFLUENCE OF THE TECHNOLOGICAL PARAMETERS ABOUT THE MECHANICAL CHARACTERISTICS OF THE PIECES OBTAINED THROUGH DIE-FORGING IN SEMI-LIQUID STATE

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ABSTRACT

The aim of the metallurgic and metallic materials processing industry consists in developing and reaching of some new materials, with improved properties and performances, low costs and finding of some new processing methods, mixed or non-conventional, to allowed producing of some parts having high mechanical characteristics at a low price. A relative new method within the forming technologies that fulfill these aims is the die-forging of the semi-liquid materials, also called thixo-die-forging. The paper shows some particularities of the die-forging in semi-liquid state of the metallic materials, points out the advantages of using this process for producing the pieces and accomplished a study looking the influence of the technological parameters of the process about the mechanical characteristics of the pieces (tensile strength, elongation and Brinell hardness).

KEYWORDS

semi-liquid state, die-forging, technological parameters, mechanical characteristics

1. INTRODUCTION

The aim of the metallurgic and metallic materials processing industry consists in developing and reaching of some new materials, with improved properties and performances, low costs and finding of some new processing methods, mixed or non-conventional, to allowed producing of some parts having high mechanical characteristics at a low price.

CIOATĂ Vasile George - KISS Imre - MIKLOS Imre Zsolt:
**THE INFLUENCE OF THE TECHNOLOGICAL PARAMETERS ABOUT
THE MECHANICAL CHARACTERISTICS OF THE PIECES
OBTAINED THROUGH DIE-FORGING IN SEMI-LIQUID STATE**

A relative new method within the forming technologies that fulfill these aims is the die-forging of the semi-liquid materials, also called *thixo-die-forging*. The expression *thixo* comes from the word *thixotropy*, expression used by H. Freundlich in 1935, in order to define the property of the solutions and suspensions to gel formation when being in latent state and to become fluid when being stirred. The phenomenon is a reversible isothermal transformation, the denomination coming from the Greek word *tixis* – touch, contact and *tropos* – change, modification. So, the thixotropy means the capacity of modifying the body by contact, respectively by external mechanical influences: shocks, vibrations, stirring, shaking, etc.^[1]

The basic principle of die forging in semi-liquid state is to produce parts within the solidification range of the alloy. Within this range, a part of the material is already liquid, while other parts are totally solid. In order to have a thixotropic behavior, the solid phase has to be made of spherical (globular) particles covered in liquid phase.

FIGURE 1 presents a model of the semi-liquid die-forging, where the processing stages are pointed out: elaboration of alloy (a); alimentation of the mold with alloy and the mechanical agitation through vibrations (b); the forming in presence of the vibrations (c); product resulted out of the processing (d).

The processing of the metals and metallic alloys in semi-liquid state offers many advantages as comparing to the conventional processing methods (casting in liquid state and forging, die-forging, stamping in solid state), advantages that come out of the behavior and characteristics of the materials in semi-liquid state. So, due to the heat content, lower than that of the liquid metal, high processing speeds can be applied, the wear of the deformation tools being lower. The presence of the solid during the filling of the die and the controllable viscosity, that is higher than that of the liquid metals, makes possible to reach parts with low blister cavities, with low macro and micro-segregation and with a fine micro-granulation structure. The gas captation is also low, and the parts have an excellent surface quality. The materials in semi-liquid state have lower flow resistance than the material in solid state, which is why parts having complicated configuration and thin walls can be produced. The energetic consumption is lowered by approximate 35...40% as comparing to the conventional processing methods because of the heating at temperatures within the liquidus range and of the low deformation strains.

2. EXPERIMENTAL EQUIPMENT

Some experiments for determine the influences of the technological parameters upon the mechanical characteristics of the used-up alloys in building machines area, obtained through die-forging in semi-liquid state, are effectuated. The experimental equipment is presented in FIGURE 2.^[3]

This is composed by a die and a press die (B), a device for production of mechanical vibrations (C), assembled on the die's basic plate. For the measurement of the temperature in the processed piece (and in the die's walls) are used the equipment D, consisted in one thermocouples T, the module of acquisition AD, the converter CT and the computer PC.

The deformation's pressure is determined using the equipments E, composed by the electronic transducer of pressure TPE, the alimentation source, the converter SCCP and the tachograph IN. These entire modules are assembled on a hydraulic press with a special construction (A).

3. EXPERIMENTAL RESULTS

I effectuate a theoretical analysis regarding the influences of the technological parameters upon the mechanical characteristics of the pieces obtained through die-forging in semi-liquid state.^[4] The technological parameters which have a major influence upon these features are: the pressure of deformation (or the force of deformation F_d), the temperature of processing (T_p), the vibrations frequency (f) and the die's preheating temperature (T_{OM}).

For the study of these influences of the main parameters upon the mechanical characteristics, I effectuate some experiments that consist in obtain of a cylindrical full pieces from aluminum alloy (AlSi7Mg0.38), in various processing conditions.

Before of the casting, the alloy temperature is between 630...650°C. The die and the press die are lubricated with a lubricating mixture's layer.

For the resulted pieces, I determine the following mechanical characteristics: the tensile strength R_m [N/mm²], the elongation A [%] and the Brinell hardness HBS. The results are presented in the diagrams (FIGURE 3).

The influences of the deformation's forces and the processing temperature upon the main mechanical characteristics in the diagrams of the figure 3 are presented.

Such as observed in FIGURE 3.a., the tensile strength increase significant with increases of the forces of deformation. The increase of the temperature of processing cause next behavior of tensile strength: in the domain of low forces of deformation (<4000 daN) an easy-increase of the tensile strength, in the domain of medium forces (8000 daN) influence is negligible, and in the domain of great forces (>11780 daN) an easy decrease of this characteristics.

The elongation (FIGURE 3.b.) presents same behavior as the tensile strength, and the hardness (FIGURE 3.c.) increase with increasing temperature of processing and force of deformation.

In FIGURE 4 are presented the mechanical characteristics of pieces obtained to different preheating temperature of the die, in the next conditions of processing: $F_d=4000$ daN, $T_p=565^\circ\text{C}$, $f=500$ s⁻¹. The influence of the die's preheating temperature upon the mechanical characteristics is insignificant.

Thus, in condition of the duplicated values of the deformation's forces, depending on the processing temperature and the vibration's frequency, the tensile strength scale up by 3.5...5.0 %, the hardness HBS scale up by 4...10%, and elongation with 15...20%.

Also, at the duplicated values of the vibration's frequency, the tensile strength scale up by 1...2%, the hardness HBS scale up by 2.1...3.0% and elongation with 8...10%.

Based on these results I can conclude that the technological parameters have an influence upon the mechanical characteristics of the pieces in the follow ascending order: the deformation's force, the vibration's frequency, the processing temperature and the preheating temperature of the die.

In the comparing with casting in the metallic die, the pieces have, in the all the situations, better mechanical characteristics (FIGURE 5).

The improvement of the mechanical characteristics of pieces obtained through die-forging in semi-liquid state is explained with the microstructures presented in FIGURE 6. Thus, I observe as through die-forging in semi-liquid state obtained the microstructures with a spheroid solid solution α covered in eutectic, dense and compact (FIGURE 6.b.), that determine the better mechanical characteristics, in compare with the dendrite microstructure obtained through casting in the metallic die (FIGURE 6.a.).

4. CONCLUSIONS

The experimental researches concerning the mechanical characteristics of pieces obtained through die-forging in the semi-liquid state permit to draw the following conclusion: the mechanical characteristics of pieces increase sensitive with increase the force of deformation and frequency of the vibrations. This thing is explained through obtaining the structures extremely fine and improvement the toughness of wall of the piece, therefore increase density and the defects absence of structure, that form discontinuities in metallic mass or primers for propagate the fissures.

The pieces, obtained from aluminum alloy AlSi7Mg0.38 through die-forging in the semi-liquid state, presented, comparing with similar pieces obtained through casting in the metallic die, a tensile strength with 2.8...13.4% elder, a Brinell hardness with 4.8...30% elder and an elongation with 7.6...50% elder.

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FIGURES

FIGURE 1. THE MODEL OF THE DIE-FORGING IN SEMI-LIQUID STATE [2]

FIGURE 2. THE EXPERIMENTAL EQUIPMENT'S SCHEME FOR THE STUDY OF DIE-FORGING IN SEMI-LIQUID STATE

FIGURE 3. THE PROCESSING TEMPERATURE'S INFLUENCE UPON THE MECHANICAL CHARACTERISTICS (IN THE CONDITIONS: $f=500\text{ s}^{-1}$)
a., b., c.

FIGURE 4. THE INFLUENCE OF THE DIE'S PREHEATING TEMPERATURE UPON THE MECHANICAL CHARACTERISTICS ($F_d=4000\text{ daN}$, $T_p=565^\circ\text{C}$, $F=500\text{ s}^{-1}$)

FIGURE 5. THE IMPROVEMENT OF THE MECHANICAL CHARACTERISTICS OF PIECES OBTAINED THROUGH DIE-FORGING IN SEMI-LIQUID STATE, COMPARISON WITH THE PIECES OBTAINED THROUGH CASTING IN THE METALLIC DIE:

Die-Forging Min. - Processing in the Conditions: $T_p=560^\circ\text{C}$, $F_d=4000\text{ daN}$, $f=500\text{ s}^{-1}$
Die-Forging Max. - Processing in the Conditions: $T_p=560^\circ\text{C}$, $F_d=11780\text{ daN}$, $f=2500\text{ s}^{-1}$

FIGURE 6. MICROSTRUCTURES OF THE AlSi7Mg0.38 ALLOY:
a - THROUGH CASTING IN METALLIC DIE;
b - THROUGH DIE-FORGING IN THE SEMI-LIQUID STATE

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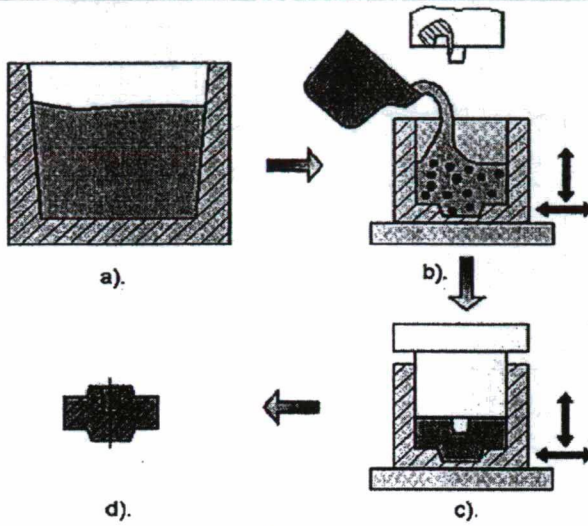


Figure 1.

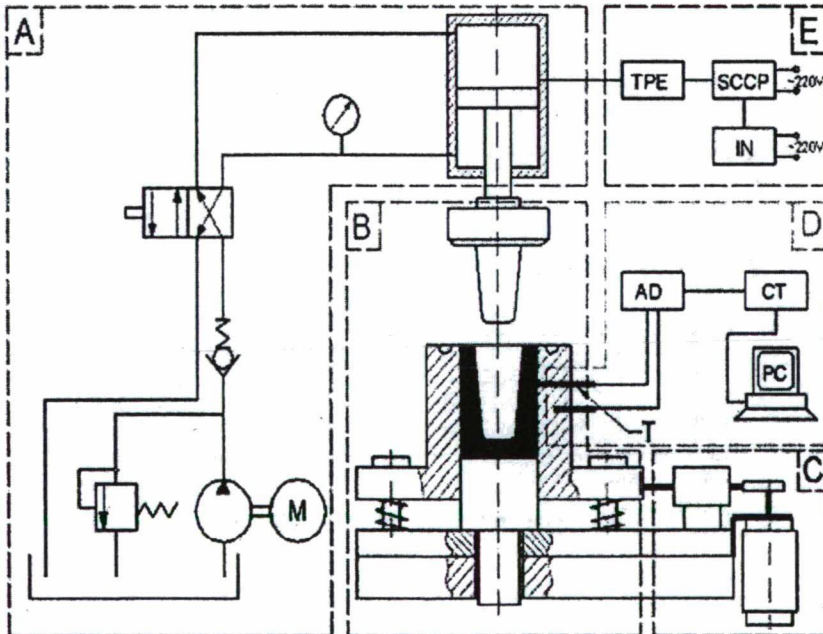


Figure 2.

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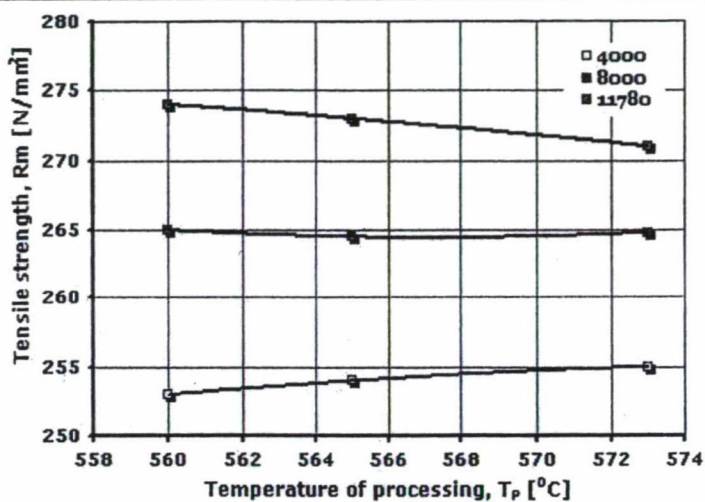


Figure 3/a

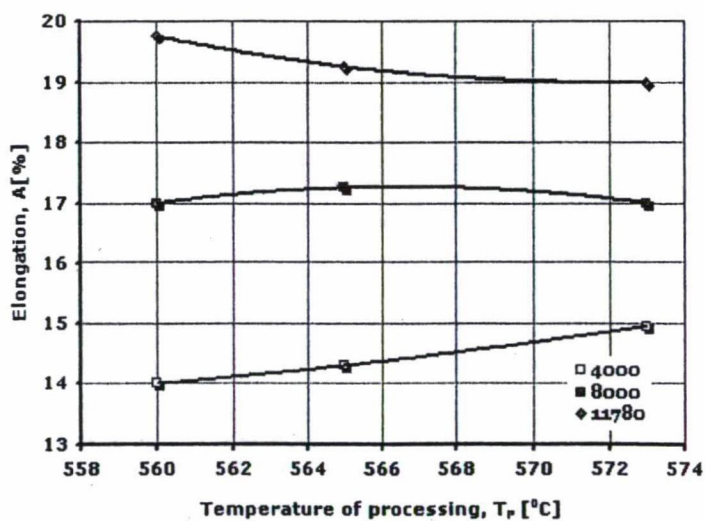


Figure 3/b

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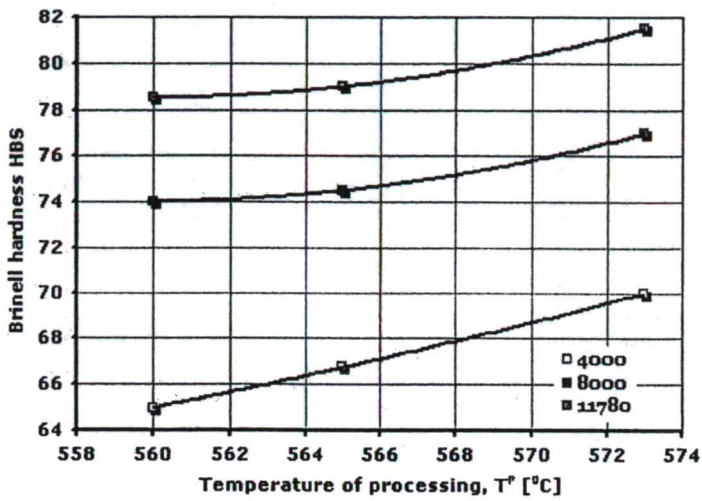


Figure 3/c

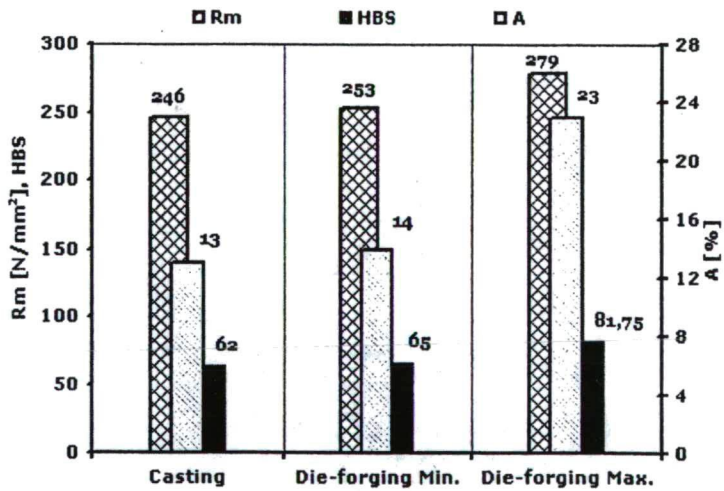


Figure 4.

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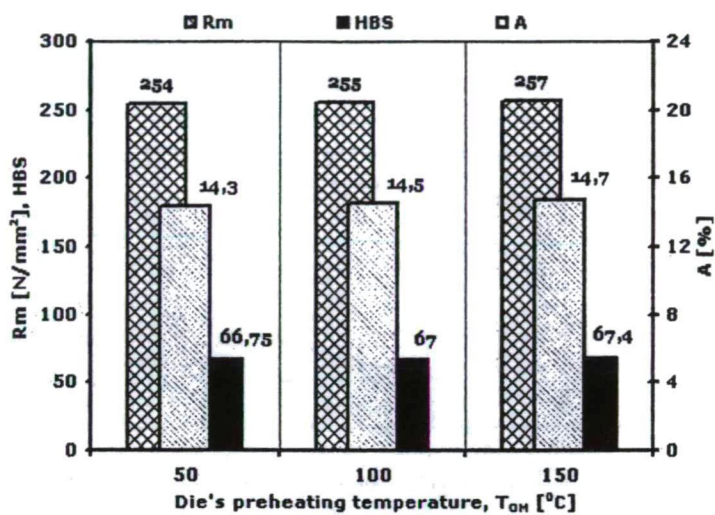


Figure 5.



Figure 6/a

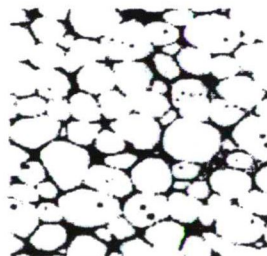


Figure 6/b

APPLICATION OF AN ULTRASOUND TECHNIQUE IN THE MECHANICAL WASHING OF PLASTIC BOXES AND CRATES IN THE FOOD INDUSTRY

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1. INTRODUCTION

The food industry uses a large amount of plastic cases, boxes and containers for transportation within and outside of the company. These contain strong bounded dried, bloody and fatty contaminations. Their removing is difficult especially in case of complicated surfaces. The traditional washing machines equipped with high pressure nozzles are not able to remove the contaminations from places situated in shaded areas (ribs, holes, and corners). It can not be accepted in case of tools having direct contact with foods. Therefore we investigated the introduction of ultrasonic procedure for cleaning of objects having complicated surfaces.

2. LITERATURE REVIEW

2.1. Fundamentals of industrial cleaning

In the food industry can be found biological, non wetting and surface adhering contaminants first of all. Different cleaning technologies, using a combination of mechanical chemical and solving effects, are applied for removing them. The solving of the contamination is an important task in the course of cleaning. The formerly properly quelled and peptised contamination can be removed more easily. It is made by mechanical scrubbing or washing solution high pressure streaming out from nozzles traditionally. Another task is the disinfection for destroying the harmful microbes. These operations are influenced by different physical and chemical characteristics.

- Treating time
- Temperature of the detergent,
- Chemical composition of the detergent,
- Concentration of the detergent,
- Form and impulse power of the protruding fluid flow.

The efficiency of the operations can be significantly improved by proper choosing the values of the above mentioned factors (1, 15).

2.2. Mechanical cleaning of cases boxes and containers

The sophisticated and efficient mechanical cleaning has to be consisted of the following operation steps in case of strong adhered biological contamination:

- pre-soaking, pre-washing,
- intensive washing,

- rinsing and disinfection,
- rinsing,
- drying.

These phases are separated within the applied machines and have an individual fluid treating and transportation systems. A transporting device conveys the objects through the phases of cleaning in case of continuous cleaning in large scale factory. Their configurations are passed to the object to be cleaned, their length and moving speed depends on the measure of the contamination and the washing capacity (2,3,4,5).

The literature survey and the practical experience showed that there are several deficiencies of the procedures and equipments used till today and in case of most modern solutions as well. The pre-washing and pre-soaking phase is missing or too short generally. Most of the contaminations are not slacked in this way. Shaded areas are always remaining for the cleaning. Further practical deficiency is that the applied solving reagent is not suitable for the art of the contamination, making the technology inefficient (6,7,8).

3. THE AIM OF THE INVESTIGATION

We have tried to demonstrate with comparative tests that the efficiency of the cleaning of the strongly adhered and dried biological contamination can be improved if the pre-soaking washing and ultrasonic treatment are combined.

To determine the most important operation parameters (time and temperature) by which the combined cleaning procedure gives satisfactory success on the base of the experimental results.

4. MATERIALS AND METHODS

4.1. The effect of the ultrasound in the fluid

The ultrasound is a mechanical oscillation for which the laws of acoustics are valid. Its more important physical parameters:

- high frequency range (20 kHz-1000 MHz),
- low wavelength,
- The transmitted waves stepping out from the resonator (electromagnetic transformers) can be directed,
- It can be created with high intensity.

The acoustic oscillation transmitted with high intensity causes detectable changes in the fluids. The characteristic and most important effect in the point of view of cleaning is the cavitations. The sound waves spreading in the fluid create a propagating high and low pressure periods in sequence. The fluid is disrupting in the attenuating region and numerous small bubbles are created. In the next moments, in the pressurised phase, these holes are eliminated accompanying a local shock wave having 10^5 N/m² pressure. This is the explanation of the destructing and eroding effect of the cavitations. The most advantageous frequency region of the cavitations is 18-44 kHz and the best temperature region is 55-65°C

for cleaning. The erosion due to the cavitations can be intensify if the fluid is a properly chosen cleaning solution (9,10).

4.2. Model experiments for the determination of the efficiency of the ultrasound cleaning

In the course of the model experiments we have determined how the cleaning efficiency can be increased by changing the temperature and time within the definite region. We have compared the cleaning by soaking and ultrasound and their combinations.

4.2.1. Measuring the cleaning efficiency

In the course of the experiments the contamination must be reproducible. Therefore the investigated surfaces had the same type and amount of contamination, the temperature and concentration of the applied solvent had constant values. In this way the initial conditions of the solving and cleaning process remained constant. We carried out two kinds of experiments: cleaning with ultra sound and without it in the same solution. In this way the graphical and numerical comparisons could be carried out directly.

The efficiency of cleaning is the following (1):

$$\eta = \frac{m_0 - m}{m} \leq 1 \quad (1)$$

where m_0 amount of original contamination [g]
 m amount of contamination remaining after treatment [g]

These were measured in dry state with a balance having 0,01 g accuracy. The test contamination was a dried milk. It was dried onto the surface of each sample piece of containers under the same conditions.

4.2.2. Cleaning effect vs. time

Investigated material:	plastic container Dried milk on its elements
Solvent:	1 % NaOH, 65°C alkaline solution
Ultrasound equipment:	TESLA UG 160/320 TA, 20 kHz
Volume:	10 dm ³
Treatment:	50-60 sec long treatment with ultrasound and without it.
Method:	5 measurements in each treatment time. The average efficiency of 5 measurements can be found in Table 1 (η_{US} , η_S)

Table 1. Cleaning time and cleaning efficiency of ultrasound and soaking cleaning

Time t (s)	Average efficiency of ultrasound treatment (η_{US})	Average efficiency of soaking treatment (η_S)
5	0,41	-
10	0,77	0,22
25	0,86	0,53
30	0,91	0,61
35	0,90	0,63
40	0,93	0,61
50	0,92	0,63
60	0,96	0,67

The values of the table are depicted on Figure 1. The power function of $y = 1 - e^{-ax}$ is fitted on the efficiency values of soaking and ultrasound treatment [(2) and (3) equation]. The obtained correlation coefficients were 0.9170 and 0.8810 for soaking and ultrasound treatment respectively.

$$\eta_S = 1 - e^{-0,0248t} \tag{2}$$

$$\eta_{US} = 1 - e^{-0,11104t} \tag{3}$$

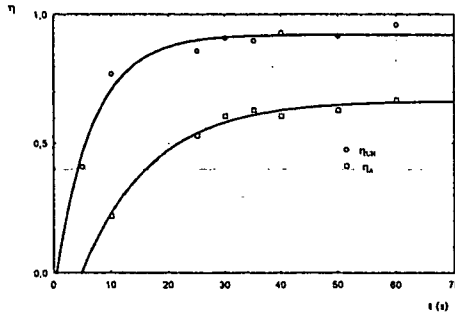


Figure 1. Efficiency of soaking and ultrasound cleaning vs. time

4.2.3. Cleaning effects in dependence of temperature

The material, solvent and investigation equipment were the same as in 4.2.2.

Treatment: Constant $t = 60$ sec treatment time and the temperature was changed between 20-65°C.

The measuring figures are shown in Table 2:

2. táblázat Cleaning temperature and cleaning efficiency

Temperature (°C) θ	Average efficiency of ultrasound treatment (η_{UH})	Average efficiency of soaking treatment (η_S)
20	0,73	0,4
30	0,78	0,4
35	0,77	0,54
40	0,79	0,53
50	0,92	0,6
60	0,88	0,66
65	0,99	0,67

The values of the table are depicted on Figure 2. A linear line ($y=a+bx$) was fitted on the figures ((4) and (5) equation). The obtained correlation coefficients were 0.9266 and 0.9563 for ultrasound and soaking cleaning respectively.

$$\eta_{US} = 0,607 + 0,005\theta \tag{4}$$

$$\eta_S = 0,263 + 0,007\theta \tag{5}$$

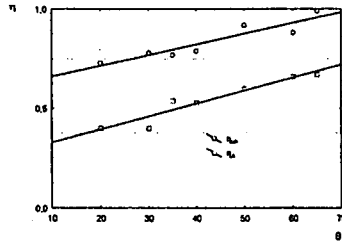


Figure 2. Efficiency of soaking and ultrasound cleaning vs. temperature

4.2.4. Cleaning operation in two stage

In this experiment we investigated how develop the cleaning efficiency in dependence on time if we soaking cleaning was combined with ultrasound after a definite time. Similar to the earlier experiments the soaking was carried out in solvents of 1% NaOH at 60°C and for 30 s, and then the solvents was treated with 20 kHz ultrasound for 30 s. The efficiencies shown in Table 3 were calculated from 5 measurements:

Table 3. Efficiency of soaking and combined cleaning

	t_s (s)			t_{comb} (s)				
	10	20	30	35	40	50	60	
η_S	0,32	0,57	0,59	0,72	0,85	0,87	0,93	η_{UScomb}

The values of the table are depicted on Figure 3 showing the change of the efficiency in the course of time. On the Figure 4 we show the data of Figure 1 and the data of combined treatment shown Figure 3.

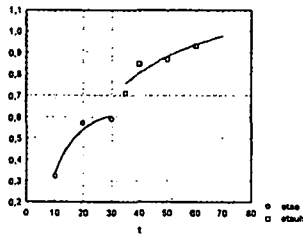


Figure 3. Efficiency of soaking and ultrasound cleaning (30s soaking and 30s ultrasound)

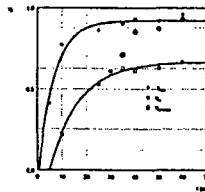


Figure 4. Comparison of figure 1 and figure 3

5. DISCUSSIONS

In the cleaning operation, involving physical and chemical processes and diffusion phenomenon as well, the time and temperature play a significant role (11., 12., 13.,14.).

The first experiment series showed that the cleaning efficiency changes in time as an exponential function approximating 1. The efficiency of cleaning changes only slightly after a definite time (Figure 1). Therefore the treatment time must be limited to a high efficiency accompanying reasonable running costs.

The second experiment series showed that the efficiency of the soaking and ultrasound cleaning increased linearly with increasing temperature of solvent. The advantageous temperature region of the ultrasound and the soaking cleaning and solving effect of the solvent falls into the same region (55-65°C) (Figure 2).

It can be seen from the third experiment series that similar high cleaning efficiency can be reached when the soaking cleaning is combined with the ultrasound after the half of the operation time (30s).

6. CONCLUSIONS

Summarising the results of the experiments it can be stated:

- The efficiency of the cleaning showed an exponential curves approximating a maximum value if we consider the solvent property and concentration as constant and holding the time and temperature within a definite limits.
- The strongly adhering contamination, e.g. dried milk, can be removed from the plastic material in a measure of 90% applying low concentration of solvent (1% NaOH) and ultrasound for 50-60 s.
- The results of cleaning in two stages gave useful information for transferring the results into the industrial application. The time of the intensive cleaning operation demanding high energy usage can be reduced by the properly chosen soaking cycle significantly.

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SLIDING MODE CONTROL IN PNEUMATIC POSITIONING

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ABSTRACT

This paper deals with one of the challenging problems in the field of robot control, namely how to make a pneumatic driven robot manipulator to move as fast as possible without violating the accuracy requirements. The main contribution of this paper is a design of a robust sliding mode controller implemented on a DSP system.

Keywords: Sliding mode control, DSP, chattering, pneumatic system

1. INTRODUCTION

As an important driving 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. The most widely used controller is still the PID (Proportional, Integral, Derivative) controller because of its simplicity and ease of implementation, but it isn't good for nonlinear systems with parameters and load variations. The pneumatic servo-system is a very nonlinear time-variant control system because of the compressibility of air, the friction force between the piston and the cylinder, air mass flow rate through the servo-valve, etc. Because of control difficulties, caused by the high nonlinearity of pneumatic systems, a robust control method must be applied. There are two main classical directions in the field of robust control. One is the H infinite control for linear systems, and the other is the sliding mode control for nonlinear systems. Another solution is to employ the advanced nonlinear control strategies developed in recent years (soft computing) [10][11].

Sliding mode control was introduced in the late 1970's [1][2] 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 [3]. These initial works were followed by a large number of research papers in robotic manipulator control [4], in motor drive control and power electronics [5]. 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 behavior which was predicted by the theory [6]. 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 [7][8], 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 [9].

2. DESIGN OF A SLIDING MODE CONTROLLER

A good introduction into sliding mode control can be found in [13][14]. The design of a sliding mode controller consists of three main steps. One is the design of the sliding surface, the second step 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 and a different gain if the trajectory drops „below” the surface.

To introduce the idea of sliding mode control we can consider a single-input, single-output second-order nonlinear dynamic system:

$$\begin{aligned} \ddot{x} &= f(\dot{x}, x) + G(x) \cdot u \\ y(t) &= x(t) \end{aligned} \tag{1}$$

Where x is the state variable, y is the output signal (position) of the controlled plant, u is the control signal and G is gain of control signal. If x_d denotes the reference state trajectory, then the error between the reference and system states may be defined as $e = x_d - x$. Let $s(\dot{e}, e) = 0$ define the „sliding surface” in the space of the error state. The purpose of sliding mode control law is to force error vector e approach the sliding surface and then move along the sliding surface to the origin (Fig.1) (where ① denotes the approaching phase, ② denotes the sliding phase and ③ denotes the chattering).

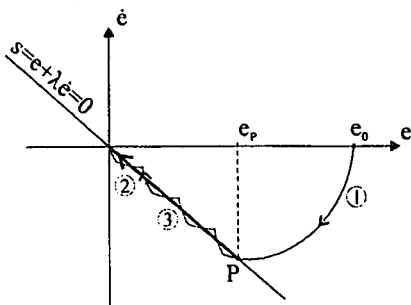


Fig. 1 Sliding motion in the state space

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 $s(\dot{e}, e) = 0$.

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

$$s(\dot{e}, e) \cdot \dot{s}(\dot{e}, e) < 0. \tag{2}$$

This means that e will always go toward the sliding surface. In classical method of sliding mode control the scalar variable is calculated as a linear combination of the error and its derivative.

$$s = e + \lambda \cdot \dot{e} \qquad \dot{s} = \dot{e} + \lambda \cdot \ddot{e} \tag{3}$$

Where λ is a time constant type parameter. The simplest control law that might lead to sliding mode is the relay.

$$u = \delta \cdot \text{sign}(s) \tag{4}$$

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

$$u = \hat{u}_{eq} + \delta \cdot \text{sign}(s). \tag{5}$$

The role of the discontinuous term in the control law is to hide the effect of the uncertain perturbations and bounded disturbance. The more knowledge is implied in the control law, the smaller discontinuous term is necessary. Usually, all state variables are not measurable, the system parameters are not known and the unmodeled dynamics may cause chattering.

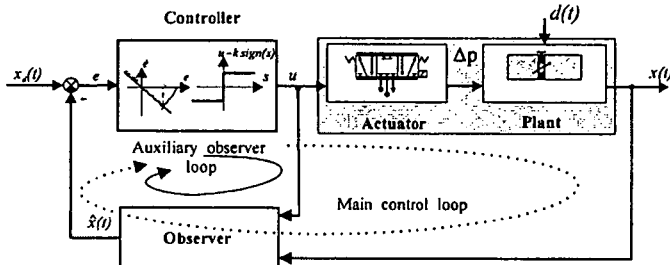


Fig. 2 Observer-based solution

The most commonly cited approach to reduce the effects of chattering has been the so called boundary layer control. The discontinuous control law is replaced by a saturation function which approximates the $\text{sign}(s)$ term in a boundary layer of the sliding manifold $s(t)=0$.

To solve the chattering problem, another solution is the asymptotic state observer. An asymptotic observer can eliminate chattering despite discontinuous control laws. The key idea as proposed by Bondarev et al. (1985) is to generate ideal sliding mode in an auxiliary observer loop rather than in the main control loop (Fig. 2).

3. THE SERVO-PNEUMATIC POSITIONING SYSTEM

The system is shown in Fig. 3 Fig. 4 and Fig. 5 (details can be found in [12]).

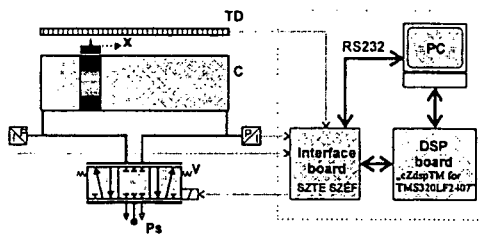


Fig. 3 Configuration of pneumatic positioning system

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-5-1/8 HF-010B 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.

Because of control difficulties caused by the high nonlinearity of pneumatic systems a nonlinear control method must be applied. So we will deal with robust control and a DSP based sliding mode control

was designed. We have used the „eZdspTM for TMS320LF2407” DSP target board from Spectrum Digital.

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 errors.

In order to design an optimal controller and predict the control performance for the pneumatic test rig, a theoretical and practical modeling of the rig is needed (Fig. 6). The equations derived are based upon Burrows.

Motion equation:

$$p_a \cdot A_a - p_b \cdot A_b - m \cdot \ddot{x} - k \cdot \dot{x} - c \cdot x - \text{sign}(\dot{x}) \cdot F_f = 0 \tag{6}$$

Pressure build-up equations:

$$\dot{p}_{apol} = \frac{n_a}{V_a} \cdot (\dot{m}_{in} \cdot R \cdot T_{in} - p_a \cdot A_a \cdot \dot{x}) \tag{7}$$

$$\dot{p}_{bpol} = \frac{n_b}{V_b} \cdot (p_b \cdot A_b \cdot \dot{x} - \dot{m}_{out} \cdot R \cdot T_b)$$

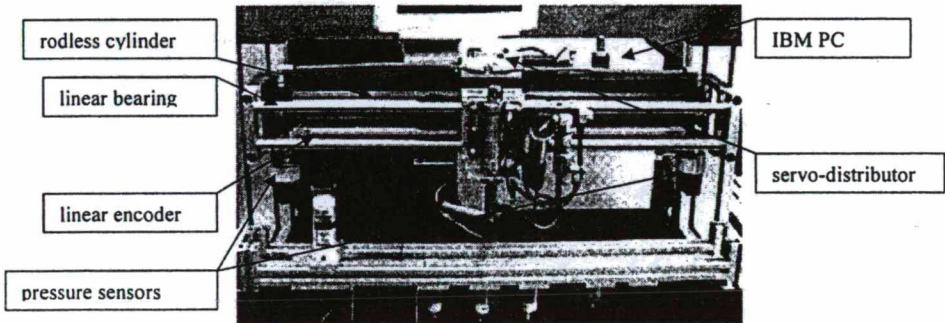


Fig. 4 The experimental positioning system

Mass flow rate equations:

$$\dot{m}_{in} = \mu_{oa} \cdot A_{oa} \cdot p_e \cdot \sqrt{\frac{2}{R \cdot T_e}} \cdot \Psi \tag{8}$$

$$p_a / p_{in} \leq 0.528 \quad \Psi = 0.484$$

$$p_a / p_{in} > 0.528$$

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

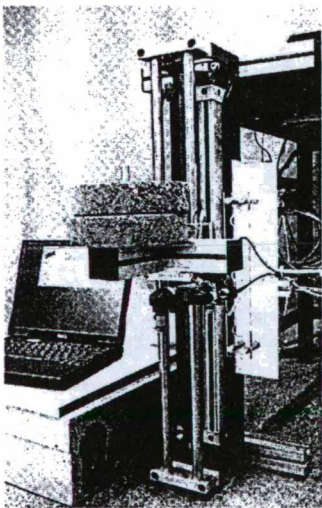


Fig. 5 Positioning with mass load disturbances

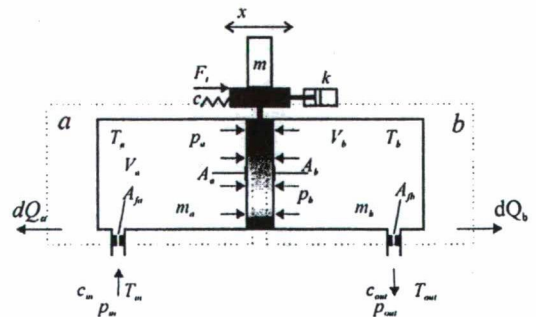


Fig. 6 Analysis model

The paper [12] utilizes MATLAB and SIMULINK in order to investigate the basic properties of pneumatic actuators.

For flexibility, the design includes an extra interface board to fit I/O ports, to support both of the two main types of position encoder and providing two analog outputs for the servo-valves and serial communications link to a host computer. In this application, the second board can be plugged.

In our experiments, we use D/A channel (Analog Devices AD420) for control and incremental encoder channel for position measurements. The two boards contain a DSP controller (TMS320LF240) and its oscillator, a JTAG and an RS232 link and the necessary inputs and outputs. The system pressure is set to be 6 bar, the sampling time is 2 ms. In order to analyze the positioning methods a real-time data acquisition program was designed for a PC to capture the system output data through the communication interface between the PC and the DSP controller. The control program is in the DSP program memory. So the DSP controller can operate independently. The DSP Starter Kit (DSK) enables the user to connect the DSP to the parallel port on a PC and download code using a DOS interface. This interface allows the programmer to step through the code on the DSP and check the values of registers and memory locations while debugging.

The control algorithm is written in "C" language, and compiled into assembly language and downloaded into the DSP board.

4. EXPERIMENTAL RESULT

First, the performance of a well tuned PID controller and SMC are compared in case of a step change in the position reference signal (Fig. 7 – Fig.8). Because of the well known stick-slip phenomenon, the steady state error is alternating with the value of 3.8 mm. The position error of the DSP based sliding mode control is within ± 0.01 mm. It is less than 1% of the steady state error of a well tuned PID controller.

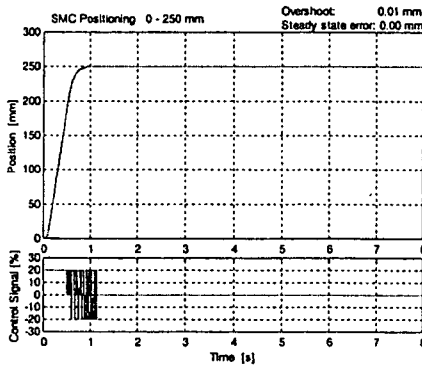


Fig.7 Positioning result with SM controller

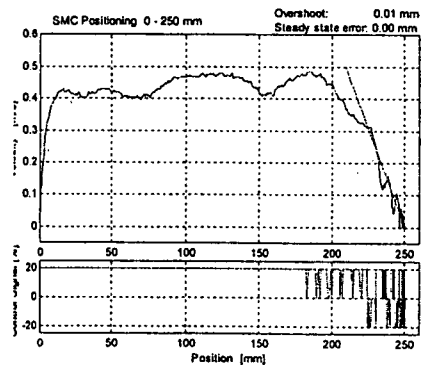


Fig.8 Phase plane trajectory with SM controller

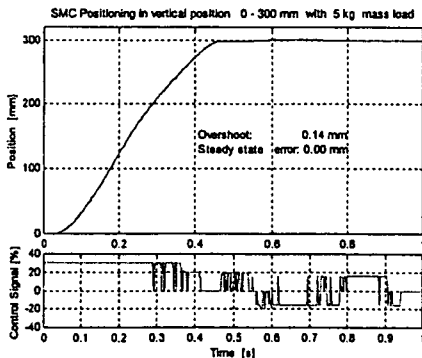


Fig. 9 Positioning result in vertical position

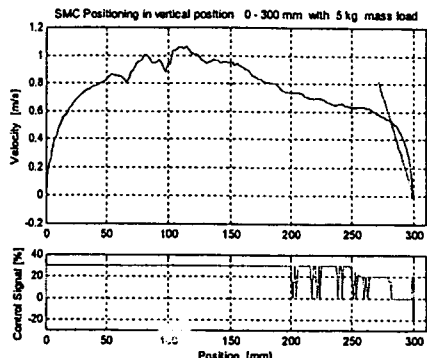


Fig. 10 Phase plane trajectory in vertical position

Since the DSP has a fast operation speed and a large memory, it can be applied in the control loop to increase the sampling frequency and the control accuracy.

The robustness of the proposed SMC is also tested on the vertical position cylinder with mass load disturbances (Fig. 9 and Fig. 10).

For the purpose of measuring the tracking error of the piston, a sinusoidal (amplitude of 200 mm) desired input position trajectory is used. The experiment is repeated for 4 different frequencies (1/30, 1/10, 1/5 and 1/2 Hz).

We can see the tracking errors are smaller (less than ± 5 mm) at low frequencies, mainly in the points where there is inversion in the direction of movement.

The experimental results indicate that the proposed sliding mode controller gives also fast response, good transient performance and it is robust to variations of system parameters and external disturbances, and they do not require accurate modeling.

Further works we have done with applying the BTL5-S101 type Micropulse Linear Transducer with 1 μ m resolution from Balluff (Fig. 11).

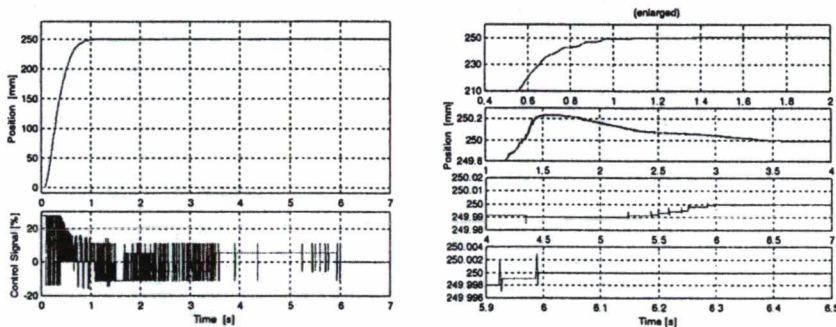


Fig. 11 Performance of the SM controller with boundary layer

5. CONCLUSIONS AND FUTURE WORK

This paper presents a brief introduction to sliding mode control theory and takes the first step toward the practical. Based on the laboratory measurements, we can conclude that the DSP based Sliding Mode Control is suitable and effective for the position control. Furthermore we interested in trying out several methods with simulation and on "real world" systems. So, further experiments were carried out to compare the simulation results with experimental results.

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MANAGING CHANGE IN HUNGARIAN HIGHER EDUCATION: KEY RISKS AND THEIR HANDLING

Gabriella KECZER

SUMMARY

Change management in case of universities should not merely involve restructuring based on centralized control, focus on business, and orientation toward profit – that would actually lead to the end of universities. If, however, we are taken aback by the difficulties associated with change and allow academic staff to set up university structure according to their preference for convenience, the institution will develop a rigid architecture and lag behind competition. Change management should involve — both centralized and decentralized — restructuring activities which encourage innovation, competition, contacts with the outside world, and appreciation for real performance.

1. INTRODUCTION

These days, no organization can achieve success without changes (Noszkay 2004, p. 4). Change has become a prerequisite in our rapidly changing world: not a single organization can survive tomorrow without implementing changes (Farkas 2004, p. 27). Institutions of higher education (IHE's) are no exception to this rule, either. The second half of the twentieth century and globalization has triggered changes that represent an unprecedented challenge and threat regarding the historically established structures maintained by universities (Barakonyi 2004b, p. 15). IHE's are inevitably forced to respond to a growing number of challenges, in other words, universities must undergo changes at a rate and speed higher than before. By the turn of the millennium, changes taking place in higher education (HE) had penetrated into Hungary as well. Expansion in mass education has created complex and large organizations that cannot be managed by old management models in Hungary either (Barakonyi 2004a, p. 584). A significantly larger number of students, an extended arrangement of administration and infrastructure brought about by development in technology have created, through mobilizing enormous financial resources, systems that are several magnitudes larger and more complex (Barakonyi 2004b, p. 64). The problems that Hungarian higher education is to face cannot be resolved within the confines of the present framework of higher education (Barakonyi 2004b, p. 22). Thus, the need for a change is motivated, on the one hand, by internal challenges prevailing in the system of Hungarian higher education. On the other hand, accession of Hungary to the European Higher Education Area in 1999 also entails, as a precondition of implementing the reforms connected to the Bologna process, comprehensive and unavoidable restructuring of Hungarian HE. Current management structures of the universities and colleges that have evolved over centuries and undergone whimsical changes generated by external circumstances based on nostalgic feelings toward periods of time before the Second World War are, as a matter of fact, incapable of elaborating and implementing global reforms (Barakonyi). Consequently, we are now in situation that is both fortunate and unfortunate as the changes are called for as a result of our own needs, on the one hand, and are also facilitated by our accession to the European Higher Education Area, on the other hand. As a result, a situation has evolved in Hungarian HE that is similar to that of a number of other areas (economy, environmental protection): on the one hand, change is motivated by external compulsion, on the other hand, it represent an internal need derived

from our own and justified interest. What is at stake relative to the strategic restructuring and the size of the task stemming from the Bologna process is something that considerably exceeds the importance of integration attempts made so far: a faulty and only superficial change in structure may push Hungarian higher education into the third line. An even more serious threat is related to the damage to the competitiveness of the country (and, hence, that of the EU), in case we cannot provide for the conditions of student mobility and employee mobility at the EU level (Barakonyi).

A restructuring of this size can be implemented successfully only if the management of change is accomplished in a professional way. One of the most important elements of the process is identification of the threats related to the proposed changes, and their possible elimination.

2. THREATS OF THE PROPOSED CHANGES

A key issue in the management of change is identification of the threats that are connected to the change. Three types of problems are distinguished in special literature:

- a) the breadth issue:
The breadth issue arises when change is performed without due attention to the relationships that hold within the system, which involves improvement of targeted process parameters but does not result in overall system efficiency.
- b) the depth issue:
The depth issue has to do with change that fails to penetrate lower layers and, hence, provide the expected results.
- c) the institutionalisation issue:
This issue may lead to failure even if a change is reasonably well elaborated in terms of breadth and depth, especially in case of revolutionary, BPR-like reforms. This source of danger emerges because not only structure affects elements, but elements also exert an impact on structure. While BPR is aimed at structure to make it affect the content of element function, changes oriented toward organizational development (OD) pertain to the content of the function of elements to make the changes taking place in them affect the structure. Since structures cannot be fixed „directly”, it is the change in the content of the function of elements that must be fixed so that changes can be preserved – this is the role of institutionalisation. (Noszkay 2004, pp. 45-47.)

It appears that the second and the third issue of the above three, and, first of all, the third one is to be considered with due respect during the proposed restructuring of Hungarian HE. The first issue may be neglected because the proposed reform has a systematic character, in other words, it is intended to change inter-related issues (training reform, management reform, financial reform) jointly and in harmony with each other.

There is a danger, however, that the changes to be made will affect only the top levels of the university, as the law does not mention changes to be made to the structure and operation of the faculties and departments. Admittedly, it would be difficult for lower levels organized according to former principles and operating in a traditional way to cooperate with a new type of top level in a uniform manner, even if benevolent intentions are presumed. That is especially true, given that such a presumption of benevolent intentions appears rather naive on account of OD and a failure to institutionalise changes, as well as the mistakes made during the elaboration of the reform and those to be possibly made in the course of implementation.

Institutionalisation of changes is especially timely in HE, as units of, and individuals at the universities characterized by Cohen and March as organized anarchies (Cohen, March, 1986) have ample opportunity to „sabotage” and reverse changes. As an example, one can think of

the extent of autonomy that university departments and instructors enjoy, in contrast with departments of a business entity, and the small scope of competence assigned to university management and administration. Departments are free to decide who they wish to employ or promote, what they wish to teach and according to what curriculum, what kind of research they wish to pursue – the scope of competence of any manager or decision-maker over them appears plainly formal. If individuals and departments do not undergo a change in their attitude and if a top level with a completely different composition, thinking, approach, and culture is imposed on the current low levels, thereby preventing changes from pertaining even the lowest level of organization and thus becoming institutionalised, then the current disturbances in operation will be impossible to eliminate, in addition, further conflicts will be encoded into the system. Available draft reforms appear to be silent about restructuring lower levels, or organizational development, training, programmes of „accustomisation”.

3. MANAGING RESISTANCE

Human body always tries to maintain equilibrium of the functions of operation, an employer would perceive a change as a moment disturbing the said equilibrium, and therefore he develops resistance to it (Farkas 2004, p. 94). Managing resistance to proposed changes is of special importance in a conservative institution such as a university.

Among other factors, the special literature lists the following reasons for resistance to change:

- misconception and lack of confidence
- different assessment of the situation by senior staff and their subordinates
- organization-related issues (threat to power or position, adherence to habits, dependence, organizational structure, etc.) (Farkas 2004, pp. 98-100),

In addition to the above, the following reasons for resistance to change can be noted with respect to Hungarian HE:

- cultural barriers (conservative institutional culture, adherence to out-dated traditions, autarchic faculty intentions, ivory tower approach)
- myths (faulty or idealistic views on autonomy, looking down on americanisation)
- management problems (weakening of central management, institutional management lacking professionalism – see below later)
- insufficient financing and lack of advanced infrastructure (Barakonyi 2004b, pp. 123-124).

According to Kotter, it is necessary to obtain the support of more than half of the employees of a company and more than 75% of its management in order to effect change successfully (Kotter 1999). As far as the situation in Hungary is concerned, support of the management of universities and the national bodies of HE (dominated by university managers) for the draft law has been obtained, at least on „paper”. This may, presumably, have been due to the fact that current rectors may automatically become chairpersons of the governing bodies. One should not, however, disregard the fact that these bodies supported the draft only with a number of reservations and conditions which was later omitted from governmental communication. Also, it can be suspected that a part of the university rectors do not consent to the attitude formulated in the law and would rather stick to the old arrangement in case they had a word in it. They are likely to implement only as much of the change as is absolutely necessary. Especially because although the rector will be appointed by the governing body in the future, he or she will have to cooperate with the deans and department heads, and a lack of their support would place the rector in between two fires or into a vacuous space.

According to my experience, the majority of university staff also disagree with drastic and mandatory changes; senates decided not to vote against the draft law as they were afraid of a political „revenge” (regarding the outcome of their submitted applications). In fact, senates

conducted fierce disputes about passing a decision on whether to support or reject the law, and rather extreme positions were articulated, in particular, with respect to restructuring university management. One of the deans did not hesitate to identify the implementation of a board type management as „imposing stupid bourgeoisie on us”. Thus, it cannot be stated at the moment that 75% of the management and half of the employees are in favour of the proposed changes.

It is exactly the control of universities that is the target of most fierce attack. The government had to consent to the largest number of compromises in this area in the course of preparing the draft law, and also that is why the Law on Higher Education had to be submitted to the Constitutional Court, which found it contradictory to fundamental law.

The relevant reasons are as follows:

- a change in status quo is against the interests of current management and termination of collegiate control leads to uncertainty in personal career
- there is a lack of knowledge regarding management
- there is a lack of knowledge regarding related practical experience
- vehement protection of out-dated principles and a low-efficiency practice motivated by the university ideal of Humboldt (Barakonyi 2004b, p. 186).

Let us turn now to a consideration of the circumstances and approaches that would allow for higher support and successful implementation of the proposed changes.

a) raising awareness to the necessity of the changes:

The need for a change is to a large extent dependent upon how urgent the problem to be resolved appears to people (Bakacsi 1996, p. 288). A major part of Hungarian university instructors do not sense a need for a change. They find that existing problems are only related to financing and state control, with teaching and research being pursued on the highest level, and structure and operation being appropriate. They like to refer to the outstanding achievement of Hungarian front-line scholars (see the rank prepared by the University of Shanghai which assigns a favourable position to the University of Szeged, attributed, however, to a large extent, to Albert Szent-Györgyi alone), while a large number of instructors have a rather medium-level output both as instructors and as researchers, and there are also many of them who would have to have lost their jobs at the university a long time ago. Their short-sightedness prevails in their sensing no trouble as long as there is no radical drop in the number of students and they can teach their customary subjects as usual, while concepts like market (of knowledge), competition, efficiency, transparency, etc. appear to them as remote, vague and often pejorative notions.

b) identification of challenges:

A part of the Hungarian university instructors have but a cursory knowledge of the Bologna process and the idea lying behind the European Higher Education Area, including the patterns rooted in Western tradition and to be followed as the basis of the reform. Although a large part of academic staff often travel abroad, they are not exempt from selective perception, just like our politicians. They also appear to ignore the challenges listed above because they do not maintain close relations with the world of work and economy. It would be illusionary to expect them to accommodate their thinking to the responses to be provided for challenges which they fail to understand.

c) thorough presentation of the efforts toward change:

Newly emerging drafts of the law on higher education, sometimes re-written almost every other day, were hard to follow even by those obliged to do so ex officio; the „plain” university instructor will face its entering into force without an idea about its content. There are some who still think – in line with the original concept – that universities will be

transformed into business enterprises where instructors will lose their status as a public servant. No wonder then that many of them talk of the devil.

d) assessing the advantages and disadvantages of change:

Most instructors have no exact idea how the changes will affect him personally, and what kind of advantages he may derive from them. They need to be informed clearly on the consequences of the planned changes for an individual, assuming the risk of having to tell bad news to some of them. It goes without saying that a comprehensive impact assessment is to be conducted by the relevant decision-makers prior to implementing a reform of such magnitude, so that a picture of the consequences of change can be obtained. To the best of my knowledge, no such impact assessment has been prepared.

e) enabling the management and the employees

Changes necessitate professional change management even in cases where less radical reforms are to be implemented in systems that are less complicated compared to HE. However, there is a risk that the proposed reform will fail, owing to a reason similar to that currently faced by Hungarian HE: lack of a professional management. While regular training of HE managers in other countries is absolutely common, the same is not even mentioned in our context. Actually, it is hard to imagine our current rectors and deans sitting at a school desk and learning management from professional managers (the stupid bourgeois), or a senior lecturer teaching management. Similarly, retraining of the instructors in line with the new training requirements would be important in order to acquire familiarity with mass training, achievements in information technology, and challenges posed by globalization. As a fearsome phenomenon, mention should be made of the fact that a part of the instructors have not taken part in any type of professional or methodological training for decades now. In addition, the constraints imposed by the law on public servants, lack of performance assessment, and characteristic institutional culture make it very hard to get rid of such personnel. Similarly, training would be necessary in order to acquire the new attitude toward employment. OD that ensures institutionalisation of the changes is simply impossible without these activities. A programme accommodating external members of the governing body, acquainting them with the operation of and actors within the institution that they will actually assume responsibility for is also indispensable. Unfortunately, there is no mention thereof in the reform concepts either.

f) convincing and authentic communication

Regrettably, a considerable part of the academic staff perceives the proposed reforms as a matter of politics and sees them as apocryphal as any other initiative coming from top level politics. One can observe that politically active instructors take positions according to their respective political bias, while the others would, for the same reason, rather keep themselves away from such issues. This is not at all beneficial for the outcome of the proposed changes. Many have emphasized for a long time now that a political consensus in training issues or, to put it differently, a common strategic platform would be desirable. That is a precondition for our experts in educational policy to ensure uniform and authentic communication of the proposed concepts, regardless of their political adherence. In the given case, however, the consensus and, therefore, authentic communication, failed to be realized. As a result, there are many who consider the Hungarian Universitas Programme as an intention of the present minister of education to erect a monument for himself, thereby questioning the authenticity of its content. This feeling is further strengthened by the forced, mandatory, and immediate implementation of these changes, notwithstanding the fact that authentic experts have opted for voluntary (albeit encouraged) and gradual implementation (see, for example, the studies prepared by the otherwise reform-advocating Barakonyi).

- g) financial promotion of change, provision of required resources
According to analysts, HE integration in Hungary, at least in terms of relevant respects pertaining to content, has failed, among other reasons, because the government did not provide for the necessary resources. Current reform efforts, too, may fail because the financial support and infrastructure necessary, first of all, for restructuring the system of training, is unavailable. Provision of appropriate financial incentives would also help increase dedication to change. As mentioned above, there have been proposals advocating voluntary implementation of the changes, backed with financial support. This idea was rejected by the government. Under these circumstances, the resources necessary to implement the changes should be provided as a minimum. An institute that has problems in making ends meet, one that has accumulated debts and faces permanent difficulties concerning infrastructure will not be an ideal place to achieve substantial changes, and will be less likely to be persuaded by reference to advantages to be derived from the changes in the long run.
- f) performance evaluation, introduction of a system of interests and incentives
Implementing a system of performance evaluation based on objective, formal assessment relying on a variety of aspects, as well as introducing a system of interests and incentives based on such assessment is extremely timely, among other things, for letting employees who perform well enjoy the benefits of change. Otherwise, those capitalizing on change will be not those who in fact deserve such benefits. As a result, those who could make the greatest efforts to implement the reforms and raise the efficiency of operation of HE may turn against changes.

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CONFLICT OF SHORT-TERM AND LONG-TERM INTERESTS RELATED TO PROJECTS CONCERNING ENVIRONMENTAL PROTECTION

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SUMMARY

An apparent contradiction is clearly observed in the area of development of regional infrastructure related to environmental protection between short-term adverse interests and the long-term interests connected to improving the quality of environment and the quality of life. Local governments in larger cities were quicker in realizing that prevention of environmental pollution offers serious advantages even in the mid-term, albeit at extra costs to be assumed in the period at hand. Those who managed to develop their regional programmes in time have made considerable progress by now, with development activities started, investment activities launched, and external funds acquired to finance the majority of implementation expenditures, thereby achieving significant savings for the population over the longer term.

As an important task, operation that follows the regional development activities should be accomplished in the most efficient way possible. As a precondition, the integrated regional system of public services and the common intra-regional tariff system should be implemented. The former is to ensure the most efficient and least expensive operation based on aspects of economies of scale, the latter is to account for a fair distribution of the public burden.

In the event of a failure to introduce the integrated regional system of public services and the common intra-regional tariff system, serious disturbance of operation, problems and tension are to be encountered between the local governments concerned, which may present a difficulty in operating the system and even make it inoperable.

INTRODUCTION

The process of catching up, including as one its major areas that of legal harmonization, commenced several years before the accession of Hungary to the European Union. Considerable lag was noted, among other areas, in environmental protection and, in particular, waste management. Without the albeit partial catching up with the said lag, we would have been left with hardly any chance of meeting the accession criteria. In the first phase, the national legal system was adapted to the requirements of the EU directives, actually, by the turn of the millennium. In order to facilitate accession, the Commission of the EU established a fund (ISPA) in its budget in 1998-1999 to support the candidate countries in their efforts to develop infrastructure mainly related to transport and environmental protection.

Based on the ISPA project entitled the „Regional Waste Management Program of Szeged”, I tried, in addition to dealing with current issues related to waste management, to analyze the tension situations and conflicts of the society which emerged sharply in the course of preparation and implementation of domestic EU programmes between short-term and long-term interests of various groups and which to date have not been solved in a favourable manner.

1. ADVERSE SHORT-TERM INTERESTS IN THE AREA OF WASTE MANAGEMENT

In the short run, the society as a whole maintains adverse interests with respect to the implementation and provision of efficient and high quality environmental services. Simply put: the establishment and long-term continuous operation of an advanced infrastructure of environmental protection is extremely costly and, in economic terms, either clearly produces losses or grants a return only over a very long term. Considerable increase in public utility fees (public service related to canalization – waste water purification – waste management) entails dramatically higher costs of living for families, as well as short-term expenditures of the country.

2. ADVANCED ENVIRONMENTAL MANAGEMENT IS A LONG-TERM INTEREST OF THE COUNTRY

2.1./ Prevention of pollution and elimination of damage

Maintaining a society which operates in a way that pollutes and destroys its environment may have unpredictable consequences that may bring with them, even in the mid-term, extra costs which by far surpass the expenses we may avoid by delaying the implementation of an advanced system of environmental protection. Notwithstanding the diverse approaches offered by special literature, all researchers appear to share the view that the costs arising in the course of elimination of environmental pollution and also recultivation are by several magnitudes higher than those connected to the prevention of pollution.

2.2./ „Unlimited” natural resources

Contamination and continuous destruction of the natural resources, including clean air, clean water, soils, forests, and seas, the natural flora and fauna of the Earth, is a global process that is clearly manifest. What has been heretofore considered as a free and „unlimited natural resource” will soon be accessible only at a constantly growing price. This will entail, in the long run, a significant and unavoidable increase in production costs as a result of global pollution-related processes whose extent is impossible to estimate at the moment. At any rate, its rate will definitely be higher than the costs of prevention of pollution and elimination of damage.

2.3./ A national interest or a European interest ?

In global terms, one can conclude that there is extreme interest in the implementation of an advanced system of environmental management that will have a favourable impact on the quality of the environment and the quality of life of the population of the regions concerned already in the short term. Member states of the European Union had realized this several decades ago, that is why they jointly elaborated one of the most advanced system of regulations and infrastructure related to environmental protection, i.e. the IPPC: Integrated Pollution Prevention and Control, which clearly stresses the importance of pollution prevention. The strict policy of the Union regarding competition under equal

terms between member states requires that the countries with recent accession to the EU establish an advanced infrastructure of environmental protection as soon as possible so as to prevent them from acquiring competitive advantage over other states through cutting back on costs pertaining to environmental protection.

Often times it may appear that we are forced by the European Union to undertake costly investment in environmental protection. Of course, primarily, environmental protection is a national priority whose neglect would entail unforeseeable damage to the country not only in terms of its national values but also in terms of the national economy as a whole. A wrong decision made today may have an unfavourable impact on the quality of life and future prospects of those living here.

2.4./ Resolving conflicts of short-term adverse interests

The stringent Hungarian legal provisions on environmental protection developed within the framework of law harmonization with the European Union have partly implemented administrative measures to eliminate conflicts resulting from adverse interests. Those concerned, including the local governments, will be forced to establish a local infrastructure of environmental protection within a foreseeable period of time, otherwise they will have to pay considerable amounts of environmental protection penalty or, more recently and in certain areas, fees related to environmental load (environmental use).

It is the responsibility of local governmental policy at the national and also local level – first of all, that of the Hungarian political parties – to resolve conflicts of short-term adverse interests and gradually, yet at the fastest possible rate, establish a technical and technological background for environmental protection in Hungary in such a way that domestic and community resources are utilized in order to allow the process to be accomplished with minimum load.

2.4./ Short-term adverse interests and project marketing

Project marketing deals with the issue of assessing the impact of various interest groups on the implementation, result, and success of a project. Viewed from the angle of a project, an interest group represents any community organized on a single basis or operating as an organization whose members share nearly identical interests with respect to the implementation of the project or the operation of an outcome thus created. Interest groups may exhibit a supportive or a hostile attitude.

Project marketing is a pro-active activity used by the investor not simply to "sell" his project, i.e., make the interest groups accept it, but also as a means promoting effective implementation of an establishment by way of making apparent the emotions and expectations of the interest groups concerning the establishment. Thus it allows the management responsible for project supervision to avoid unnecessary conflicts by satisfying reasonable and legally appropriate demands, on the one hand, and providing targeted and authentic information, on the other hand, which in turn increases readiness of the interest groups to provide support.

3. THE MARKET OF SERVICES RELATED TO ENVIRONMENTAL PROTECTION

A large number of enterprises active in the area of environmental protection came to life following the change of the regime. The large number of competitors triggered fierce price competition and many actors were forced to undertake work at costs below those actually incurring in order to survive. As a result, the market of services related to environmental protection became one of the sectors representing the largest environmental risk. Cases of considerable abuse were noted especially in one of the newest areas of the field, i.e., the treatment of hazardous wastes. There is a large number of cases which demonstrate that a free market and an unbounded price competition result in dramatic increase in environmental risks and direct environmental pollution.

An entrepreneur can realize extra profits regardless of his low prices in case he reduces transportation distances, on the one hand, and environmental protection costs, on the other hand, by depositing waste at the nearest out-of-the-way location, green belt around the city, or an illegal disposal site established in a small nearby forest („illegal dumping ground”). It goes without saying that such deeds have unpredictable social consequences and environmental damage. In summary, it can be stated that exposure of environmental protection to the law of the market leads to direct environmental pollution as a result of unreasonable price competition and globally deprives the sector of considerable resources of development.

4. THE REGIONAL WASTE MANAGEMENT PROJECT OF THE EUROPEAN UNION

The given programme is oriented toward the establishment of a safe regional waste management system that is to be accomplished completely with biogas utilization, selection and collection of recyclable wastes, treatment of wastes to be recycled for composting, and re-utilization of building and demolishing wastes. As a result, considerable decrease in environmental pollution can be achieved, with the added benefit of lower amounts of wastes to be deposited on the landfill. Costs incurring relative to the sector may be diminished through the sale of recyclable wastes, which, in turn, will lead to significant improvement in the area of cost efficiency.

The development activities within the ISPA project, with a budget of more than HUF 7 billion (28 million euros) prepared on the basis of a concept design elaborated earlier include the following:

5. COOPERATION OF LOCAL GOVERNMENTS IN THE AREA OF WASTE MANAGEMENT

Unfortunately, there are no deep-rooted traditions of regional cooperation based on volunteer participation in Hungary. The forced relations that were upheld in the earlier period automatically came to an end at the time of the change of the regime. Today, personal aversion and total lack of confidence appear largely accepted and typical in national and local politics and various forums of publicity. It is impossible to acquire community funding and assistance without regional cooperation. Therefore, an interesting phenomenon has evolved in Hungary.

Project regions have gradually emerged where real or presumed conflicts of interests, harms and even personal aversion have been temporarily put aside for the sake of making joint efforts to ensure access to support opportunities. Such cooperation activities resemble those of the period before the change of the regime in that they, too, have the character of forced relations, rather than evolve on the basis of discovering mutual benefits of regional cooperation. With the expiry of support agreements, earlier tension is expected to come to the surface again, leading to termination of cooperation and division of the assets acquired together in accordance with the relevant bargain made earlier.

5.1./ The relation between the local governments of the city and the small settlements

The relation between Szeged and the surrounding settlements is far from being ideal. Owing to the particular mechanisms of resource allocation used in the period of socialism, considerable tension had accumulated between the local government of the county seat and the smaller municipalities of the county. The county seat used to receive far more central subsidy (that was where the majority of county leaders lived). The smaller settlements around Szeged felt like being subjected to real oppression compared with the city. The same holds for the other major cities of the county.

5.2./ Setting up a consortium (33 settlements, 250 thousand inhabitants)

When the objectives and the system of criteria related to the ISPA programme were revealed, it was apparent that chances for a success were scarce without regional cooperation. The foundation of the regional programme was derived from the waste management concept for Csongrád county elaborated by the waste management service provider of Szeged, i. e., the Waste Management Public Benefit Company of Szeged. At the time of preparing the ISPA programme, the concept was modified in such a way that the earlier concept aimed at county level cooperation was reduced to cooperation of about thirty settlements because that was the size which corresponded to the population of 250,000 inhabitants as foreseen in the community directives then in force. According to calculations pertaining to economies of scale, that was the size which allowed for reduction of unit costs to an optimal level. The major difficulty encountered in this respect was to persuade the large number of local governments to join the consortium.

5.3./ Consortial Agreement

Pursuant to the Consortial Agreement, the local authorities signing the agreement agreed to cooperate in finding a mutual solution to the waste management problems faced in the region, and act jointly in order to utilize various opportunities for support. The Local Government of Szeged, a City of County Rank, is the host organization that represents the Consortium, with the public services provider of the local government, i.e., the Waste Management Public Benefit Company of Szeged, acting on its behalf.

5.4./ Equitable distribution of the public burden and local politics

At the time of drawing up the Consortial Agreement, the local governments of the surrounding settlements insisted on the agreement being free from any stipulation assigning the assumption of concrete liabilities to them. Abusing the need to cooperate, they blackmailed Szeged by stating their reluctance to sign the Consortial Agreement in case it contained any provision obliging them to effect payment. As a result, the local government of Szeged was forced to assume all costs related to the preparation of the entire development programme and also to secure own municipality resources required for implementation. This was accomplished in such a way that the local government of Szeged undertook, at the time of submitting the project documentation, to increase the fee charged for waste management public services by an annual rate of 10% above inflation, over a period of 7 years from 2000, and use the extra revenue thus derived to finance the required own resources of the local government as well as the extra costs of operation to be assumed after the investment is completed.

The given arrangement offers considerable benefits for Szeged, as the amount of own resources will be considerably lower than 10% at the time of completion, and the city of Szeged will receive in exchange the ownership rights of the whole public service assets created in the course of development. As far as operation is concerned, however, significant tension is expected to emerge. The other settlements of the Consortium, of course, did not increase the fees for public services at a rate comparable to that of Szeged, the actual rates were commensurate with the rate of inflation as a maximum. Therefore, the rates collected at present in Szeged amount to nearly double the rate of the rest of the region.

During the period of investment and with the given shaping of ownership relations, this difference does not represent a problem. In the period following implementation, that is, the period of operation, on the other hand, the rates collected for public services in Szeged clearly cannot be expected to cover the higher costs of the regional waste management system alone.

6. LONG-TERM COOPERATION

6.1/ Operation of the facilities created within the project

The facilities created within the project will become property of Szeged, a City of County Rank, their operation will be task of the waste management service provider of Szeged, the Waste Management Public Benefit Company of Szeged. While this solution will present no particular problems regarding the operation of the central facilities, disturbances may be expected in operating the network of waste-yards and waste collection islands. In the event that the planned integrated regional system of public services is implemented — which is also foreseen in the Consortial Agreement — such disturbance in operation may be negligible and a long term solution will be found for the issue of regional financing along with distribution of the public burden in proportion with the system. An important objective of the uniform system of public services is to implement a common intra-regional tariff system which represents a prerequisite for fair distribution of the public burden.

6.2./ *Integrated regional system of public services*

The scales of operation also preferred by the European Union ensure that a regional waste management system is operated with the smallest unit costs, while maintaining an acceptable level of efficiency. Based on the Consortial Agreement, chances are favourable for the establishment of the proposed integrated regional system of public services, which is aimed, among other objectives, at implementing a common intra-regional tariff system. The common tariff system is a precondition for a fair distribution of the public burden because existing disproportion prevents the population of the region from assuming public burden in a uniform and proportionate way. This objective will have to be achieved, according to a well-designed programme prepared in advance, within a period of 5 years, but in any case by not later than 2011.

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METHOD OF INDIVIDUAL SELECTION INTERVIEW

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SUMMARY

One of the most important function of human resource management is selecting employees. In present days the human resource managers are using very large scale of selections ways, for example application forms, interviews, aptitude test, personality test, assessment centres, etc. But the interview remains one of the most common and popular ways of selecting people. Even tough it has been subjected to a number of criticism.

The selection interview has different types. One of them is the individual interview, and our paper we dealing with the method of this type of interview. We examine the process of individual interview from preparing the interview to the final rating.

1. INTRODUCTION

1.1. Definition

A selection interview is an extension and development of the inevitable meeting which takes place between an employer and prospective employee (*Graham and Benet 1995*).

According to another definition a selection interview is a controlled conversation with an applicant for the job and the employer, or someone representing the employer, designed to test the suitability of the applicant for the job in question (*Cushway 1994*).

Our opinion is, that a well-conducted selection interview fulfills three functions (*Karoliny et. al. 2003*):

1. To elicit information about the candidate's motives and behaviour in order to asses personality.
2. To check the factual information the candidate has already given about himself (or herself) to examine the value and relevance of experience and qualifications.
3. To give information to the candidate about the job and company. This part of the interview is very often omitted or skimped, but it is quite essential. Selection is mutual: the employer selects the candidate, and the candidate must be given the information needed to select the employer.

1.2. Description of this paper

Selection interview can take a number of different forms. There are three types of interviewes according to the number of interviewers. (*Graham and Benet 1995; Cushway 1994; Karoliny et al. 2003; Sonnenblick et al.; 1997; Weiss 1988*):

1. **The individual interview**

One candidate and one interviewer (*Weiss 1988*).

2. **Sequential interviews**

One candidate and two or more interviewers. In this method the candidate is seen by one interviewer, then by second and then by third (rarely more). This is a series of individual interviews. Sequential interviews are useful as they can give the employer a broader picture of the candidate and they also allow the applicant to have a contact with a greater number of potential bosses and colleagues (*Torrington-Hall 1987*).

3. **Multiple interviews**

This type of interview has two forms:

A/ panel interviews: when the candidate seen by a comparatively small number of people simultaneously. The usual membership of panel is three or four.

B/ board interviews: when the candidate seen by a comparatively large number of people simultaneously. The usual membership of board is five or more.

In this paper we examine only the method of individual interview.

2. THE PROCESS OF INDIVIDUAL INTERVIEW

Our opinion is that the individual interview consists of three parts:

1. preparing for the interview
2. making the interview
3. assessment the interview.

In the next part of our paper we will investigate these parts in details:

2.1 Preparing for the interview

Before the interview the interviewer have to prepare for interview, which means the following (*Graham and Benet 1995; Cushway 1994*).

1. The interviewer has to read all necessary documentation especially the job description and the personal specification.
2. The interviewer has to take care, that written information about candidate is obtained.
3. The interviewer has compare to candidate's written statement with the job specification. So the interviewer can decide where clarification or further information is needed.
4. The interviewer has to make notes of the key questions to be asked.
5. The interviewer has to make sure that the interview will not be interrupted by visitors or telephone calls.
6. The interviewer has to take care about place of interview, using two chairs with a low table between them.
7. The interviewer has to make an appropriate arrangements for the reception of applicants, in particular giving them somewhere to sit, and make sure that the reception staff knows that they are coming.

2.2. Making the interview

The interviewer needs to work systematically through the structure that has been planned.

Table 1. Interview structure

Interview stage	Objectives	Activities
Beginning	Put the candidate at ease Develop rapport and Set the scene	Greet the candidate by name Introduce him/herself Neutral chat Agree interview purpose
Middle	To collect and give information, maintain rapport	Asking questions within a structure
End	Close the interview and confirm future action	Summarize the interview Check that candidate has no more question Indicate what happens next and when

Source: Torrington-Hall 1987. 320. p.

We have some note for the "Table 1." (Cushway 1994; Graham and Benet 1995; Pintér 2002; Telkes 2003): In part of the beginning the interviewer welcomes the candidate and introduce himself (or herself). Very important part of the beginning is the neutral chat. Most experienced interviewers begin the interview with a few remarks and question designed to welcome and set a candidate at ease. For example, a question about the candidate's journey to the place of the interview, helps the break the ice.

After the beginning will start the middle part of interview, when the interviewer makes the questions. The object of the question is to get a candidate to talk about their experience and reveal their motivations, social adjustment and the ways in which they have dealt with any difficult episodes in their private or working lives. These rules should be followed:

I. Rules about questions

1. *Questions should not suggest their own answer or be answerable in a very few words.* For example: I' am sure you have had experience in stocktaking, haven't you? Open-ended questions are the best, they suggest no particular answer and encourage the candidate to talk at some length. For example: Tell me about any stocktaking experience you have had.
2. *Very large of number of question should begin with the words how and why.*
3. *The meaning of questions should be clear.* The interviewer must try to adapt his or her manner and choice of the words to suit the candidate.
4. *Probing questions should be used.*
If a candidate says he or she was a responsible for a certain activity, this must not be taken at its face value. Further question may show that the responsibility was confined to keeping records about it.
5. *Rude, insensitive and irrelevant question should not be asked.*

II. Rules about interviewer behaviour

1. *The interviewer should unobtrusively guide.*
The candidate should do most of the talking, but on subjects which have been chosen and introduced by interviewer.
2. *Interviewer should not compare candidates with themselves.*
3. *Inappropriate selection criteria must be avoided.*
Particularly avoid the „halo effect”, whereby the interviewer assume that one desirable characteristic in an applicant necessarily means, that the candidate is equally worthy in other respect. For example, an attractive physical appearance does not imply that an applicant for a secretary’s job will be a good typist

III. Other rules

1. *The interviewer should try to keep timetable.* It seems often to be the norm that the interviews overrun. That is both bad planning and bad manners, as candidates presumably have other commitments as well.
2. *The interviewer should follow a clear structure.* It means the interview has a beginning, middle and end.

In the last part – we called the end stage - of the interview the interviewer should be given opportunity for candidate to ask questions about the job or the organisation. Finally the interviewer should indicate clearly to the candidate when the interview is at the end, and what the next step will be. For example the candidate will receive a letter or should telephone the company on a certain day.

3. ASSESSMENT OF THE INTERVIEW

3.1. Recording the interview

Note taking during the interview should be avoided, but a full note should be taken immediately after the interview and certainly before the next candidate is seen (*Cushway 1994*). It is essential for the record to be made in a systematic way to be sure that the comments have been made on all important points and to enable comparison with other candidates, there are many systems for describing candidates, two of which are the follows:

Table 2. Two typical systems for describing candidates

The seventh-point plan of the National Institute of Industrial Psychology devised by A. Rodger	The five-fold grading devised by Munro Fraser
Physical make-up	First impression and physical make-up
Attainments	Qualifications
General intelligence	brain abilities
Special aptitudes	Motivation
Interests	Adjustment
Disposition	
Circumstances	

Source: Author’s own construction
(based on A. Rodger 1952 and J. Munro Fraser 1958)

Two problems arise when applying these systems:

1. Subjective and incorrect allocation of people categories, for example what seems a pleasant disposition to one person may appear as surly and aggressive to someone else.
2. Applying the same categories to candidates of widely varying background, experience and educational qualifications.

3.2. Assessing the candidate and final rating

The information given by the candidate and recorded by the interviewer must now be interpreted so that suitability for the job can be assessed. It is now comparatively easy to make an objective judgement about the candidate's experience and qualifications, particularly if question on these subjects have been carefully thought out in advance. Assessment of personality is much less reliable (*McKenna-Beech 1995*).

It is useful to conclude the written assessment of the candidate with a final rating, particularly if a number of candidates are to be seen over a period (*Graham and Benet 1995*). A five-point scale can be used:

Table 3. Final rating

Category	Assessment
A	Outstanding candidate!
B	very good candidate but...
C	good candidate but...
D	needs further consideration because...
E	Unacceptable because...

Source: Author's own construction

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