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CONTEMPORARY TENDENCIES IN WASTE MANAGEMENT IN SERBIA

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***Abstract**: Recycling has great influence on the concept of economic sustainability. Recycling contributes to the realisation of appropriate economic results by creating new use value of the recyclable products, and by employing the new workers as well as decreasing the import of the deficient raw materials. Recycling of secondary materials worldwide is immensely important. In this sector there are more than 1,5 million people who recycle and return to the market more than 600 million tons of waste paper, non-ferrous metals, plastic, textile, glass, electronic waste, etc. Numerous analyses provide the economic justification for recycling of waste materials, mostly in respect to lowering the costs, but also saving energy and other inputs. Recycling has become a lucrative business throughout the world because the collection costs are low in comparison to the secondary material price when sold. The community plays an important role in the reuse, recycling and product disposal in the sense of establishing general awareness about the importance of waste collection and the need to recycle, by introducing the appropriate education and promotion, and legal acts. Therefore, the responsibility to reuse, recycle and dispose of a product should be adopted by producers and consumers, as well as the entire community. The waste recycling analysis and the development opportunities in Niš region will be presented in this paper.*

***Keywords:** environment protection, recycling, sustainable development, economy development*

1. INTRODUCTION

In order to achieve sustainable development, in accordance with the demands and nature limits, determined by the modern world at the Conference on environmental issues held in 1992 in Rio de Janeiro, it is determined that adequate connection between economic policy and environmental development on all levels of social communities and in all economy and non-economy sectors is necessary, and they should be integrated into modern processes. The first warning that former concept of sustainable development was non-sustainable was the raw materials and energy sectors crisis during the 70s. Developed countries reacted first by adopting savings programme and rational use of primary resources, as well as the mineral raw materials and energy preservation programme. The use of raw materials scrap takes special place within the activities. Sustainable development concept is mostly based on the secondary resources. Knowledge on low natural resources and necessity for their rational usage conditioned a new approach in concepting future economic development. It is based upon long-term sustainable development as well as upon high stability degree in business operations.

Economic growth and development, introduction of new processes and products, and constant growth of the city population, produces large amounts of waste materials from the households and industry, and the necessity for their taking out and dumping. It is necessary to take certain measures for the most appropriate way of waste dumping, and further processing, that is, recycling, in order to stop the waste material from polluting the environment.

Globally observed, the greatest benefit form recycling is seen in the environment protection and preservation. The environment protection and preservation are one of the most important civilization tasks whose future and survival will depend upon its fulfilment. Creation and deepening of awareness of both consumers and producers on environmental preservation and protection importance and significance will greatly influence on successful task fulfilment.

However, it is necessary to point out the fact that recycling represents an economic activity, which can have significant economic effects. Recycling produces many products used as raw materials in final products fabrication (various metals), as energy fuel and as finished product intended for final consumption. There is real demand for these products, and therefore its production is manifold justified in technical-technological and social-economical way.

In Serbia, recycling has the potential to grow having in mind large quantities of generated waste and the lack of local and regional centres for waste collection and recycling, also the competitive wages and energents. Waste recycling represents an important industrial sector of vast development potentials.

According to the present situation, domestic economy will not reach the level of highly developed countries in the recycling sector. However, in the starting phase it is necessary to register amounts and locations of recyclable materials, research the possibilities of its regional collection, sorting, transport, treatment or disposal, as well as to determine the conditions for treating the material in the least harmful way for human health and environment.

2. MAIN FEATURES OF SUSTAINABLE DEVELOPMENT CONCEPT

Sustainability or sustainable development is a crucial precondition and the final goal of efficient organisation of numerous human activities on the Earth. Sustainable development disrespect leads to inefficient economy development, greater waste of resources and energy, that is, the tendency of long-term input-output ratio deterioration at the global scale. Sustainable development is therefore, the development, which establishes balanced relation between ecology and economy, in order to preserve natural wealth of our planet for future generations. It can be said that sustainable development represents general orientation, desire to create better world by balancing social, economic and environmental factors [1].

The Second Conference on environment and development was held in the early 90s. The Conference was held in Rio de Janeiro in 1992, and one of the main deliberation directions was *sustainable development concept*, which was examined in the late 1980. *Agenda 21* represents instructions for applying and implementing the sustainable development concept in all development and environment usage sectors in 21st century, and all countries signatories are obligatory to apply and to form committees for sustainable development. The Agenda contains 4 basic chapters: social and economic issues, protection and management of the development resources, role and importance of social groups strengthening and instruments for realising the Agenda [2].

Based on the set directions, UN Conference Planet Summit +5 was held in New York in 1997 with a view to perceive how much has been done regarding the agreement and accepted documents from the summit held in 1992 and especially the implementation of Agenda 21. Ecological rationality has become component of economic practice of the most developed countries in the world. Preservation of natural resources and especially rational usage of all resources and their potentials, gained strategic importance, perceived from the development priority point of view. Sustainable development and environmental

preservation concept is of high priority of the EU (Article 2 from the Amsterdam agreement) [3]. EU committee adopted the theme strategy on prevention and waste recycling [4] in December 2005 and it represents one of the frameworks, which marks the beginning of the changing decade in the EU.

One of the basic Agenda 21 conclusions, which represents instructions for appliance and implementation of sustainable development concept in all development sectors and environment usage in the 21st century, is that the *waste recycling is undoubtedly the best and the most rational way to manage waste materials.* By applying various waste material recycling procedures, the spending of natural resources is shrinking by returning useful substances and energy saving is achieved. Recycling effects useful to the society are seen in the following:

- a part of the ecological problems that are the result of waste materials pollution, are solved effectively, and
- conditions for starting the low cost production along with decreasing the volume of primary raw materials usage are created.

According to Canadian experiences [5], the key for reducing the waste materials for 50% is so-called *4R: reduction, reuse, recycling, recovery.* The stated "4R" formula represents the hierarchy, starting from reduction, which is primarily a choice – minimising the creation of waste materials, and if it is created then it should be reused many times, if it is possible. The third and the best alternative is recycling. Finally, tendency for regeneration of raw materials, materials and energy from waste materials, which cannot be reduced, reused or recycled, should be used if possible.

Regarding European accomplishments in this area, the EU has made decision upon decreasing waste disposal for 25%, that is, upon necessity to increase average recycling degree until 2010. The most significant results in this area in the EU countries are made in Holland, Denmark, Germany and Sweden [6].

3. IMPORTANCE OF RECYCLING

The recycling process often demands discovering new technological procedures, as well as new production machines and gadgets that are used for returning waste – production redundancy, as well as used products from the consumption sphere back into production process and in further consumption. One of the ways to reuse the waste involves collecting the various waste materials, which can be potentially reused. The advantage of the process is reusing and recycling and resource preservation. The other recycling advantage is decreasing the effects made during raw materials usage and transformation (influences on environment, energy and natural resources consumption) [7].

Recycling is mainly defined as a production process, which encompasses reuse of the same raw materials in a production process. These raw materials have already been used, that is, they have had certain function in the reproduction process. Recycling enables them to gain higher utility value. Many useful goods are produced by recycling. They are used as raw materials for final products fabrication (various metals), energetic fuels, and finished products intended for the use. Therefore, those utility goods are necessary, and their production is justified.

Besides, modern technology and technique enable production of high quality products by processing waste materials. In this respect, there is a constant progress, which leads to a higher degree of resources usage, and also business rationality and profitability.

One of the recycling goals is protection and preservation of available primary resources, from those that are non-renewable, to their further usage. There are noticeable results in this filed. It is real to expect this trend to continue in the future. The state can

have special role in the usage of secondary raw materials in economic development. The preservation and protection of natural resources and providing healthy environment is in its best interest. For many countries, it means less import dependence, because development resources already present in the country are used. Therefore, many countries, first of all developed ones, create convenient business environment and directly encourage massive usage of secondary raw materials by applying various measurements and activities.

Certainly, a special benefit from recycling is seen in protection and preservation of the environment. Recycling process is useful, instead of leaving the waste materials in environment often uncontrolled and without proper waste disposal site, and by doing it so the soil, air, water and other natural wealth are polluted.

This activity, as the other ones, contributes to the accomplishment of relevant economic effects. These effects, besides the production of utility goods, are new employment in secondary industry branches, as well as in similar economic areas, profit creation, which contributes to the faster economic development and higher life standard of the employees, and the growth of the general welfare.

Recycling of secondary raw materials is impressively developing worldwide. Annual transaction of these goods is about 160 billion USD dollars. 1.5 million people work in this sector, which enable to annually recycle and offer on the market over 600 million tons of waste paper, non-ferrous metals, plastics, textile, glass, electronic waste and etc. Many analyses show that waste material recycling is economically justified, which is perceived mainly in the decrease of business costs, but also in saving energy and other inputs.

4.WASTE TYPE AND QUANTITY ESTIMATES AND STRATEGIC AND LEGAL FRAMEWORK FOR WASTE MANAGEMENT IN SERBIA

Waste collecting and disposal, especially waste processing, was not of great interest in Serbia. However, a certain progress has been perceived lately. Communal waste is put on the waste disposal sites, and small proportions of industrial waste are used. Due to the lack of proper data, structure and amount of waste cannot be estimated with certainty. It is estimated that 2.5 million tons of waste are collected in Serbia, but half of the waste stays in the yards, next to the roads or in the river beds. It is estimated that 0.8 kg of communal waste is daily produced per citizen.

According to the waste morphology, organic waste (yard waste and other bio hazardous waste) amounts up to 50% of the communal waste, then 37,62% of bio hazardous waste, three times more than yard waste. Total plastic waste comprises 12,73%, while the total amount of cardboards is 8,23%, then glass (5,44%), paper (5,34%), textile (5,25%), single-use diapers (3,65%) and metal (1,38%) [8]. Waste structure implies that what an average European family throws is similar to the waste structure in bigger Serbian cities.

The collected waste has no adequate treatment. Communal waste is mainly disposed on the waste disposal sites without any treatment. No composting is performed even though it contains large part of organic waste. In addition, there is no waste incineration nor it is used as alternative fuel in railway station or cement plants. There is no primary recycling, that is, separation on the source.

Things are a bit better regarding industrial waste recycling [9]. 300 companies are in waste recycling business in our country.

The volume of secondary raw material recycling has been constantly increasing since 1990, but during the NATO aggression (1999) it dramatically fell, and then it rose

again afterwards. The most collected waste is various metals and paper. Significant amounts of waste materials are exported, that is, imported.

National Strategy on Waste Management describes the hierarchy of waste management in detail. It points out possible solutions, according to the hierarchy and by acknowledging the order of importance.

The long term strategy for the environmental protection of the Republic of Serbia envisages the improvement of the life quality by securing certain environmental conditions and by preserving nature through sustainable environmental management. Key activities foresee the creation of new and the enforcement of the existing measures directed towards integrated waste management system, further integration of environmental policies into the other sectorial policies, increased acceptance of individual responsibility for the environment and increased involvement of the general public in the decision making processes [10]. This strategy is in line with EU regulations related to this field, defines short term and long term objectives and measures and activities for their completion. The Strategy in accordance with both legal and strategic documents: National Integration Programme, National Strategy for Sustainable Development, Strategy for Energy Development of the Republic of Serbia until 2015, Regional Development Strategy of the Republic of Serbia 2007-2012, Strategy for Introducing Cleaner Production in the Republic of Serbia, Ordinance on defining the National Programme for Environmental Protection, Spatial Plan of the Republic of Serbia.

Short term objectives (2010-2014) defined in the Waste Management Strategy envisage further legal harmonization with EU regulatives, drafting of national plans for certain types of waste, development of local and regional plans, development of primal selection systems, establishment of 12 regional waste management centres, establishment of a system for management of different waste categories, promotion of waste usage as alternative fuels and recovery of existing dump sites.

Long term objectives (2015-2019) envisage separate collection and treatment of hazardous waste, securing burning, reuse and recycling of packaging (25% of its mass), establishing a system for construction waste management, strengthening of professional and institutional capacities.

Law on Waste Management defines types and classification of waste, waste management, hazardous waste management, conditions and procedures for issuing permits, cross-border transport of waste, reporting on waste and data bases, financing waste management and surveillance, etc. The Law aims at securing conditions for adequate waste management, reduce the generation of waste by introducing new technologies and resource rationalization, promote recycling, define manners of waste disposal, raising general awareness about waste management in order to preserve the health of people and the environment.

Apart from the technical aspect of the Law which defines the preventive measures and how to reduce the generation of waste, recycling, collecting and transport of waste, there is also an economic aspect as well:

- Application of a slogan “the producer pays”
- Prolonged responsibility of producers for their products,
- Restructuring and transformation of certain sectors.

Namely, the polluter is responsible for all of the costs related to his activities; therefore, all of the costs in relation to generating, processing and disposing of waste are built in the final price of a product. Thus, the producer becomes more responsible for his products and doing business, because he has to make sure his operations are economical, which can be achieved by reducing the generation of waste, developing products which can be recycled, developing the market for reuse and recycling of his products. Since this

concept is in line with the waste management hierarchy, it will certainly become a trend and will influence the restructuring and transformation of certain sectors. This legal framework also has social aspects because it promotes rising of awareness and professional improvement [11].

All of the strategic and legal documents of the Republic of Serbia are in line with the current needs and real needs, EU tendencies and future needs of our country [12]. In Table 1, there is a projection of waste quantities from 2010 to 2019 which show that the quantities of the waste will increase along the industrial development, population increase, especially in cities and due to the modern way of life.

Table 1 – Projected waste quantities, in thousand tons per year in Republic of Serbia 2010/2019. Source- Waste Management Strategy of the Republic of Serbia from 2010 to 2019 (Official Gazette of RS, no.29/10), April 2010, p. 78.

Type	Quantity, in thousand tons per year		
	2010	2014	2019
Communal solid waste	2451	2785	3268
Household waste	*2084*	*2367*	*2778*
Commercial and institutional waste	*367*	*418*	*490*
Packaging	607	693	817
Biodegradable communal waste	1538	1747	2049
Hazardous communal waste	25	28	33
Construction and demolition waste	1000	1300	1700
Hazardous industrial waste	100	150	200
Oils	50	54	59
Tyres	26	30	34
Batteries and accumulators	27	29	32
Electronic waste	30	35	40
Vehicles	93	106	124
Medical waste	49	52	56
Sludge	30	160	350
Animal waste	277	296	321

Generally speaking, waste recycling is insufficient in our country. One tenth of collected waste is recycled. It is one of the problems that will have to be solved in the near future, if our country wants to become a member of the EU. Besides, from the economic aspect, it is a chance for our weary economy to form a special branch that would provide new working places, profit increase and general welfare.

Since the City of Niš is a good practice example of a local self-government which makes efforts in the field of waste management and environmental protection, several mechanisms for achieving these objectives will be presented. Namely, the City of Niš is among the first cities which established the Council for Environmental Protection in 2009 which should systematically solve problems from related to this field and initiate drafting of strategic documents. There are also numerous projects which the City implemented or was involved in, which were envisaged in the regulatory plan. Therefore, the City and the Ministry for Foreign Affairs of the Kingdom of Sweden initiated the construction of the waste recycling plant; Niš was one of the first cities which was involved in the activity of the Ministry of Environment and Spatial Planning – systematical approach towards

recycling (packaging recycling); on 31st May, 2010 the first international Fair of Ecology, Energy Efficiency and Energetics was opened, dedicated to the rational usage of natural resources and the preservation of the natural environment; cluster Recycling – South was established, the first one from the field in Serbia, etc.

The City of Niš also drafted and adopted in 2011 Local Waste Management Plan from 2011 to 2021 which consists of the state analysis and short-term and long-term objectives. It is in line with the Regional plan which envisages the collection of communal waste on the whole territory of the City of Niš, both in the urban and rural areas, while the establishment of the cluster of polluters is regarded as one of the most important objectives [13].

Apart from the local initiatives, there are regional such as the partnership of the City of Nis and Municipality of Doljevac, Gadžin Han, Merošina, Svrljig, Aleksinac and Soko Banja which signed the Agreement on establishing the joint solid waste management for the Niš region in 2009 which was in line with the strategic documents and legislatives of the Republic of Serbia. The aim of this initiative is the establishment of a long-term regional waste management system in order to minimize the harmful effects on the environment and people's health. The regional ten year plan envisages the construction and equipment of the waste management system:

- Waste collection system,
- Waste transport system,
- Temporary storage facilities,
- Waste treatment facilities, and
- Regional landfills [14].

The regional landfill is supposed to be built for the solid waste disposal, for the minimum period of twenty years. Regional waste management plan is in its final stage and should be adopted this year.

This information and the comparison with developed countries show that recycling is in its formative years, but it holds great potential. Therefore, adequate strategy for developing the recycling sector should be defined and applied which should resolve the current and prevent the future ecological problems and would be economically acceptable and induce the rational use of resources, the use of domestic work force and decrease of the import rate, but with an acceptable profit rate [15]. Such an approach is in line with the sustainable development of the national economy, which is the only logical concept, in a long run, in line with the contemporary social and economic conditions.

5.CONCLUSION

Numerous countries, especially the developed countries, by implementing certain activities create a business favourable environment and directly promote the use of secondary raw materials, because recycling improves the preservation of primal raw materials. Apart from preserving and protecting the natural resources and securing the healthy environment, recycling of waste has an economic aspect in the sense of opening new enterprises, securing new jobs, increasing the volumes of sales and consequently, the income. However, the recycling process in the domestic economy is insufficiently developed, since only one tenth of collected waste is being recycled. Recycling in Serbia has a potential to grow, and the role of the state in improving the waste management is huge due to providing stimulant funds required for the development of recycling which is in its early stage in Serbia. A local self-government, as the state, has to improve the

cooperation with the recyclers and provide an adequate legal framework, but also stimulative measures so that they can improve their businesses. The City of Niš is a good practice example among local self-governments which makes efforts in the waste management and environmental protection fields.

According to the present situation, domestic economy will not reach the highly developed countries level in the recycling area. Involvement into European integration flows will force the domestic economy to solve the problem in a relatively short period. However, since it is a relatively new economy branch, help of the competent state institutions is necessary in order to organise special centres for waste collecting and to increase recycling capacities. In conclusion it can be said that investing in this economic branch is justified in a long run from both techno-economic and social, first of all ecological aspect.

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INTERPERSONAL COMMUNICATION IN DIFFERENT CONTEXTS

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Abstract:*In this paper we talk about communication as a process of information transfer from sender to recipient, provided that the recipient understands the information. The function of communication is in unifying organized activities. It is a means of modifying behaviour, implementation of changes, achieving information productivity and achieving objectives. The transfer of information from one person to another is a necessary process, within a family, company, church, team, group …We can understand communication as a means of connecting people in an organization to achieve a common purpose. Activities within the group are not possible without communication, because there wouldn't be any coordination and implementation of changes. The purpose of communication in an organization is to implement changes – to direct actions for the benefit of the company.*

Keywords: *Communication, information, process, group, transmission, performance*

1.INTRODUCTION

During the evolution of human beings, communication, as a basis for understanding, has been raised to a higher level than the communication between other living beings. So communication is a cause and consequence of many interactions among people, such as the cause of misunderstandings, as well as their solutions. It can be said that it is the basis of man's survival, because man is a social being in constant interaction with other people. It is the means by which we make friends, talk to other people, express our opinions, views, and ask for help, etc. People who fail to communicate well have to be satisfied with relationships, careers and self-image which is below their ability. Since their birth, everybody is learning how to communicate, and they continue developing the ability throughout their lives. People differ according to the skill, i.e. their communication competence. Here we come to the term "the level of communicative competence", which is defined as the level at which a person's behaviour is appropriate to the situation and thus allows a person to achieve their individual and relational goals. The level of competence shows the behaviour that may be less, or more appropriate for the existing situation. For example, laughter is a common reaction to a joke, but the intensity depends on the specific situation. Loud laughter in the church is so inappropriate. Communicative competence also shows individual, as well as relational goals. Achievement of individual goals only, regardless of the goals of others, can lead to a person running out of friends. In interaction with other people, it is more important to maintain a relationship, than to achieve a personal goal. Appropriateness and effectiveness of what a communicator says also contribute to communication quality, i.e. the communicator must always say what is appropriate for the situation. For example, to the expression "Thank you" it is common to reply with "No problem", and the absence of these responses may indicate bad manners or lack of attention. The success of communication refers to the speaker's behaviour in the achievement of personal goals. For example, if someone interrupts the person who is talking, and thus draws attention, it can be successful for them, but not appropriate. There

talking, and thus draws attention, it can be successful for them, but not appropriate. There is no widely accepted, competent communicative behaviour, but the situation is one that requires certain behaviour, as well as the relationships among communicators. Communicative competence includes three types of behaviour: spontaneous, trained and planned. Spontaneous behaviour is characterized by the absence of conscious planning or management. Trained behaviour requires reflection and guidance, and then, after a lot of practice there is automation. Planned behaviour is always well thought of and guided, it is the act of communication at the highest level. The competence of a speaker is influenced by his/her partner in communication, as to communicate is what we do *with* people, not *to* people. It is easier to achieve the goals of communication when others cooperate. Skills are not the only that are needed for communication competence (cognitive skills – those which help a person to discover how to achieve personal and relational goals, and behavioural – those which help to achieve these objectives, it is the behaviour during the interaction), but also relational and situational factors. Communicative competence is a matter of compromise. It demands constructive solutions, appropriateness and effectiveness.

2.COMMUNICATING IN SMALL GROUPS

Many scientists have been studying communication in small groups. One of the first was Kurt Lewin, who hypothesized that each person in a group has a "living space" which is shared with other members to some extent. According to the sociologist George C. Homans the deformation in behaviour of a person, changes the behaviour of other people around him/her. Moreno was interested in interpersonal conflicts within small groups, using a questionnaire to measure likes and dislikes of the group members and showing them in a sociogram.

What is a small group actually? The definition says: "A small group is a group of three to fifteen individuals who meet face-to-face over a certain period of time, with a formal or informal leader. Group members usually have at least one thing in common and meet in order to achieve some purpose." However, it is not possible to determine what the ideal number of members is. The bigger the group, the more likely it is that a small number of members monopolize the discussion, and it often causes dissatisfaction with less active members.

We can find an example for this in our neighbourhood, as well as in sociology management classes. We form small groups during the arrangements for producing a seminar, one of the group members has, at least partially, the leading role and we have a common purpose: to hold the seminar ... While, on the other hand, when we are in a larger group, for example, in class, really small number of members monopolize the discussion. Less active members express their opinions here and there, while a large number of members is not active at all due to various reasons.

Stages of group development

There are several divisions into phases in group decision-making. The ways of solving problems, its understanding and communication within the group itself is changing, depending on the particular phase.

Bales and Strodbeck introduced three stages of development of the group:

1. phase of directing (group members are given thought directions within the topic)
2. evaluation Phase (more asking for and expressing opinions, evaluation and analysis)
3. control phase.

Tuckman introduced four stages of group development:

1. focusing on the task (definition of objectives and methods)

2. reacting emotionally to the task (includes the resistance of the group towards the task requirements)
3. open exchange of relevant interpretations
4. phase of solutions (constructive efforts of the task accomplishment).

Fisher identified four stages or four continuous changes:
1. orientation (indecisiveness and experimentation with ideas and opinions)
2. conflict (disagreements and arguments growth, but also a sharp increase in expression of thoughts and ideas)
3. emergencies (reduction of conflict, partial decrease of differences)
4. confirmation (the moment when the group came to a decision).
Realistically, the most acceptable model of group decision making is Pool's, in which the decision making process is "a set of parallel threads, or lines of activities that develop simultaneously and are intertwined in various ways in the course of time."

3.GROUP PERFORMANCE

There are, of course, groups that we consider "successful" and those considered less successful, or "unsuccessful". Some characteristics that differentiate these groups are:
1. Quality groups carefully examine the opinions of its members, refusing to let them in without careful consideration;
2. Quality groups carefully consider the available alternatives, in light of the evaluation criteria;
3. The choice of alternatives is based on the logical conclusions, facts, assumptions and conclusions that the group considers are true.
4. A successful group has one or more members who have positive influence on the course of the discussion and guide the group to the highest quality choice of decisions.

But the very start, when we determine whether a large group is successful or not, may be questionable. For what determines the success of the group? Accomplishment of the set of goals? But is it accomplishment of given aims, or the ones the group itself has set? Some students really want to write a good essay, while some just tend to get a good mark. Can we say that those who meet the grade, or just get a mark, are unsuccessful? Do they think so? Is a C player unsuccessful? Probably not. Everybody pursues their goal, and they adjust to others if necessary, as much as they want or have to.

4.ORGANIZATIONAL COMMUNICATION

Organization is an important context for the study of interpersonal communication. Today, most organizations are defined as compositions. Every organization has its own culture, networks, information and organizational relationships.
The culture of organizing - customs, ways of communicating and organizing groups in the organization. These include common standards, memories, stories, ceremonies and rituals. It is essential to know the culture of the organization in which we work.
The example given by the authors of "Corporate Culture" Deal and Kennedy, is somewhat idealistic, typically American. It is about the heroic stories of individual employees of IBM or General Electric. But aren't there such stories in our country, and who knows how many more of them?
Organization networks – it is the structure through which the organization travels within the organization. By observing these networks we can discover streams of information that influence the behaviour of individuals, how to improve the flow of information and the

behaviour of the participants as well. There are different types of networks: networks of friends, ordering networks, networks for information exchange, networks for professional knowledge obtaining and status networks. Members of the organization have informal roles in these networks. They can be:
1. a member's role in ethics;
2. the role of a bridge – a member of a group that is associated with other groups, ensuring a flow of information between the groups;
3. the role of communication - these are the people that connect small groups, but not their members and
4. the role of the isolated – the people who maintain very little contact with other members of the organization.
Organizational relationships – the ways in which people relate to each other are a result of formal and informal rules of communication within any organization. Formal rules are, unlike the informal ones, usually codified in some way. Formal methods of communication are often useless for transmitting organizational culture, or presenting new ideas and knowledge. With open channels of communication we can easily find out what others think.
Sex is one dimension that affects the male and female roles and their relationships in organizations. In organizations, there is often a fear of romantic relationships at work, which may threaten existing relationships among co-workers. Despite the problem, the research on the subject are rare. Existing research shows that love among co-workers can really threaten the structure of relationships in the organization, bring excitement to an otherwise boring environment and threaten job security.

5.THE NATURE OF RELATIONSHIPS

Every human being needs relationships. Starting from birth, when he/she is fully dependent on another person, and then again when he/she is old, he/she needs the help of others. Why do we need so many relationships? Researchers believe that just because of the need for connection and dependence on others we differ from other species. We are connected in the mother – child relationship, while the dependence includes approval or closeness.

Different people have different needs in terms of quality and quantity of relationships. Communication greatly affects the establishment, maintenance and destruction of relationships. And the relations influence the quality of life.
There are numerous factors that influence the relationship shaping. First, we ourselves choose some relationships (friends, marriage), whereas some are imposed (parents, brothers, co-workers, boss). Then there are the age, sex, socio-economic status, religion, occupation...

We notice that the rich mostly tend to establish friendships with the rich. The simple and sufficient reason for that is that they can afford the same things, they go out to the same places...Occupation brings us to the environment in which we spend so much time and create new relationships. Researches show that young children and pensioners have strongest restrictions on establishing relationships. Parents with young children no longer have enough time to go out, socialize intensively. Older people, on the other hand, are often physically disabled, although they have a lot of free time. These people usually just deepen their family connections.
Sex is a factor that is extremely important to create relationships and communication with other people. We have always had "male" and "female" conversations. Women usually talk more just for the sake of conversation, and they are more intimate, they more easily find

common topics. However, due to the traditional division of labour (housework, children), they have fewer opportunities for socializing. There are still differences remaining between men and women, for example in politics and sports, which limit women's social contacts.

6.CONFLICTS IN COMMUNICATION

Conflict is defined as a clash between different tendencies and actions of individuals, groups and nations, or between individuals, groups and nations within the cooperative or competitive situation.

Psychologists who emphasize human problems that occur in the process of initiation, transmission and receipt of information are greatly interested in communication. They are focused on identifying barriers to successful communication, especially those related to interpersonal relationships. Interpersonal relationships are a source of different resistance, conflict, misunderstanding, imposition of personal interests and the interests of formal and informal groups, i.e., in the circumstances of different conflicts.

It is necessary to solve problems timely, to find the causes of problems as well as their shapes in order to prevent an open conflict. If there is no knowledge about the causes and types of conflict, there will not be any knowledge of their eventual constructive / destructive influence.

We can distinguish three types of situations in which a conflict arises:

1. when one party detects that the other does not respect the rules,
2. when one party is resisting the other,
3. when one party's resistance provokes the other party's reaction.

Conflict can be defined as a process that occurs, develops and prevails in disagreement relationship of at least two subjects which show interest in the same values. That means that the disparity of business goals, differences in the interpretation of the facts and disagreement regarding the practical expectations and preferences can lead to a conflict.

This definition includes all kinds of conflicts from open conflict, marked by a great antagonism, which is observed at all times, to the insidious (mysterious) disagreements, where people hide their antagonism toward others, or confirm what you are saying and fully agree with you, till you turn your back, and then...

A conflict can be functional and dis-functional. A conflict as a process of growth and development over time, and includes five phases:

1. potential opposition,
2. cognition and embodiment,
3. attention,
4. behaviour,
5. outcome.

Understanding conflict situations requires the analysis of all its elements, and the elements of conflict are as follows:

1. previous relationship partners,
2. behaviour in conflict,
3. the main problem,
4. social environment,
5. observers,
6. solving strategies,
7. consequences.

Previous partner relationship element refers to the fact that knowing what happened in previous period helps us understand what is happening now. The second element relates to a partner's conduct in conflict. The main problem of the conflict is in the third place. It

must be put into the context of the social environment, but we must take into account the present observers, that directly or indirectly affect the dynamics of conflict situations. Further elements in the resolution of conflicts are consequences.

In a professional environment, the conflict is any dispute or resistance that stems from a lack of power, resources or social position, as well as the composition of different values, i.e., it is the result of needs, desires and interests. Conflict is not necessarily negative, it can have positive results. The working group will come to a better solution by opposing different opinions than with group-thinking, i.e. agreeing with others at any cost.

Researches show that managers spend a lot of working hours (about 20%) in conflict solving, indicating the importance of understanding the causes, mechanisms and solving conflicts in the organization.

Some common causes of conflict in the organization are:

1. conflicting personalities,
2. conflicting values,
3. unclear job responsibilities,
4. limited resources,
5. inadequate communication,
6. interdependent work tasks,
7. unrealistic / unclear rules and norms,
8. unsolved / suppressed previous conflicts.

For each company the process of conflict is more important than conflict solving and identifying the causes of the conflict. If something cannot be avoided, then we need to know how to deal with it.

There are three possible outcomes of conflict situations, such as "one wins and the other loses" (victory - defeat solution), "both lose" (lost - lost - solution), "both win" (win - win - solution).

We can only conclude that the only procedure which includes good and quality dealing with conflict is the one which leads to the third outcome, victory - victory - solution.

Conflict solution styles

Depending on the intensity of an individual's personal interest and their concerns for the welfare of others, we distinguish five dominant dis-functional conflict resolution styles:

Integration: Parties confront attitudes, collectively identify a problem, propose and evaluate possible solutions.

Affability: This style is based on the reduction of emphasizing differences and on common interests.

Dominance: Dominance is more applied by individuals who care about their own interests, and less about common interests.

Avoidance: Avoiding style refers to a passive position and distancing oneself from the problem, and even active concealing.

Compromise: Compromise is the process of establishing a balance between personal and common interests. Each participant has to give up something.

When choosing a style (or combination of styles) for a conflict solution, it is important to define the goal of action. What do we expect from the communication situation? Do we want to win and see the defeated on the floor? Or is our goal to have both parties keep their pride and feel like winners?

A manager who wants to control interpersonal and intergroup conflicts in the organization successfully must take into account three facts: conflict is inevitable - too few conflicts are just as problematic as too many; there is no ideal way of solving conflicts. The manager of the organization in which lack of conflict may cause e.g. lack of creativity,

poor technology, lack of quality, poor coordination, poor organization of labour and lax controls, will have to use the usual method to encourage a clash of opinions and ideas. This method is called the "method of devil's advocate. „The name comes from the historical practice of the Roman Catholic Church, when in the process of beatification (declaration of a saint) a church official had to play the role of devil's advocate, i.e., bring the case against the candidate. „Devil's advocate" of a modern organization would be a person who is assigned the role of critics by the management.
So, the mission and goal of every manager is to achieve an optimal level of conflict situations in the company, in order to achieve success in the organization. It is important to point out that the competitiveness of the organization, which is the key to success in the market, is inseparable from ethics and morality, the foundation of successful management and company development. This sequence then leads to higher profits, since there is good coordination within the organization.

7.CONCLUSION

Communication is an indispensable item of all relationships. It is common among the people in the street, in a store, bank, coffee shop, at home, school, court and church. Today, new forms of communication are present through a variety of media: television, telephone, computers – the Internet (e-mail, chat ...).
All our projects are more or less related to each other. The diversity of our project topics - from the organization, managers, teamwork, ethics, religion, environmental awareness, strategy B player, tourism, tax free state relations in the company to the breeding of ostriches, are all the consequences of communication. They are all results of an agreement among the members of a team, as well as of all of the teams together. There must have been an agreement, since, as we can see, they are all different subjects. The meetings resulted in harsh selecting of topics for which teams thought might help in achieving a specific goal, or finding out and stressing the shortcomings that would lead to prosperity, as well as their alteration. Communication here is not a goal, but a means. We are actually trying to learn how to communicate with each other through our projects. Our desire is to raise communication to a higher level, i.e. the level at which we could minimize conflicts, where misunderstandings could be solved by negotiation, not conflict. As children learn to set words in a sentence, so we learn how to have competent communication. The essence of everything is that we must think about the others, not only ourselves. The company's communication is necessary. Here we encounter a variety of communication types: employer-employee relations (top down) and employee - employer (bottom up). Communication is a very important in the Government and the Assembly. There should be a perfect communication process without any problems, because these people were given our trust to guide us in the right direction, the direction of prosperity. Compromise is the key word that should result in communication rather than verbal or physical conflict. Each of us can give up part of their interest if the goal is of general interest. We all need to ask ourselves which level of communication we are at and what we can do to improve this communication. We should strive to become better by learning from the best, so that one day we become good source of knowledge, which we will be able to convey to others. Our purpose is to become autopoesis.

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ION CONDUCTING GEL: PREPARATION AND CHARACTERIZATION

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Abstract: *Synthesis of tetraethyl orthosilicate based proton conducting gel incorporating hydrazinium sulfate purified (N2H6SO4) was performed in this work. The characterizations have been done by the XRD and Wagner's polarization method. The partial amorphous structure of the gel gas been observed, as XRD shows a broad hallow at 10-50o. The ionic transference number was determined by the Wagner's polarization method, and it was observed that the transference number for both pure N2H6SO4 and synthesized gel were close to one. The dependence of conductivity on a relative humidity and temperature has also been measured. The conductivity initially decreases above the room temperature, due to the release of the surface adsorbed water.*

Keywords: *electrical conductivity, sol - gel mechanism, XRD, Wagner's polarization method, proton conducting gel*

1.INTRODUCTION

Superionic solids or "solid electrolytes" have attracted the great interest of the research community due to their potential application in energy storage devices (solid state batteries, dye sensitized solar cells, supercapacitors, actuators, etc.) [1-6]. Superionic solids are characterized by the ionic bonds, high electrical conductivity (>10-6 Scm-1) and low electronic conductivity. The principal charge carriers are ions, and their mobility is governed by the radius/charge ratio, ionic polarizability and the structural disorder of the lattice that provides vacancies and positions for the ionic mobility [7-14]. Defects that allow exchange of the places between neighboring ions can be divided in two classes: point defect type (thermally generated Schottky vacancies, Frenkel interstitials) and molten lattice type (ions are moving as free ions from one position to another). According to their composition and structure, fast ion conducting materials can be: a) frame crystalline materials; b) ion conducting glasses; c) composites and dispersed phase materials; d) ion conducting polymers and e) ion conducting gels.

Ion conducting gels are of the special interest as they are rather promising class of the material in the field of the ion conducting solids. The gel is defined as the substance which contains the solid skeleton and the continuous liquid phase, and the sol is the dispersion of the solid particles in liquid phase. The condition for the transformation of sol to gel is that strong particles - solvent interactions must be present in order to bind the solvent, and therefore not every sol can be converted into gel [15]. Gels are usually prepared by the sol - gel techniques from the various precursors that can be classified as the inorganic or organic [16, 17]. The sol - gel process itself can be divided to the aqueous based (start from the solution of the metal salt) and alcohol based (start from the metal alkoxide) [18].

based (start from the solution of the metal salt) and alcohol based (start from the metal alkoxide) [18].

In the aqueous based sol - gel process, the first step is the formation of the sol, and hydrolysis of metal cations. If the silicates are present in the system, silicone acid is present in the acid environment due to the hydrolysis. Once the silicone acid is present in the system, polymerization starts by the condensation of the silanol groups. Polymerization occurs in three stages. In the first stage, primary particles are formed through the silanol condensation. The condensation occurs in the manner of favoring the formation of the Si-O-Si bonds, and avoiding the placement of hydroxile groups at the terminal position in the chain. Three dimensional particles are formed, and are condensed to the compact state, leaving the most of the hydroxile groups outside the particles [14, 19]. In the further stages, particles are dissolved, and again precipitated on larger, less soluble nuclei. The growth of the particles terminates when the solubility of the larger particles approaches to the solubility of the smaller particles (difference in the order of magnitude of a few ppm). The polymerization rate is in strong dependence on the pH value of the solution. In the very acid environment (pH lower than 2), the polymerization rate is directly proportional to the concentration of hydronium ions, and at the higher pH values, is directly proportional to the concentration of hydrohyle groups. At low pH values, particles have small ionic charge they can collide, and can form the network by aggregation which leads to the formation of gel. Usual particle dimension when the growth stops at such a low pH value is between 2 and 4 nm. At the higher pH values, condensed species are more likely to be ionized, and thus the particles growth continues. However, those values may vary, due to the nature of the salt [20].

The alcohol based sol - gel process involves the hydrolysis and condensation of the metal or metalloid acoxides. Contrary to the aqueous procedure, the step of the gel formation is not distinct. Reactions of the condensation and hydrolysis occur simultaneously, leading to the formation of the gel as a final product. The gels obtained from the tetrasilicone derivate are of the high interest in this field of the research. The path of the reaction is hydrolysis (replacement of the alkoxy group by the hydroxyl group); condensation (formation of the siloxane bonds and alcohol as the by-product). The produced alcohol serves also as a mutual solvent for the siloxanes and water. The formed amount of the alcohol is sufficient to homogenize immiscible water and alkoxysilanes. The properties of the formed gel however depend on the water/alkoxide molar ratio, temperature, choice of the solvent and the nature of the catalyst [21, 22].

Alternation to the standard process can be made with the organic constituents for the modification of the oxide polymers. Those materials are classified as the organic modified ceramics or ceramic polymers. The organic network can be linked to the inorganic carrier, and variety of the modifications could be obtained. Those materials possess properties of both inorganic and organic materials [23].

Ion conducting gels offer various general advantages: they can be easily molded in various shapes, their viscosity can be controlled which allows various deposition methods, anisotropic layers exhibited improved properties, gel powders have high surface and amorphous gels contain large number of liquid filled micropores. Proton conducting gels are in general materials that charge transport is primarily by the hydronium ions or hydroxile groups. The mechanism of the hydratation involves the dissociation of the adsorbed water at the surface of the oxide. Hydronium ions are bonded to the oxygen site, while hydroxile groups are bonded the metal site. More water molecules from the environment can be adsorbed through the hydrogen bonds to the surface hydroxile groups. Those gels can be described as composite material made of solid particles and aqueous medium, and hence have specific properties. The hydrhile group bonded to metal

undergoes both acid and basic dissociation. The path of the dissociation mainly depends on a pH value and the oxidation state of the metal. The higher the charge, and the smaller the cation is, the more acidic dissociation is promoted. The conductivity of the proton conducting oxides is in the order of magnitude of 10-5 s cm-1 [24-26].

The conductivity of the gel strongly depends on the amount of water in the solid network. As the water molecules are positioned inside the solid network, and as the network is open, exchange of water with environment is rather easy. At the low water pressure, molecules of water are too far apart, and the proton cannot jump between the sites, and the electrical conductivity remains low. When the initial layer of water is adsorbed, proton conductivity occurred trough the ordered array of hydrogen bonded water molecules. At the very high water contest, water molecules are only weakly bonded to the oxide network, and conductivity is equal to the conductivity of the acid solution [27].

The transference number is defined as the ratio of partial conductivity of the mobile species and the total conductivity. The transference number of a material is equal to 1, and can be subdivided further to the electron/hole transference number (teh) and ionic transference number (ti). If the material is purely electron/hole or ionic conductor, those numbers respectively are equal to 1. The total ionic transference numbers of gel systems examined in this paper were evaluated at the room temperature by Wagner polarization method. The samples of five different compositions of the gel were measured at the room temperature. The pellets were coated with the silver in order to block mobile ionic species, and the constant voltage of 0,5V was applied to the sample. The current was monitored as a function of a time for a sufficiently long time to allow the complete polarization of the sample. From the current versus time plots, the ionic and electronic transference number (ti and te) were calculated using the equations:

$$t_i = (i_T - i_e)/i_T \quad (1)$$

$$t_e = i_e/i_T \quad (2)$$

Where iT and ie are the values of initial and final current after polarization respectively.

2.EXPERIMENTAL

The gel systems x SiO2+ (100-x) N2H6SO4 (x =10-90 mol %) were prepared by sol-gel process using tetra ethyl orthosilicate (TEOS – Si (OC2H5)4) and hydrazine sulphate (N2H6SO4) as precursor. The water solutions of the TEOS and hydrazine sulphate were prepared separately, and then mixed together in the stoichiometric ratio. The mixture was gelled for 160 hours at 30oC, and the resulting viscous gel was dried for 48 hours at 100oC. The gel was milled to the fine powder, and the pellets of 10 mm in diameter were made by the application of the pressure of 0,785 GPa

The properties of the super ionic solids have been determined by the X-ray diffraction - XRD (structural characterization) and Wagner's polarization method (ion transport number). The aim of the conducted XRD measurements was to examine the possible formation of the new material during the gelling process. The goal was also to determine the relative amorphicity of the formed gels and the possible presence of the crystalline phase in gels.

The measurement of conductivity is done on the single crystal of the solid electrolyte or pressed polycrystalline pellet. The sample is fixed between suitable electrodes, and the conductivity is measured. The geometry of the system strongly influences the measured

results, and therefore, the interpretation and the comparison of the results is rather complicated. The reasons include resistance of the electrode - electrolyte contact, interfacial electrode - electrolyte polarization and grain boundary conduction (in pressed pellet). Therefore, the measured conductivity can serve only as estimation, and do not represent the real values.
The unidirectional flow of current results into the formation of charge cloud at the electrodes and concentration gradient which opposes the effect of applied field. Therefore, the direct current measurement of electrical conductivity is not useful for solid electrolytes. To circumvent these problems, alternating current is generally used.

3.RESULTS AND DISCUSSION

The X-ray diffraction patterns of the 40(SiO2) +40(N2H6SO4) and 90(SiO2) +10(N2H6SO4) gels and pure N2H6SO4 are presented on Figure 1. It could be seen that the presence of amorphous silica appeared as a large band cantered at 21°. There is the broader halo on the X-ray difractogram of the 90 (SiO2) +10 (N2H6SO4) gel. It implies the amorphous structure of the gel which increases with the increase of the SiO2 amount.
The peaks in the halo region, as well as the peaks in the other regions of the pattern are obvious on the Figure 1a) and 1b). Comparing the position and intensity of peaks to the corresponding peaks on the Figure 1c) (the pure N2H6SO4), it is obvious that peaks are completely analogous and corresponding to each other. Therefore, it might be concluded that N2H6SO4 remain intact in the gel network of SiO2.

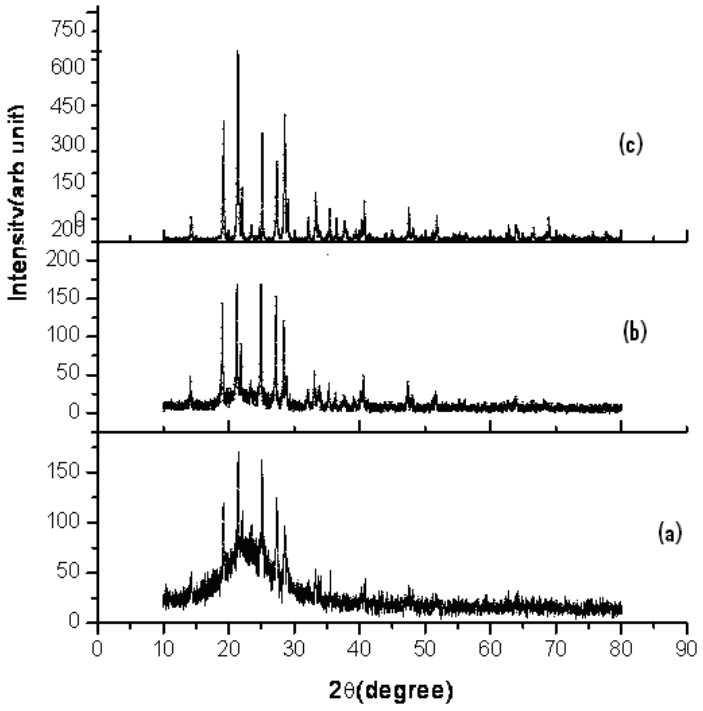


Figure 1. XRD pattern of a) $60SiO_2+40N_2H_6SO_4$; b) $90SiO_2+10N_2H_6SO_4$ and c) pure $N_2H_6SO_4$

The values of the transference number were determined by the Wagner's method. The values of both ionic end electron transference numbers (ti and te, respectively) as a

dependence of the composition of gel is presented in Table 1. The typical plots showing the variation of current with time for compositions x = 90 mole% and 80 mole% of xSiO2 + (100-x) N2H6SO4 gel system are shown in figures 2 and 3.

Table 1: Values of ionic and electronic transference number of $xSiO_2$ +(100-x)$N_2H_6SO_4$

Samp. No.	Composition		t_i	t_e
	SiO_2 mol%	($N_2H_6SO_4$) mol%		
1.	90	10	0.97	0.028
2.	80	20	0.97	0.03
3.	70	30	0.96	0.031
4.	60	40	0.96	0.035
5.	50	50	0.97	0.0005

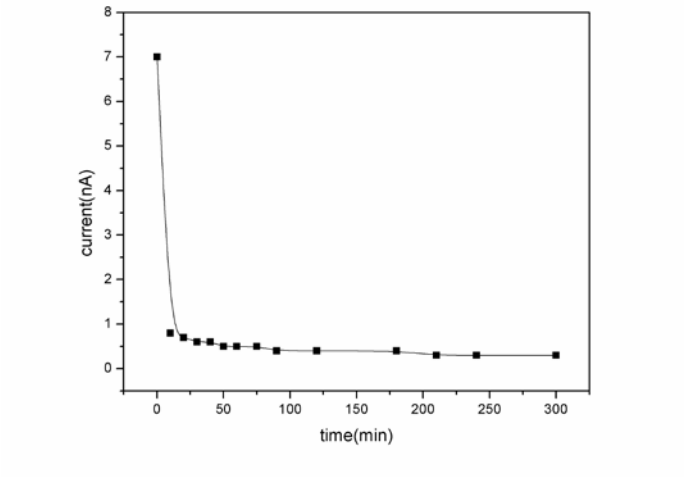


Figure 2. Current versus time plot for $90SiO_2$ + $10N_2H_6SO_4$ (temperature 30^oC; relative humidity 42 %)

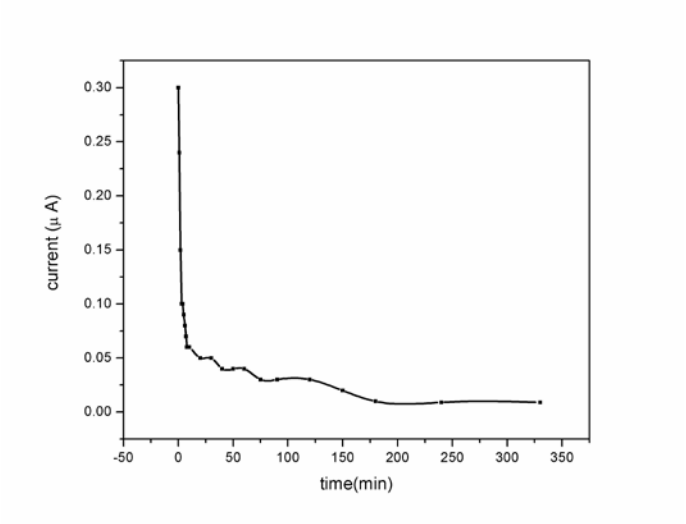


Figure 3. Current versus time plot for $80SiO_2$+ $20N_2H_6SO_4$ (temperature 28^{o}C; relative humidity 47 %)

This is to mention that above polarization experiment using Wagner's polarization method does not provide information about the type of charge carriers mobile in the prepared gel system. However, the gel systems studied by Rai and Chandra [6,7] on sodium metasilicate (Na2SiO3) based gels and Rai and Chandra (2000) on TEOS based gels have established that in sodium meta silicate based gels, mobile charge carriers are Na+ and H+ ions and in TEOS based gels, mobile charge carriers are H+ ions. On the basis of these results, we may also consider the H+ ions to be mobile in our gel systems and the other transport parameters may be considered to be arising from motion of H+ ions in the gel network.

From the Figure 4. it is obvious that the conductivity of the gel decreases with the increase of the concentration of SiO2, and that maximal observed conductivity is significantly higher comparing to the pure SiO2. This proves that the addition of hydrazinium salt enhances the conductivity of the silica gel.
Figure 4

The dependence of the bulk conductivity of the gel with SiO2/N2H6SO4 molar ratio 90/10 on the temperature as measured. The temperature range for the measurement was 20°C - 250°C. The change of the conductivity with a temperature is presented on Figure 5 (as the log δ vs. 1/T graph). Roughly speaking, the plot can be divided in the three zones: 25-115oC (zone I); 115-175oC (zone II) and 175-250oC (zone III). Starting from the room temperature, conductivity decreases from 2x10-5 s/cm (25oC) to 5.7x10-7(130oC). The reason for this decrease in the zone I is desorption of the surface adsorbed water. The conductivity increase in the zone II, and decreases again in the zone III. The reason of such a behavior is the phase transformation in the gel. The linear plot of the curve in zone II indicates the dependence of the conductivity of the Arrhenius type:

$$\delta=\delta_0 \exp\left(-E_a/k_B T\right) \quad (3)$$

The values for the pre-exponential factor δo and activation energy (Ea) in the zone II are calculated as 5.98 x 1014 s/cm and 0.074 eV respectively.

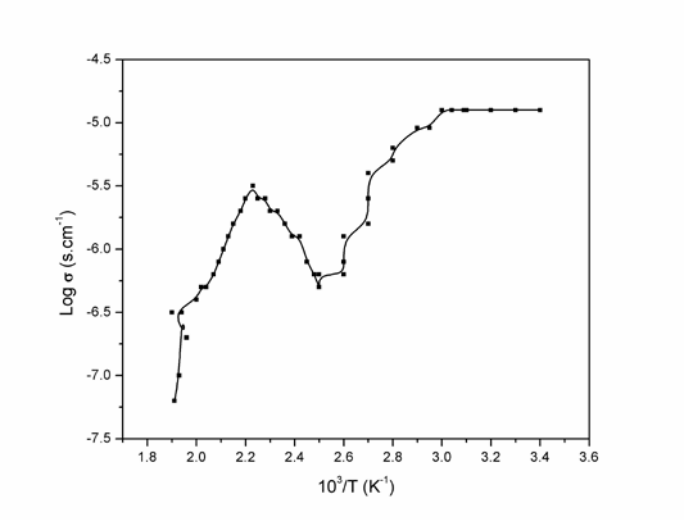
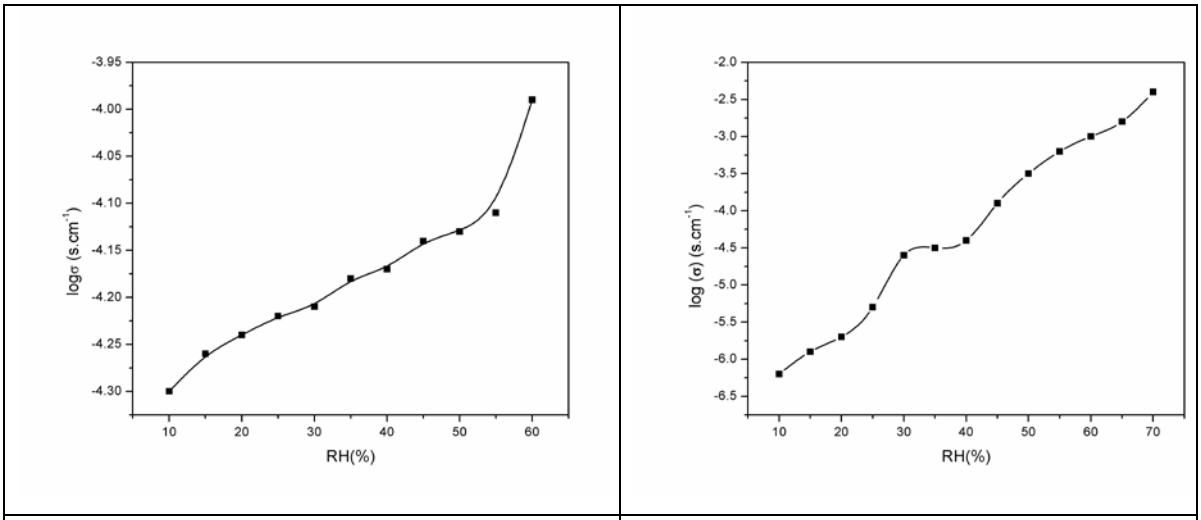


Figure 5. Temperature variation of bulk conductivity for $90SiO_2$ $+10N_2H_6S0_4$

The dependence of the conductivity on relative humidity was determined at the room temperature, by using the standard complex impedance / admittance method. The measurements were carried out at the constant humidity levels. The dependences of the conductivity on a relative humidity for two different gels are presented on Figure 6. (molar ratios SiO2/N2H6SO4 90/10 and 70/30 respectively). Both of curves indicate strong dependence of the conductivity on the humidity. With the increase of the humidity, conductivity increase as a consequence of the increased amount of surface adsorbed water. This water enhances formation of the Si-OH bond formation in the gel and increases the amount of hydronium ions. However, the measurements were done at the dynamic humidity level rather than the constant humidity. Therefore, the results are only indicative.



a) b)

Figure 6. Conductivity as a function of relative humidity for $SiO_2/N_2H_6SO_4$ a) molar ratio 90/10; b) molar ratio 70/30

4.CONCLUSION

The gel systems with silica gel - hydrazinium sulfate with different molar ratios of the components were prepared, and their conductivities were measured. The synthesized gel contained residual hydrazinium sulfate, and belong to the class of the ionically conducting gels. The total transference number is close to 1. The highest conductivity was obtained for the gel with 90 mol % of the silicon dioxide (~10-5 s/cm) at room temperature. The change of the conductivity with the increased temperature is due to of loose of the surface adsorbed water. In the temperature range 125-175°C, the dependence of the conductivity of a temperature is governed by the Arrhenius type equation. The conductivity also increases with the temperature, due to the increased amount of the adsorbed water.

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MANAGEMENT INFORMATION SYSTEM AND DECISION MAKING PROCESS IN ENTERPRISE

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Abstract: *Management Information System (MIS) is basically concerned with the process of collecting, processing, storing and transmitting relevant information to support the management operations in an organization. Thus, the success of decision-making, which is the heart of administrative process, is highly dependent partly on available information, and partly on the functions that are the components of the process. This paper will discuss the concept, characteristics, types of MIS, the MIS model, and in particular it will highlight the impact and role of MIS on decision making.*

Keywords*: information, management information system, decision making process*

1. INTRODUCTION

Management Information System (MIS) is an organized, automated, and diverse information system that gathers, stores, processes, and distributes data associated with different departments of the organization. This data is processed in various forms, such as graphs, diagrams, charts, and reports to generate accurate, relevant and valuable information for the management. This information is further communicated to the various departments to be used for decision-making and business management. MIS system provides central storage of all the business information. There are various types of MIS systems which are used to gain better understanding of the market and enterprise.

MIS is used across all levels in an organization. For example, MIS provides vital information at senior levels to help make strategic decisions. At other levels, MIS observes an organization's activities and distributes information to everyone in the organization and customers. MIS is very important for every organization because it not only collects and manages information, but also represents it in various formats useful for the management to make important organizational decisions.

2. MIS CONCEPT AND INFORMATION

Information is a set of classified and interpreted data used in decision making and it has also been defined as “some tangible or intangible entity which serves to reduce uncertainty about future state or events” [1]. Management information is an important input at every level in the organization for decision making, planning, organizing, implementing, and monitoring and controlling. In the context of different levels of decision making, information can be described as:

- source,
- data,
- inferences and predictions drawn from data,

- value and choices (evaluation of inferences with regard to the objectives and then choosing a course of action), and
- action which involves course of action.

Management information system is one of the major computer based information systems. Its purpose is to meet the general information need of all the managers in the firm or in some organizational subunits of the firm. A subunit can be based on functional areas on management levels.

There are many definitions for MIS, but one of the most appropriate definitions describes management information system (MIS) as "an organizational method of providing past, present and projected information related to internal operations and external intelligence. It supports the planning, control and operation functions of an organization by furnishing uniform information in the proper time frame to assist the decision makers" [2]. The information in MIS describes the firm or one of its major systems in terms of what has happened in the past, what is happening now and what is likely to happen in the future. The information is made available in form of periodic reports, special reports and output of mathematical simulations. All managers use the information output as they make decisions to solve the firm's problems [3].

A management information system has also been defined as "an integrated user-machine system for providing information to support operations, management and decision making functions in an organization. The system utilizes computers, manual procedures, models for analysis, planning, control and decision making, and a database" [4]. MIS facilitates managerial functioning and it is an important system because of its content, form and timing of presentation.

3. MIS CHARACTERISTICS

In general, management information systems have a number of characteristic, which include the following [5]:

☐ **Report with fixed and standard formation.** For example scheduled reports for inventory control may contain the same type of information placed in the same location on the reports.

☐ **Have report developed and implemented using information system personnel, including systems analysts and a computer programmer.** Typically analysts and programmers are involved in developing and implementing MIS reports. Users are normally involved in the design of the reports, but they are not typically involved in writing the computer programs to produce them.

☐ **Require a formal request from users.** Because information systems personnel typically develop and implement MIS reports, a formal request to the information systems department for report is usually required.

☐ **Produce scheduled and demand reports.** The major type of reports produced by MIS is scheduled; demand reports (Stair, 1992).

☐ **External data is not captured by the organization but is used by MIS,** (i.e., customer, supplier and competitor information).

4. TYPES OF MIS

MIS can be categorized as follows:[6]

· *Databank information systems* refer to creation of a database by classifying and storing data which might be potentially useful to the decision-maker. The information provided by the databank is merely suggestive. The decision-maker has to determine contextually the cause and effect relationships. MIS designs based on the databank information system are better suited for unstructured decisions.

· *Predictive information systems* provide source and data along with predictions and inferences. The decision-maker can also enquire as to 'what if a certain action is taken?' and whether the underlying assumptions are true. This type of MIS is useful for semi-structured decisions.

· *Decision-making information systems* provide expert advice to the decision-maker either in the form of a single recommended course of action or as criteria for choice, given the value system prevailing in the organization. The decision-maker has just to approve, disapprove or modify the recommendation. Decision-making information systems are suitable for structured decisions. Operations research and cost-effectiveness studies are examples of decision-making information systems.

· *Decision-taking information systems* integrate predictive information and decision-making systems.

5. MIS MODEL

The database contains the data provided by accounting information system. In addition, both data and information are entered from the environment [5]. The data based content is used by software that produces periodic and special report, as well as mathematical model that simulate various aspects of the firm operations. The software output is used by people who are responsible for solving the firm's problems. Note that some of the decision makers might exist in the firm's environment. The environment will involve once the firm bonds together with other organizations such as suppliers to form an Inter Organizational Information System (IOS). In such case, MIS supplies information to the other member of the IOS [3]. MIS model is illustrated in Figure 1 [3].

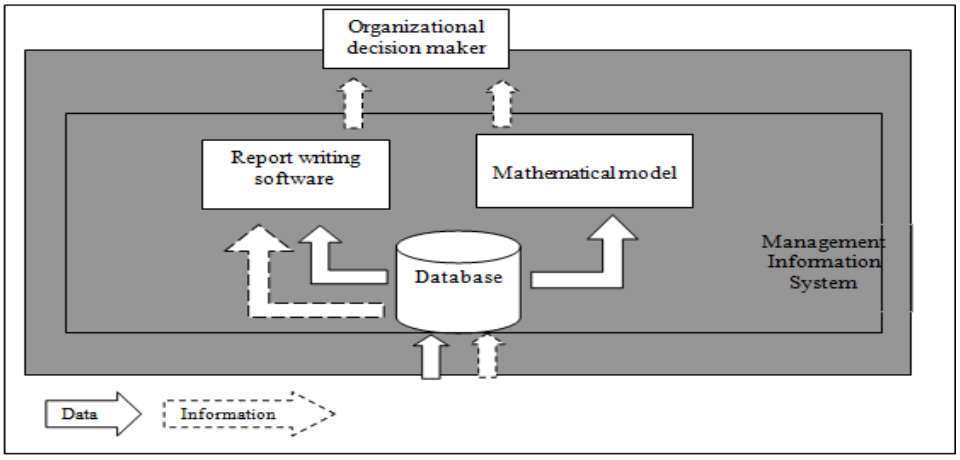

Figure 1: MIS Model

6. MIS AND DECISION MAKING PROCESS

MIS is a system providing management with accurate and timely information. Such information is necessary to facilitate the decision-making process and enable the organizations planning, control, and operational functions to be carried out effectively. MISs increase competitiveness of the firm by reducing cost and improving processing speed. The power of technology has transformed the role of information in a business firm. Now information has become recognized as the lifeblood of an organization and without information, the modern company is dead [7].

MIS and its organizational subsystems contribute to the decision making process in many ways. Power [8] has stated that making decisions is an important part of working in the business environment. Companies often make decisions regarding operational improvements or selecting new business opportunities for maximizing the company's profit. Companies develop a decision-making process based on individuals responsible for making decisions and the scope of the company's business operations. A useful tool for making business decisions is a management information system. Historically, MIS was a manual process used to gather information and funnel it to individuals responsible for making decisions.

MIS is an organization – wide effort to provide decision making process information. The system is a formal commitment by executive to make the computer available to all managers. MIS sets the stage for accomplishments in the other area, which is DSS, the virtual office and knowledge based systems. The main idea behind MIS is to keep a continuous supply of information flowing to the management. Afterwards, by data and information gathered from MIS, decisions are made [5].

According to Obi (2003), MIS is useful in the area of decision making as it can monitor by itself disturbances in a system, determine a course of action and take action to get the system in control. It is also relevant in nonprogrammer decisions as it provides support by supplying information for the search, the analysis, the evaluation and the choice and implementation process of decision making. Adebayo (2007) stressed the need for MIS in decision making as it provides information that is needed for better decision making on the issues affecting the organization regarding human and material resources [9].

MIS may be viewed as a mean for transformation of data, which are used as information in decision-making processes. Figure 1 shows this understanding about information as data processed for a definite purpose [10].

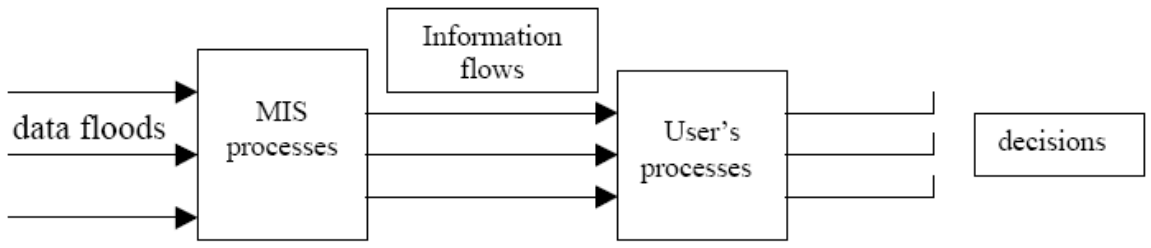

Figure 2: MIS and decision making process

MIS differs from regular information systems. The primary objectives of these systems are to analyze other systems dealing with the operational activities in the organization. MIS is a subset of the overall planning and control activities covering the application of humans, technologies, and procedures of the organization. Within the field of scientific management, MIS is most of ten tailored to the automation or support of human decision making [11].

7. CONCLUSION

The role of information in decision making cannot be overemphasized. Effective decision making demands accurate, timely and relevant information. MIS provides accurate and timely information necessary to facilitate the decision-making process and enable the organizations planning, control, and operational functions to be carried out effectively. MIS also plays the crucial role of providing a wide range of streamlined options from which decision-makers are able to make their preferred choices and this ensures that whatever choices are made by decision makers, the outcome, more often than not, becomes positive. This, as a matter of fact, is the reason why many decision makers tend to prefer using MIS tools when making tough business choices. MIS as renowned concept, having good decision choices guarantees viable decisions in our businesses.

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WASTE HIERARCHY CONCEPT IN RELATION WITH EUROPEAN AND WORLDWIDE USED LUBE OILS MANAGEMENT PRACTICES

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Abstract: *Benefits of waste lube oils management are well known. They impact the environment, the public health, and the economy. These aspects have different priorities of the same measures in managing this kind of waste. Consequently, different strategies for solving this problem have emerged in different parts of the world. This paper shows the data from literature management practices in various world regions related to waste hierarchy concept. It also shows insight into the situation in Serbia.*
Keywords: *waste lube oils management, stocks, environment, economy*

1. INTRODUCTION

Used lube oils is just a part of waste oil stream. From the environment and economy point of view it is the most important one. Other streams are: fuel tanks residues and sludge on the ships and on the land, contaminated fuels, emulsions, and water contaminated with different non biodegradable oil, waste food oils, etc.
Two major types of lube oils are: automotive and industrial lubricants. Industrial lube oils presents less than 30% of the collectable waste oils in EU. They are under better control, part of them can be re-used and recycling process can be done “on site” in some cases. Collecting of waste is much easier and with lower costs. It is a usual practices that supplier of lube oils are the collector of waste oils at the same time [1].
Automotive lube oils are mainly engine (motor or crankcase) oils and gear (transmission) oils.

Engine oils present the biggest single waste oil stream. It is also more specific and lower percentage of these used oils is recycled. Engine oils have shorter service interval (6-24 months) then gear ones (5-10 years) and the service fill is usually double. As a result more than 90% of the marketed automotive lubes are the engine oils [2,3].
Lube oils are mixtures of base stocks (oils) and additives. Most industrial oils contain no more than 5% additives whereas most motor oils contain up to 20–25% additives. Some of industrial lubes are pure base oils without additives [4].
Base oils are produced mainly from crude oil, even when they are synthetic ones. During the use, lube oils became dirty, but only additives are worn and the base oil remains almost same as new especially in the case of industrial oils. In the case of engine oils few percents of it could be (thermally) degraded. Contaminates of the combustion of fuel are present in used oil as well as heavy metals from depleted additives and wear. Thus, used (engine) oil is a hazardous waste [5].

The key difference in processing used oil to manufacture automotive oils, industrial oil and fuels is energy and processing severity. A more severe process is needed to produce

base oil for automotive use and this requires higher capital investment. Industrial oil processing is less severe.

2. WASTE HIERARCHY CONCEPT

Current EU waste policy is based on a concept known as the 'waste hierarchy', which classifies the different options for managing waste from 'best' to 'worst' from an environmental perspective: Prevention; re-use; recycling; recovery; and disposal [6].

Figure 1. Waste Hierarchy Concept [7]

Although the waste hierarchy should not be seen as a rigid rule, the aim of moving towards a recycling. In more general concept, the minimisation should be added between prevention and re-use but it can be treated as the part of prevention. It could be said that waste hierarchy in similar form is worldwide accepted. It is often called Resource Conservation Hierarchy [7].

Managing waste engine lube practice is extraordinary example of making compromises between different influences: technical and economy vs. environmental.
There is no big limitation from technical point of view but they exist. Engine oils are hard to re-use. Prevent the waste in the first place is possible to some extent. Recycling to meet all environment requirements is complex from technical side.
Economy is more difficult to go with this concept but fortunately it is not completely opposite. With some legislation assistant economy can be (and almost is) nearly equalized for all options in the concept. The biggest obstacles were interests of industries directly connected with the issue.

It is obvious then lube (oil) industry has not interest for extended oil drain intervals. It found its interest with more expensive synthetic oils which equalized smaller quantities of lubricants. But construction of engine was not ready for the possibilities of synthetic lubes. Low share of market for the synthetic oils was obvious till mid-90 in XX century. New ecological legislation gave the automakers difficult task to fitful them and they have lot of technical problems in 90's but after technical improvement in late '90s the pressure has moved on lubricant producers which has to adopt new formulations for the new requirements which also reduced the quantity of lubricant in vehicles. Oil industry, also, have no big interest in recycling waste engine oils. Virgin base oils are less expensive and recycled oils are not competitive with them. The quality of recycled base oils is much smaller problem, although is technically demanding one [8,9].

Legislation is important part of the waste oil management but can not solve the whole problem.
Same legislation often leads to different practice and results where EU is the best example.

3. PREVENTION AND MINIMISATION OF WASTE ENGINE OIL STREAM

Although possibilities exist and base for this option are very serious, it is not achieved as much as possible in this field. Theoretically, the quantity of waste engine oils per vehicle could be several times less, and the total quantity at least half of the one 20 years ago. But actually it was not happened. Over the period from 1995 to 2003 the total quantity of oil marketed/sold, in EU, decreased by 11% [6]. Since the number of cars raised from 230 million to 290 million (26%) [9], during that period the result is more significant.

Automakers achieve big improvements in better usage of engine (and gear) lubes during the last decade of XX century and in the first decade of the XXI. Long life oil drain intervals become very common. European car makers are extended drain intervals from average 7500 km (5000-10000 km) in 80's to 30000 km (20000 to 50000 km) nowadays. What's more, they reduced quantity of service fill for approx. 20% (from 5 to 4 liters). The transport vehicles have even more extension of the oil drain intervals (with similar service fill), typically from thirty thousand to 120 thousand km [10].
It gave conditions for 5 times less quantity of waste stream for the cars no older than 5 to 10 years theoretically but in the practice reduction was much smaller. However EU is obvious world leader in the minimisation of waste stream since there is no decrease in lube market in other regions of the world. North America has slow growth (less than 10%) in last decade [9] and Japan has a volume which has remained stable for the past decade [5,10]. On the other hand BRIC (Brazil, Russia, India, and China) has growth of 30% from 1998-2008 and now has ¼ of global consumption, same as Europe [6]. Europe is also leader in use of biolubricants, followed with Japan, even market share is still symbolic one, 2% in 1999, with estimates that would be 5% by 2010 [8]. Biolubricants would be the most important way for minimisation of waste oil (WO) as hazardous. Major obstacle for biolube growth is their higher prices.
The biggest improvement in the prevention can be achieved due the fact that almost 48% of total lube oils in 2006 are lost during use (evaporation, combustion) and through leakages [9]. It leaves plenty of room for improvement in minimisation of waste.

4. RECYCLING VS. INCLINATION (ENERGY RECOVERY)

Legislative framework for waste oils management at European level is:
Directive 75/439/EEC from 16. June 1975, followed by Directive 87/101/EEC from 22. December 1986 (amending Directive 75/439/EEC). Directive 2008/98/EC from 12/12/10 (as more general) repeals the Directives 75/439/EEC, 91/689/EEC and 2006/12/EC [8].
Serbian legislative is partly harmonized with the EU and is based on the "Zakon o upravljanju otpadom" ("Sl. glasnik RS", br. 36/2009 i 88/2010). Subordinate legislation is still in progress and should be completed in the next few years.

The directive 87/101/EEC gives regeneration priority over other disposal. However, some studies and practice itself shows different point of view and less rigid position about the priorities. "Combustion of used oils in cement kilns or in power plants under controlled conditions provides better, or at least, equivalent benefits in terms of crude oil and energy savings" [11]. The average WO collection rate reached about 70-75% in the E.U. and was stable during the period between 1994 and 2000. In 2003 collection rate was 81% [12,13].

Similar collection rate of about 75% had Canada. Japan and Brazil [14,15] virtually collect all used oil and are world leaders in this segment of WO management. In Serbia WO collection rate is only about 10%. The most of those 3000 tons was incinerated but percentage of recycled WO rising since end of the first decade of XXI century.

An average of 25% of the collectable WO (and 33% of the collected WO) would have entered a regeneration plant in the EU and two times more (50% and 67% respectively) of WO were energetically used in the E.U., in 1999. Uncollected WO (20-25% of collectable) is illegally burned or dumped in the environment; include sewage, where concentrations of 50 to 100 ppm of used oil can foul sewage treatment processes [16]. Waste oil management in USA shows different results with WO collection rate of 46.7% in 2000 and 47.9% in 2005 but with two-thirds of total collected WO recycled (32% of total waste generated where just 15,9% was incinerated) [13]. Problems are not just higher cost for WO recycle then for produce virgin base oils but also high investment cost for WO recovery plants. European WO regeneration industry is global leader and is constituted of about 28 plants; nearly 4000 people are employed in re-fining and in WO collection [9].

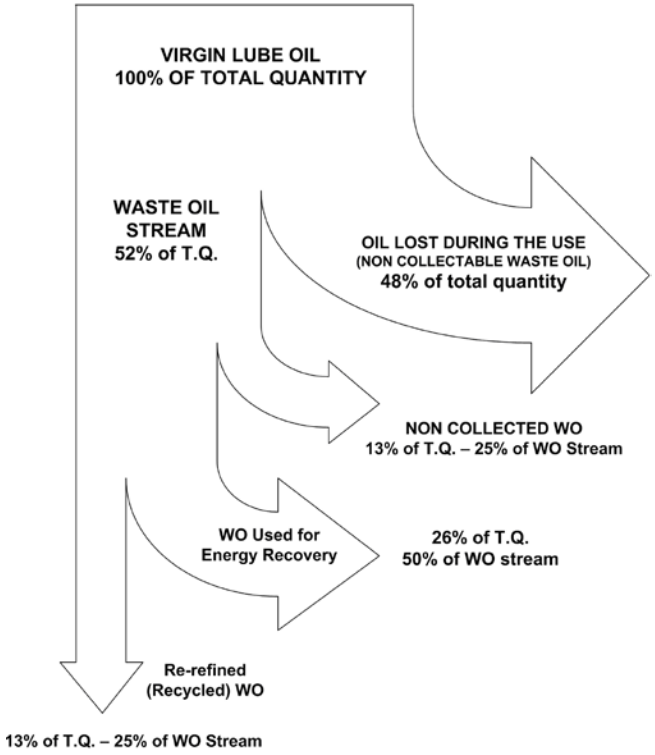

Figure 2. Distribution of lube oil in EU

Figure 2 shows the ways for improvements:

1) Main losses in the cycle are the waste during the use. Inappropriate handling, storage and operating procedures, is the leading problem that has to be solved by waste management in near future [16]. It is also important to make more rigorously standards and approvals for the lube oils in the terms of seals for lube oils and their better implementation.

Education of lube oil users is very important part of the process and not just regulations.

2) Collection rate could be higher as stated above. WO from 'Do-It-Yourself' (DIY) oil changes are less likely to be collected so the risk of improper disposal is higher [17]. Main issue in WO collection is its high costs.

3) The acceptance of re-refined oils in the marketplace is improving. It is significant for recycle rate which stagnate in many regions.

In Serbia a few companies have the plants. The first company with licence for WO recycling was "Ekosekund" d.o.o. Beograd, followed by "Delta" Company from Kladovo and Remol from Merošina (Niš) in process. Destilation or thin film evaporation are the main treatments. "Delta" Kladovo is the biggest recent investment in WO recycling (about 2 million euros) in Serbia. Greater significance is in fact that facility also processes other waste streams as: fuel tanks residues and sludge on the ships, contaminated fuels, emulsions and water contaminated with different non biodegradable oils. Oil Refinery Belgrade has old re-refining plant (from 1978.) with capacity of 22,000 tons per year which is about half of the used quantity in the country. Plant uses process of solvent extraction with propane and treatment with hydrogen. This is still the most advanced plant in the Serbia but unfortunately doesn't work continuous from economical reasons.
Although regeneration of used/waste oil can produce base oils of adequate quality, very severe and energy consuming re-refining processing needs to be employed to accomplish this. Quality of refined used oil is shown in the table 1 [17]. It is clear that recycled oil is comparable quality with fresh lube oil but it cannot be used for all purposes or even same for the top tier products.

Table 1. Results of tests using the various refining methods [17]

Parameter	Fresh lube oil	Used lube oil	Distillation /clay treatment	Acid / clay treatment	Acid treatment method	Activated charcoal / clay treatment
Water content v/v	< 0.20	13.70	0.66	0.40	0.60	0.47
Specific at gravity at 60°F	0.90	0.91	0.86	0.88	0.86	0.86
KV at 100°F (Cs)	82.20	61.60	84.10	82.00	84.20	80.20
Viscosity Index	92.80	21.10	85.80	88.90	84.40	86.80
Flash point °C	188.00	120.00	168.00	182.00	170.00	178.00
Pour point	-9.00	-35.00	-16.00	-11.00	-15.00	-13.00
Sulphur content	-	0.80	0.05	0.04	0.04	0.04
Iron (ppm)	-	22.50	10.30	2.60	10.50	9.50

The major disadvantage of the above conventional technologies, shown in the Table 1, is incomplete removal of heavy metals from waste oils.

European Petroleum Industry Association (Europia) believes that the re-refining processes should include, as a minimum, (a) thin film evaporation/vacuum distillation, plus either (b) severe hydrogenation/hydro cracking, or (c) solvent extraction, (a combination of both would be preferable) and hydro finishing as a finishing step [5]. It might be a point of view from the interests of the association; however, it is more or less confirmed in several other studies [9].
Practice shows, at least, that the controlled combustion is more economical method. From 2000 to 2004 price of WO increased by 120% to 80€ per ton in Germany [10] and exceed

100$ per ton in United States and used oil transport with re-refining operational cost are over 200$ per ton [15-17].

5. CONCLUSION

Waste oil management practice is fairly in line with waste hierarchy concept in EU but also worldwide. Main differences are in efficiency. Lot of improvements could be done. It is opinion that the easies one is the most important one. It gives opportunity for waste oil management system to make improvement with optimal resources usage. Stimulating of recycling and environmental restrictions on used oil combustion has given good results in EU and elsewhere. In all, recent worldwide activities relating to used oil management shows that the subject continues to be a controversial issue with many varied opinions.

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DETERMINATION OF POLYMETALIC ORE VALUE

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Abstract: *Value of ore is a most important parameter for determination of its quality. This parameter is especially dominant lately, when wave of companies' privatization embraced our country. In such situation, most accurate evaluations of natural goods are required.*
This paper presents methodology for ore evaluation in ore bodies of Lece mine. Based on available geological data, authors have calculated volumes and quality of mine's ore reserves. Geological ore reserves were classified by ore bodies and categorized. Exploitable ore reserves were calculated, along with volumes of metals by ore bodies and a value of ore concentrate. The calculation was difficult due to a fact the deposit is polymetalic, with two outputs: lead concentrate and zinc concentrate, and with four metals participating – lead, zinc, gold and silver.

Keywords*: value of ore, value of ore concentrate, lead and zinc ore deposits, ore reserves.*

1. INTRODUCTION

Lece mine is situated in southern Serbia, at the eastern part of Lece andesine massif, which is located from Arbanas mountain at north to Ajkobila and Propastica mountains at south. Geographically, it belongs to village Medvedja near Leskovac town.

Mineral processing plant is placed in village Gazdare, along the Medvedja – Lece road.

Polymetalic lead and zinc ore deposit Lece, with significant percentage of gold and silver, has been mined since 1931. Some 3 million tons of ore has been extracted so far.

In a period from 1931 to 1941, 58,822 t of ore had been extracted. In 1941 the production was stopped.

After World War II, the mine was reactivated, followed by further explorations. Until 1953, the mine was completely renewed and new mineral processing plant was built in Gazdare village, with a 100,000 t annual capacity. Besides processing plant, cyaniding facility was built in 1956, too.

During the period between 1953 and 1990, a total of 2.88 Mt of ore was exploited and processed. Average metal content in the ore was: 1.55 % Pb, 3.43 % Zn, 3.78 g/t Au and 16.16 g/t Ag.

Period between 1990 and 1997 brought a serious decrease of production, with strong variations of annual outputs.

Between 1997 and 2000, Lece mine and its mineral processing plant were a part of Trepca Company, from Kosovska Mitrovica. During this period, Lece mine was very limited in its independency, and its further development was disabled.

In 2001, Lece mine was separated from Trepca Company, renewed its independency and started its development from the beginning [5]. During this year the mine was renewed, objects at the surface and underground transport drifts were rehabilitated.

In 2001 the production slowly started, by engaging a contractor, but it was insufficient to completely activate the mine and reach expected production, adequate for

survival at the market [4]. The most important difficulty in this period was lack of working assets. Unfortunately, since 2001, the production in Lece mine is minimal.

2. ORE RESERVES

Success of ore production and processing companies is strongly related to available ore reserves and their quality.

Last calculation of ore reserves for Lece mine was performed in 1986 [1]. This calculation included only three main ore bodies: Suta – Rasovaca, Jezerina 1 and Jezerina 2, along with veins 43, 1058 and 1059. Number of minor veins was excluded from this calculation, so their reserves belong to category of out – of – balance reserves.

Exploitable reserves are gained when we take away exploitation ore losses and add in the incoming waste. Designed ore losses for ore bodies in Lece mine reach 12 – 20 %. For this type of deposit, expected ore dilution is 10 – 20 %.

Based on available geological data, ore reserves in Lece mine are given in table bellow.

Table 1. Overall geological ore reserves classified by categories and ore bodies [1], [2]

Category of reserves (ore body)	Bulk ore (t)	Dry ore (t)	Percentage of metals in the ore			
			Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)
''A'' category reserves	963,170	917,305	1.58	3.33	2.69	15.14
Suta –Rasovaca	459,161	437,296	2.03	4.28	2.77	12.47
Ore body 2	367,967	350,445	1.25	2.70	2.08	10.93
Jezerina 1	119,527	113,835	0.96	1.73	4.31	38.35
Jezerina 2	16,515	15,729	1.20	2.30	2.20	15.00
''B'' category reserves	526,548	501,474	2.20	4.21	3.62	14.14
Suta –Rasovaca	257,835	245,557	2.55	4.75	3.31	19.56
Ore body 2	80,220	76,400	1.93	3.81	2.03	14.78
Jezerina 1	136,373	129,879	1.99	3.93	5.03	30.56
Jezerina 2	52,120	49,638	1.39	2.93	3.91	44.45
''C_1'' category reserves	727,558	692,912	2.27	4.21	3.95	26.59
Suta –Rasovaca	371,585	353,890	2.70	4.79	3.50	21.06
Ore body 2	133,488	127,131	1.93	3.81	2.04	14.79
Jezerina 1	132,093	125,803	1.99	3.87	7.13	40.46
Jezerina 2	90,392	86,088	1.39	2.91	3.99	46.44
Overall: A+B+C_1	2,217,276	2,111,691	1.95	3.83	3.32	21.03

Exploitable ore reserves, with 80% recovery and maximal 20% dilution, equal geological reserves – 2,217,216 t.

Potential ore reserves, C_2, were gained by estimation, both for deeper parts of the deposit and strike ore structures which were not included in former explorations.

According to estimation, there are 2,000,000 tons of ore with following percentages: Pb, 0.93%; Zn, 1.98%; Au, 2.38g/t; Ag, 14.96g/t (percentages of metals match the C_1 category reserves).

Estimated D category reserves reach 15,000,000 tons of ore. Ore bearing ratio used for estimation is K_v = 793,157 t/km^2, for the area of quartz zones of 19 km^2.

Table 2. Overall geological reserves classified by ore bodies and categories [1], [2]

Ore body (category of reserves)	Bulk ore (t)	Dry ore (t)	Percentage of metals in the ore			
			Pb (%)	Zn (%)	Au (g/t)	Ag (g/t)
Suta –Rasovača	1,088,581	1,036,747	2.38	4.56	3.15	17.08
''A'' category reserves	459,161	437,296	2.03	4.28	2.77	12.47
''B'' category reserves	257,835	245,557	2.55	4.75	3.31	19.56
''C_1'' category reserves	371,585	353,890	2.70	4.79	3.50	21.06
Ore body 2	581,675	553,976	1.50	3.11	2.06	12.35
''A'' category reserves	367,967	350,445	1.25	2.70	2.08	10.93
''B'' category reserves	80,220	76,400	1.93	3.81	2.03	14.78
''C_1'' category reserves	133,488	127,131	1.93	3.81	2.04	14.79
Jezerina 1	387,993	369,517	1.67	3.23	5.52	36.33
''A'' category reserves	119,527	113,835	0.96	1.73	4.31	38.35
''B'' category reserves	136,373	129,879	1.99	3.93	5.03	30.56
''C_1'' category reserves	132,093	125,803	1.99	3.87	7.13	40.46
Jezerina 2	159,027	151,455	1.37	2.85	3.78	42.52
''A'' category reserves	16,515	15,729	1.20	2.30	2.20	15.00
''B'' category reserves	52,120	49,638	1.39	2.93	3.91	44.45
''C_1'' category reserves	90,392	86,088	1.39	2.91	3.99	46.44
Overall: A+B+C_1	2,217,276	2,111,691	1.95	3.83	3.32	21.03

3. CALCULATION OF METALS QUANTITIES IN ORE BODIES OF LECE MINE

Quantity of metal in the ore deposit is:

$$M = \frac{Q_r \cdot m}{100}, t \quad (1)$$

where:

Q_r – quantity of ore in the deposit, t
m – percentage of metal in the ore, %.

Or partially, for each specific metal:

Lead (Pb): $M_{Pb} = \frac{Q_r \cdot m_{Pb}}{100} = \frac{2,111,691 \cdot 1.95}{100} = 41,177.975\,t$

Zinc (Zn): $M_{Zn} = \frac{Q_r \cdot m_{Zn}}{100} = \frac{2,111,691 \cdot 3.83}{100} = 80,877.765\,t$

Gold (Au): $M_{Au} = \frac{Q_r \cdot m_{Au}}{1000} = \frac{2,111,691 \cdot 3.32}{1000} = 7,010.81\,t$

Silver (Ag): $M_{Ag} = \frac{Q_r \cdot m_{Ag}}{1000} = \frac{2,111,691 \cdot 21.03}{1000} = 44,408.86\,t$

4. CALCULATION OF BULK ORE

Bulk ore consists of clean ore and waste. Graphically, it is presented in figure 1:

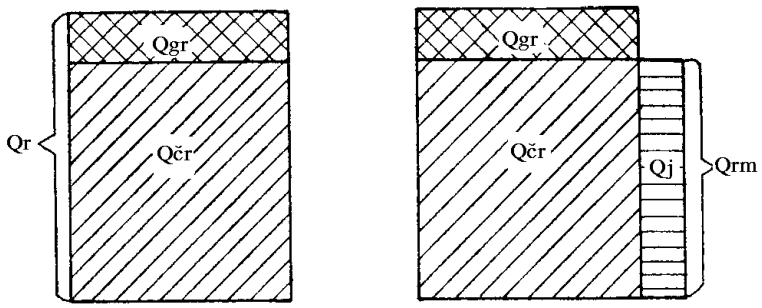

Figure 1. Scheme of mining block with ore reserves [6]

Simplified calculation of ore losses and dilution (without consideration of metal percentage) is based on main relations (Figure 1):

$Q_r = Q_{cr} + Q_{gr}$, t
(2)

$Q_{rm} = Q_{cr} + Q_j$, t
(3)

where:

Q_r – quantity of ore in mining block, t

Q_{cr} – quantity of clean ore, t
Q_{gr} – quantity of lost ore, t
Q_{rm} – quantity of bulk ore, t
Q_j – quantity of waste, t.

Ore recovery ratio (K_{ir}) is a relation between clean ore and entire volume of ore in the block, i.e.:

$$K_{ir} = \frac{Q_{cr}}{Q_r}, \text{ which means that: } Q_{cr} = K_{ir} \cdot Q_r$$

Dilution ratio (K_{or}) is a relation between volume of waste and bulk ore:

$$K_{or} = \frac{Q_j}{Q_{rm}}, \text{ which means that: } Q_j = K_{or} \cdot Q_{rm}$$

When we put these relations into formula (3), we come to:

$$Q_{rm} = K_{ir} \cdot Q_r + K_{or} \cdot Q_{rm} \text{ , or:}$$

$$Q_{rm} = \frac{Q_r \cdot K_{ir}}{1 - K_{or}}, \text{ t}$$

(4)

This formula shows that bulk ore is reduced for ore losses and increased for volume of waste. Also, we can conclude that geological reserves are equal to ore reserves in the deposit or in mining block, while extraction reserves are equal to volume of bulk ore:

$$Q_{geol} = Q_r \; ; \; Q_{exp} = Q_{rm}$$

Calculation for Lece mine has following input parameters:

- Recovery ratio is: $K_{ir} = 0.8$ (ore recovery is 80 %),
- Dilution ratio is: $K_{or} = 0.2$ (ore dilution is up to 20 %).

Volume of bulk ore is:

$$Q_{rm} = \frac{Q_r \cdot K_{ir}}{1 - K_{or}} = \frac{2,217,276 \cdot 0.8}{1 - 0.2} = 2,217,276 \text{ t}$$

Such result, where volume of bulk ore equals geological reserves, is a consequence of calculation where ore ratio (K_{rm}) is 1:

$$K_{rm} = \frac{K_{ir}}{1 - K_{or}} = \frac{0.8}{1 - 0.2} = 1$$

5. CALCULATION OF CONCENTRATED ORE VALUE FROM ORE BODIES OF LECE MINE

After the ore is mined, it is hauled and hoisted to the surface, i.e. mineral processing plant. Phases of mineral processing are following:

- Primary crushing,
- Secondary crushing,
- Tertiary crushing and
- Grinding.

After that, grinded ore goes to floatation.

The authors' attention was to determine quantities of metals in the concentrated ore. Based on data on masses of specific metals it is possible to determine value of concentrate, for each metal or overall. Concentrate will be the product whose value will be estimated, and that will be used as a base for determination of ore value.

Considering the fact that Lece mine is a polymetalic deposit, the evaluation is complicated, since we have two products – lead (Pb) and zinc (Zn) concentrates, with four metals: lead (Pb), zinc (Zn), gold (Au) and silver (Ag).

Lead concentrate is i first product of mineral processing. Rest of raw material is called lead outflow. Zinc concentrate is made from lead outflow, and the rest is a waste. So, we can derive following relations:

$$R = K_{pb} + O_{pb} \quad (5)$$

$$R = K_{pb} + K_{zn} + J$$

$$O_{pb} = K_{zn} + J$$

$$O_{pb} = R - K_{pb}$$

where:

R – ore, t
K_{pb} – lead concentrate, t
K_{zn} – zinc concentrate, t
O_{pb} – lead outflow, t
J – waste, t.

Based on these inputs, it is possible to perform a calculation.

6. OVERALL VALUE OF CONCENTRATE (FOR ORE FROM EACH ORE BODY: SUTA – RASOVACA, ORE BODY 2, JEZERINA 1, JEZERINA 2)

In order to determine the value of concentrate, we need to know volume of ore as input, masses of concentrates, percentages of metals in ore and concentrates, masses of metals and ore recovery in mineral processing.

Input data, as well as results of calculation, are given in table 3.

Value of metal in lead concentrate:

$$V_{(K_{Pb})} = m_{Pb} \cdot \alpha^{*}_{pb} + m_{Au} \cdot \alpha^{**}_{Au} + m_{Ag} \cdot \alpha^{**}_{Ag}, \text{ US \$} \quad (6)$$

where:

m_{pb} – mass of lead in the concentrate, t
m_{au} – mass of gold in the concentrate, kg
m_{ag} – mass of silver in the concentrate, kg
α^{*}_{Pb} = 2,430.00 US $/t
α^{**}_{Au} = 800.00 US $/oz (troy ounce)
α^{**}_{Ag} = 14.00 US $/oz (troy ounce)

Note: 1 ounce is 31.1035 g. Troy ounce or fine ounce is used for precious metals – gold, platinum and silver.

$$V_{(K_{Pb})} = \mathbf{35{,}001.28 \cdot 2{,}430 + 5{,}258.11 \cdot 25{,}720.99 + 26{,}645.32 \cdot 450}$$

$$V_{(K_{Pb})} = \mathbf{85{,}053{,}110.04 + 135{,}243{,}794.7289 + 11{,}990{,}394}$$

$$V_{(Kpb)} = 232{,}287{,}299.1289 \text{ US \$}$$

Table 3. Overview of calculation results for metal masses (Pb, Zn, Au, Ag) in lead and zinc concentrates from Lece mine [3]

Product	Masses of products, t	Metal percentages				Metal masses				Metal recoveries			
		Pb, %	Zn, %	Au, g/t	Ag, g/t	Pb, t	Zn, t	Au, kg	Ag, kg	I Pb, %	I Zn, %	I Au, %	I Ag, %
Ore	2111.691	1.95	3.83	3.32	21.03	41177	80877	7010	44408	100	100	100	100
Pb conc.	55557	63	5.88	94.643	479.60	35001	3267	5258	26645	85.00	4.04	75	60
Pb outfl.	2056133	0.30	3.77	0.85	8.64	6176	77610	1752	17763	15.00	95.96	25	40
Zn conc.	135874	1.17	50	2.06	22.88	1589	67937	280	3108	3.86	84.00	4	7
Waste	1920258	0.24	0.50	0.77	4.58	4587	9672	1472	8792	11.14	11.96	21	33

Note:

α^{*}_{Pb} - price of metal at London market at the day of 18.12.2007. (average three – months price);

α^{**}_{Au} - price of metal at New York market at the day of 18.12.2007. (average price – average between maximal and minimal price);

α^{**}_{Ag} - price of metal at New York market at the day of 18.12.2007. (average price – average between maximal and minimal price);

Value of metal in zinc concentrate:

$$V_{(K_{Zn})} = m_{Zn} \cdot \alpha^{*}_{Zn} + m_{Au} \cdot \alpha^{**}_{Au} + m_{Ag} \cdot \alpha^{**}_{Ag} \quad (7)$$

where:

m_{zn} – mass of zinc in the concentrate, t
m_{au} – mass of gold in the concentrate, kg
m_{ag} – mass of silver in the concentrate, kg
α^{*}_{Pb} = 2,288 US $/t
α^{**}_{Au} = 800.00 US $/oz (troy ounce)
α^{**}_{Ag} = 14.00 US $/oz (troy ounce)

Note:

α^{*}_{Zn} - price of metal at London market at the day of 18.12.2007. (average three – months price);

α^{**}_{Au} - price of metal at New York market at the day of 18.12.2007. (average price – average between maximal and minimal price);

α^{**}_{Ag} - price of metal at New York market at the day of 18.12.2007. (average price – average between maximal and minimal price);

$$V_{(K_{Zn})} = \mathbf{67,937.32 \cdot 2,228 + 280.43 \cdot 25,720.99 + 3108.62 \cdot 450}$$

$$V_{(K_{Zn})} = \mathbf{151,364,348.96 + 7,212,937.2257 + 1,398,879}$$

$$V_{(Kzn)} = 159,976,165.1857 \text{ US \$}$$

Value of metal in lead and zinc concentrate:

$$V_{(K_{Pb}+K_{Zn})} = 392,263,464.3146 \text{ US \$}$$

Value of ore:

$$V_r = V_{(K_{Pb}+K_{Zn})} \cdot 0.69$$

$$V_r = 392,263,464.3146 \cdot 0.69$$

V_r = 270,661,790.38 US $

This value presents value of metals after metallurgy processing, and it is an overall calculation for all of the ore bodies in Lece mine.

If we calculate ore value partially for each ore body, sum of these values is:

V_r = 270,697,198.78 US $

As we see, the results of two calculations differ by only 0.01 %. It is an aproximation error. As more accurate, we take the result of separate calculation by ore

bodies as final. So, value of ore in Lece mine is **V_r = 270,697,198.78 US $.** This value also presents the income that could be gained by selling the lead and zinc concentrate.

7.CONCLUSION

Lece mine, with all of its ore bodies, has a total of 2,217,276 t of wet ore, as verified geological reserves of A, B and C_1 category.

Ore reserves are classified by ore bodies and categorized by level of their exploration.

Most of geological reserves are situated in ore body Suta – Rasovaca (49.1 %). Rest of reserves is spread in other ore bodies like this: Ore body 2 – 26.2 %, Jezerina 1 – 17.5 % and Jezerina 2 – 7.2 %.

Highest percentage of lead and zinc in the ore is in ore body Suta – Rasovaca (2.38 % of lead and 4.56 % of zinc). Ore body Jezerina 1 has the highest content of gold (5.52 g/t), while ore body Jezerina 2 has the highest content of silver – 45.52 g/t.

Total volumes of metals in Lece mine were calculated based on average percentages and ore reserves by ore bodies, and final result is that Lece mine has 41,177.975 t of lead, 80,877.765 t of zinc, 7,010.81 kg of gold and 44,408.86 kg of silver.

Separate calculations for values of metals in the concentrate, by ore bodies, provide following results:

- ore body Suta – Rasovaca: **V_r = 145,686,709.917 US $** or 53.825 % of total value;
- ore body Ore body 2: **V_r = 51,514,418.5716 US $** or 19.03 % of total value;
- ore body Jezerina 1: **V_r = 55,598,448.802 US $** or 20.54 % of total value;
- ore body Jezerina 2: **V_r = 17,897,621.49467 US $** or 6.61 % of total value.

Total ore value of Lece mine is a sum of separate calculations by ore bodies:

V_r = 270, 697, 198.78 US $ (two hundred seventy milion, six hundred ninety seven thousand, hundred and ninety eight point seventy eight US dollars).

This value of ore is also a possible income that could be gained by selling lead and zinc concentrate from Lece mine.

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