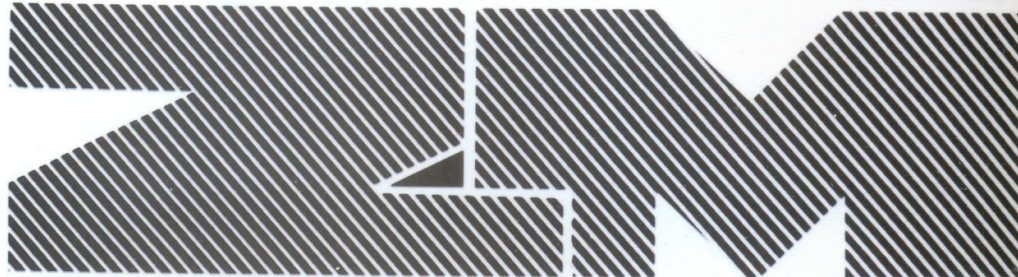


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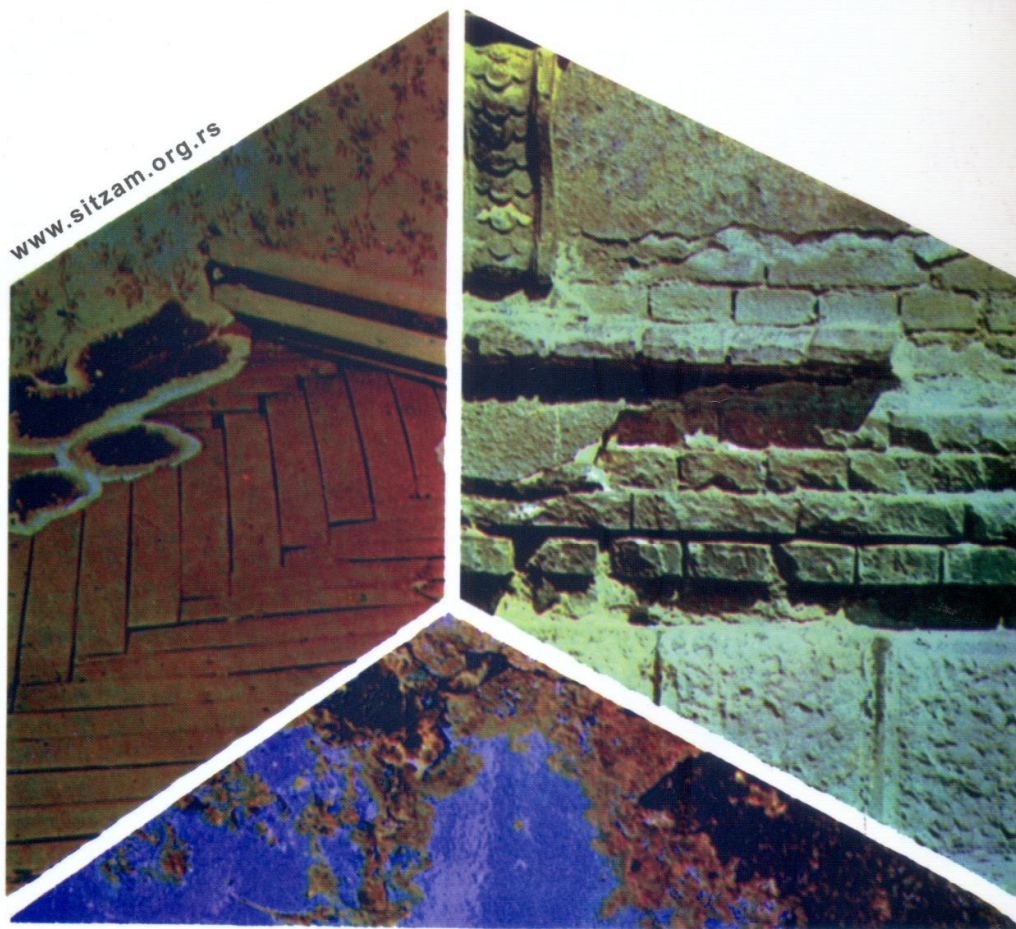


Godina LI

Beograd, 2010.

# 1 ZAŠTITA MATERIJALA

MATERIALS PROTECTION



INŽENJERSKO DRUŠTVO ZA KOROZIJU  
ENGINEERING SOCIETY FOR CORROSION

# ZAŠTITA MATERIJALA

Godina LI

Beograd, 2010.

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EVROPSKA KOROZIONA FEDERACIJA (EFC) SMATRA OVAJ ČASOPIS ZVANIČNIM  
ORGANOM ZA PUBLIKOVANJE INFORMACIJA I IZVEŠTAJA

## The influence of the exploitation of the gas CO<sub>2</sub> and mineralwater from vicinity "Popojci" village Dolno Orizari - Bitola on the living environment

*The pollution of the underground water, concerning their easy injurance is the most important problem that the civilization is facing, present days. The protection of the surface and underground water, soil, the air is most important thing, which in the present civilization is left to be done and to release pure resources of clean drinking water for the next generations.*

*Normally, every additional motive power on this space from Pelagonian basin should be expected to bring micro and macro changes of the living environment, which can arose multiple consequences first of all in the harmless of the underground water.*

*It should be mentioned that every drop of dirt that falls on the surface of the soil will migrate in the depth of the soil.*

*In this paper, gained results from the research and the quality of the mineral water and the gas CO<sub>2</sub> are described, as well as the way of the exploitation of the mineral water and the influence of the exploitation on the living environment.*

**Key words:** *underground mineral water, gas CO<sub>2</sub>, Popojci, Dolno Orizari, living environment, pollution.*

### 1. INTRODUCTION

The space for exploitation of mineral water and CO<sub>2</sub> gas is found in Popojci vicinity in the surrounding of the village Dolno Orizari, Bitola municipality in the central part of Pelagonian basin.

The researches for mineral water and CO<sub>2</sub> gas are done in the Pliocent sediments, actually in the frames of the complex type of issues.

In the frames of this space there is continental climate prevailing, that is characterized with long-term winters, pretty warm and dry summer with small amounts of rain.

The average annual temperature of the air, measured in the weather stations in Bitola is  $t = 11,0$  °C. The maximum temperature of the air is  $t = 41,2$  °C (06. 07. 1988), and the minimum  $30,4$  °C.

Main recipients of the surface water are Crna reka and Eleska reka who belong to the Vardar drainage-basin who on the other hand belongs to the Aegean see drainage-basin. The first geological researches on

this locations are from the period from the 70's, till today. The researches are stepped-up and are made with certain aim. In that period along with the geological researches and mapping of the location, there is Basic Geological map for the leaves Bitola and Vitoliste done [1].

In the period 1973-1977, "Geological institute" Skopje and "Geobiro"- Bitola have made hydro-logical researches and examinations of the field towards water supplying and opening the mine for coal "Suvodol". In that period during these researches, mineral water "Pelisterka" is discovered in the village of Midjitlija.

More intensive researches for mineral water and gas CO<sub>2</sub>, in the Pelagonian basin are started in the period from 2003 till now.[2],[3],[4]. In this period on these locations there are 12-13 concession researches done on gas CO<sub>2</sub>, and mineral water, on different levels and with different quality and quantity.

### 2. HYDRO-GEOLOGICAL CHARACTERISTICS OF THE FIELD

Rocky masses that are building Pelagonian basin and its wider surrounding, according their hydro-geological function are dividing into: hydro-geolo-

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gical collectors, hydro-geological conductors, hydro-geological complexes and hydro-geological non-conductors.

As hydro-geological collectors and conductors there are water environments divided in the rocky masses, with inter-granular and leak porosity. In the frames of the hydro-geological complexes there are pliocent sediments divided, and in the group of hydro-geological conductors there are clay and poorly cracked rocky masses divided.

On the hydro-geological basis and structural type of porosity, rocky masses in the frames of these locations are divided in: - Water environments with intergranular porosity; Water environments in the Neogenic complex and conditionally waterless fields.

According to the hydrodynamic characteristics that are present in the frames of the water environments there are following types of protrusions: fraetesian, water environments with free level of underground water and artesian and subartesian, water environments with level of underground water under pressure.

### 3. GAINED RESULTS AND DISCUSSION

Research-exploitation gaps are divided in the frames of quarter and neogenic lake sediments, in the spaces foreseen for the research.

Basic goal of the Research-exploitation gaps was, defining already existing water horizons and detection of other gas water horizons on bigger depth, their examination and adjustment for gas exploitation.

The Underground water in these cracks are awarded with levels of pressure and so IED-1 on the mouth of the creak there is measured pressure of 3.5 bar, and in the creaks IED-2 there is pressure of 8.0 bar measured.

During the measurement of the flow trough from the creak IED-1 there is stabilized flow of mineral water with capacity of 15.0 l/s with manometer pressure of 0.0 bars and flow trough of gas CO<sub>2</sub> from around 1 tone of gas. The amounts of gas are not measured because there is no appropriate equipment, and the same are given basically on the ground of measured quantities of gas CO<sub>2</sub> from the existing creaks in the frames of Pelagonian basin. During the measurement of the flow trough the creak IED-2 there is stabilized flow of mineral water gained, with the capacity of 25.0 l/s with manometer pressure 0.0 bars,

and flow of gas CO<sub>2</sub> about 2.5 t/č gas CO<sub>2</sub>. During jointly testing of the creaks IED-1 and IED-2, during the measurement of the flow trough, there is total amount of the same gained: 40.0 l/s of manometer pressure 0.0 bars and there will be flow trough of the gas CO<sub>2</sub> from both creaks, around 3.5 t/č gas CO<sub>2</sub>. Exploitation hole ED-1 is deducted with aim to secure technical water for supplying the object. It is deducted to 30.0 m depth, and it is characterized with free level of the underground water, and capacity of around 20.0 l/s.

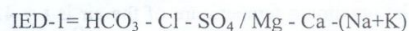
Total deducted exploitation objects in the frames of the research location are disposed with exploitation reserves of mineral water of  $\Sigma Q = 40.0$  l/s. of over pressure of  $P=0.0$  bar, wit expected flow of gas CO<sub>2</sub> from the both creaks around 3,5 t/č. From the total amounts of mineral water, only mineral water from exploring-exploitive creak IED-1 would be exploitive, in fact the mineral water from IED-2 is with very high mineralization.

### 4. QUANTITY OF THE MINERAL WATER AND CO<sub>2</sub> GAS

According to standards and regulations there is one complete physical-chemical, bacterial and radiological analysis in the Republic Institute for health protection of Republic of Macedonia in Skopje (table 1) (annex: list of chemical analysis).

On the basis of the gained results from the analysis trough microbiological, physical-chemical, and radiological characteristics of the water, in its parameters does not respond to the Regulator for accuracy of the drinking water, and the Regulator for quality of natural mineral water.

According to the chemical composition, the mineral water from exploring-exploitive creaks belongs to the following types of water (according to the formula of K̄rulov).



Possible sources of pollution, (ecological hazards) of the living environment are connected first of all with human activities in the complex, and then with the technological process of manufacturing and its accompanying effects.

Table 1 - Macro-component composition of the water from the spring

References	cations			$\Sigma$ cations	anions			$\Sigma$ anions	pH	dH
IED-1	Ca	Mg	Na+K		Cl	SO <sub>4</sub>	HCO <sub>3</sub>			
Mg/l	145.2	92	160.9	398.1	43.5	26.1	976	1045.6	5,92	45,6
Mekv	7.245509	7.565789	6.995652	21.806951	1.22708	0.54341	15.99738	17.767868		
% mekv	33.22569	34.69439	32.07992	100	6.906177	3.058388	90.03544	100		
IED-2	Ca	Mg	Na+K		Cl	SO <sub>4</sub>	HCO <sub>3</sub>			
Mg/l	2414.2	131.2	2140	4685.4	11517	80	4785	16382	6,45	365,0
Mekv	120.4691	10.78947	93.04348	224.30201	324.8801	1.665626	78.42977	404.9755		
% mekv	53.70842	4.810244	41.48134	100	80.22216	0.41129	19.36655	100		
ED-2	Ca	Mg	Na+K		Cl	SO <sub>4</sub>	HCO <sub>3</sub>			
Mg/l	40.78	23.92	62.25	126.95	8.1	15.6	244	267.7	6,90	11,97
Mekv	2.03493	1.967105	2.706522	6.7085571	0.228491	0.324797	3.999344	4.5526322		
% mekv	30.33335	29.32233	40.34432	100	5.018873	7.134268	87.84686	100		

Possible sources of pollution: sanitary and fecal sewage, technological sewage, waste derivatives and gases, atmospheric water, hard communal waste. With aim to accomplish all the potential ecological hazards of the living environment and nature, which will mean having complete control of the space and resources, as well as the polluters in the zone of influence, there are several measurements that are to be taken, such as: collecting sewage and sanitary water (removing the suspended particles 40-75 %, removing the bacteria 40-75 %, decreasing the BPK 20-65 %, removing the mud 0.5-1.5 l/1000 liter), accepting the technological water, decreasing the distribution of the sewage derivatives, accepting the atmosphere water, collecting the solid garbage, planting grass.

From the aspect of sanitary protection of the spring, it is necessary the zones of sanitary protection of the spring to be defined (capitation) in which with preventive observations and analysis, measures can be taken to prevent eventual pollution in time, and the removal of the same.

##### 5. MEASURES FOR PROTECTION OF THE LIVING ENVIRONMENT

This does not belong in the group of objects that are big polluters. But, to eliminate all the potential risks, in fact all the ecological hazards of the living environment and the nature, and that will mean having complete control of the space and the resources, as well as the polluters in the zone of influence, there are several measurements to be taken, and that will be:

**Sanitary and sewage water:** will be collected in so called Emsir's two chamber septic tank (dropping and sedimentary), with total volume of 7.3 m<sup>3</sup>. Septic tank will be located in the complex out of the production hall. Sewage water from the tank will be carried out with vehicles-tanks, and will be depositing in the places defined from the authorities. Cleaning the waste from the tank will be done every six months or every time the opportunity shows for that, that will leave 20 % from the waste for faster fermentation of the new mud. In that way efficacy will be made in the following functions: removing the suspended particles 40-75 %, removing the bacteria 40-75 %,

decreasing the Bpk 20-65 %, removing the mud (1 liter mud on 1000 l channel water) 0.5 – 1.5 l/1000 liter.

**Technological sewage water**, who as is said before in this text are very little contaminated and with very acceptable composition, and will be embraced with special sewage pipes from the hall (production hall) and will be dropped out in a channel.

**Sewage derivates** – for decreasing the distribution of the sewage derivates on the open concrete locations, routine control of the vehicles that will be in function of the complex will be done, while the reduction of the waste gasses will be regulated with special regime of managing the vehicles inside the complex.

**Atmospheric water** – will be collected from the roof with appropriate dimensioned drainpipes and together with the water from the open surface channels will be collected in appropriate tank (reservoir) with inputted oil-catcher, from where after the treatment, the atmospheric water will be taken to the mail sewage channel.

**Hard communal waste** – for collecting hard communal waste there will be containers putted that the communal services regularly will be carried out to the dump. Considering that the mineral water will be bottled in plastic ambalage, and the harmed ambalage will be collected in special containers and will be returned to the producer for recycling. Concerning the loss of natural gass during the filing of the bottles with water, it is estimated that there is no danger of ecological damages in the micro-atmosphere considering that this gass, with its characteristics, it can't be found on the list of harming agenesis and because of that there is no special protection foreseen.

**Greening the space** as biotechnical measurement there will be greening the space in the complex provided, and with that there will be hygienically conditions provided in its contents and function. Horticultural decoration or greening the space around the production hall and the environment will have the following tasks:

To remove or decrease the harmful influences of toxic gasses and polluters, as well as all the other harmful agentives that is becoming because of the work. That is the most important and the hardest thing, in the horticultural practice, so it is necessary to be familiar with the toxicology of the gasses and durability of the plants and separate gasses.

To improve climate conditions of the working environment and to get closer to the borders of working comfort, where and in what way although that will increase the productivity.

To make the working environment pleasant, that is in correlation with the esthetics of the working environment and its meaning.

To make barrier around the form, trough wind-protecting shield from green plants that will protect from wind snow etc. The way of horticultural solution and the choice of species of forming the space around the production hall require some activities that will depend from the natural actions and the use of the principles of decorations. The meaning of the green is multiple, and: it freshness the air in the atmosphere, it has biological function in the change of oxygen and carbon, it regulates temperature of the air, air pressure and air circulations, it increases the wetness of the air, it decreases the influence of the noise, protects from strong winds, absorbs dust and smoke, it influence positively on the physiological functions of human, it has big esthetic meaning, to use tall green plant that is very valuable hygienically, to use wooden species that are sustainable on all conditions, they grow fast, they have longer vegetation period, as well as the species resistant on vegetation diseases, it is suitable the surfaces to be planted with green plantations dimensioned according to the European standards, in fact around 15 m<sup>2</sup> per person.

The above mentioned is saying that the landscaping treatment with the greening the locations and around the walls (that will be built properly), must have protectoral function.

Due to the selection of the species of horticultural decorating the space around production hall, it would be necessary: the use of high green plants that is highly hygienically valuable, use of wooden species that are durable, that grow fast, and have long vegetation period, as well as special species resistant on vegetative diseases.

## 6. MAKING THE REINEACTION CREAK

From the protection aspect on the living environment, in these conditions of exploitation, it is specially pointed the disorder of the natural regime of the underground. From the above mentioned reasons in the phase of exploitation it would be necessary the problem with extra underground water to be solved, concerning the same to be returned in the primary tank. Solving the problem with extra water will be solved with extra researches, with making reineaction

creaks, that would be with aim to return the underground water and keeping the primary composition of the water and the concentration of the gasses in it.

The same is foreseen from the aspect of the quality of the water in fact its mineralization, destroying the regime of underground water and protection of the natural environment.

Reinacting of the extra water will be done in horizons of sandy environments between 150 m and 250 m depth.

The parameters of the reneaction creak will be given correctly with the perception of the hydrogeological conditions on the field with executive project for it.

## 7. CONCLUSION

According the analyses that are done on the natural characteristics on the field of the wider locations, as well as the ecological factors and resources in the influence zone of the objects, the following can be said:

Motive power for manufacturing mineral water and CO<sub>2</sub> it is presented with modern technical and functional contents.

The creak-wails are well made and secured with all protection measurements so the mineral water would not be polluted, on its way to the underground water.

Extra mineral water will return in the primary reservoir with making reneaction creak RD-1.

The space around the creaks will be protected and cultivated, so it can not be accessible without previous approval.

With respect and realization of all protection measurements of the living environment, for what all the necessary conditions and possibilities exist, there will be eliminated all the existing risks from degradation of some of the life resources in the environment and the wider surrounding, and from ecological aspect the foreseen complex can fulfill the necessary conditions.

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