

CONTROVERSY OVER THE IMPACT OF NICKEL ORE ON ENVIRONMENT AND SAFETY IN THE REPUBLIC OF SERBIA

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ABSTRACT

Discussion on the exploitation of the nickel ore in Serbia has connected two different communities, academic and civic initiatives, to express their opinions on this important issue and initiate taking a stance in terms of relevant factors which are concerned with the policy in the field of environmental protection and ecological safety. At the level of creating such policies there were apparent different approaches and interests which ultimately had a significant impact on environment and human health. In this work, the authors are likely to show not only that nickel is very much present in the human environment but also that its exploitation leads to the pollution of our environment and our health, whether by the ore or its derivatives, at any production level, use and recession.

Keywords: nickel, environment, ecological safety, human health.

AIMS AND BACKGROUND

Everything that makes our planet unique in the universe – beautiful landscapes, seas, oceans, rivers, lakes, mountains, forests, planes, settlements, has such an awkward appearance today, the one our ancestors could not even guess. Regrettably, for the disappearance of harmonious relations between human and nature, the only and exclusive culprit is human, since plants and animals have very little impact on the environment, and nature tolerates it easily.

Today's urban economic development and technological advances, altogether with the implementation of the new technologies have enabled better conditions for human life and workmanship. Yet, on the other hand, these activities have drastically

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affected harmony between human and nature, with which people, as well as all other living beings have had close and unbreakable bonds from the beginning of time¹. Therefore, all around the globe there is an increasing number of analyses referring to the alarming threat to the environment. Eminent experts and relevant international organisations warn that the environment is globally being degraded, emphasising that the situation is drastic and the ecological consciousness of the population in almost all regions in the world is at the low level. In doing so, there is still the question how to change awareness of individuals in terms of protection of the environment. In fact, though a man is a rational being, he has not reached such a level of awareness to realise that his further development depends on improving the damaged balance and re-establishing of his regenerative abilities.

Natural resources are common wealth. Their use, commercial application and economic evaluation should be controlled and well directed. Regardless of the type, structure and individual amounts, they are basis for the forthcoming commercial and economic development of Serbia. Sure, there is a part which has to remain outside of economic and commercial flows, which should be preserved for the present and future generations. This is especially true when it comes to renewable natural resources². In the Republic of Serbia, there are various natural resources people use in order to meet their needs. Serbia does not lack in natural resources and possess the following resources: land, waters, forests, minerals, renewable energy resources, technogenic raw materials, secondary raw materials, air, flora and fauna, animal husbandry, fruits, fishing and hunting, national parks, caves, dungeons underground world, etc. Although it is not among 10 countries in Europe or the world after its ores, Serbia has more than 200 mines and several dozens of mineral deposits. Having that in mind, protection and preservation of natural resources require responsible treatment of such an abundant living environment.

However, the fact is that the situation in terms of environmental protection in Serbia is at a low level. The laws are not applied to the extent the legislator expected and citizens are at a low level of environmental awareness. Also, there is no active attitude towards the environment. Recently, we have been witnessing different types of chemical accidents involving dangerous substances. There are frequent accidents in rail transport whilst transporting toxic substances, waste air pollution and emission of untreated waste into the environment. Essentially, the largest polluters are traffic, energy producers and agriculture.

Professional community of the world compares bombing of former Yugoslavia with ecological disaster, which does not affect people only but also the wider Balkan region. Although articles about harm of depleted uranium on human health are rarely published, even American doctors and military analysts speak about its devastating consequences³. During the 78 days of bombing in former Yugoslavia, there were thrown 15 000 t of depleted uranium (out of which USA acknowledges 11 000 t), unknown amount of plutonium and 25 000 t of gunpowder. NATO planes took off 36 219 times, and with 200 helicopter flights, spent 367 million l of kerosene, which

caused the emergence of ozone hole in the territory of Serbia and Montenegro. Firing of chemical plants and factories released large quantities of dangerous substances such as chlorine, dichloroethane, mercury, polychlorinated biphenyl (PCB) and other harmful petroleum products. In addition, decontamination is being applied too slow and inefficiently⁴. The group of experts and scientists from Serbia and diasporas organised the International Conference on Ecological Recovery of former Federal Republic of Yugoslavia (ENRY 2001) in September 2001; there were presented works of 320 authors from 21 countries, and the topics covered included: the influence of war on environment, ecological consequences of destruction of industrial facilities, pollution of waters, air and soil by toxic chemicals and heavy metals, as well as biomedical effects and psychosomatic and social consequences of the bombing⁵. Today, almost 17 years later, there are confirmed views that the atmosphere and soil in Serbia are contaminated with toxic substances because of bombing of industrial and chemical complexes and usage of depleted uranium weapons. Unfortunately, the following generations that will live on the bombed soil are going to suffer from cancers, leukemia, and number of miscarriages and deformities at newborns will be increased. In such complex circumstances of widespread degradation of environment and alarming level of ecological safety, the news about the beginning of exploitation of nickel around certain towns in the Republic of Serbia has strongly echoed. Analyses in which SANU (Serbian Academy of Sciences and Art) was included, convincingly shown that such an activity would bring more harm than good, because geological research within prescribed scope seriously disturbed and threatened flora and fauna. It was established that such actions violate the appearance of the area and degrade the basic natural values and resources, as well as the exploitation of similar ores turns green spaces into the lunar landscapes. In addition, data from the International Agency for Research of Cancer must be taken into account, in which nickel is classified as group A1 carcinogens, because it causes cancer in the nose, sinuses and larynx. In support of these allegations speak numerous reports on mining of nickel, which state that people get sick within a radius of 50 to 100 km out of which the ore separates from the waste using sulphuric acid.

EXPERIMENTAL

Nickel was discovered by Axel Fredrik Cronstedt in 1751. It has a large presence in the human environment, and it is mostly abundant in the Earth crust, it occupies twenty forth place. Natural sources of nickel include dust originating from volcanic ash, rocks and soil. The occurrence of nickel in water is due to its chemical cycle and dissolution of nickel compound in water. The data indicates that around 150 000 t of nickel are being thrown into environment from natural sources and 180 000 t originating from human activity, especially emissions during combustion of fossil fuels, industrial production and industrial waste rich in nickel⁶. Nickel is a dazzling metal, silver-white colour, its characteristics are strength, elasticity and resistance to cor-

rosion, and for that reason it is used to coat other materials for protection, e.g. it is added to steel and other alloys to increase their resistance to corrosion. Nickel is also fairly good conductor of heat and electricity. It is included in the Earth crust in amount of 80 ppm (parts per million) in the form of minerals garnierit and pentlandite. It is not common in nature in its elemental form, but in the form of sulphides, arsenides, antimonides, oxides and silicates. Nickel is building a series of complex compounds such as nickelsen. Larger quantities of nickel for exploitation are actually unavailable because they are deep in the earth⁷.

Table 1. Key characteristics of nickel⁸

Name	Nickel	
Chemical symbol:	Ni	high melting point, 1453°C
Atomic number:	28	resists corrosion and oxidation
Atomic weight:	58.71	very ductile
Melting point:	1453°C	alloys readily
Boiling point:	2730°C	magnetic at room temperature
Density:	8.90 g/cm ³ at 25°C	can be deposited by electroplating
Curie temperature:	253°C	has catalytic properties

Table 1 shows basic characteristics of nickel. Reflecting these characteristics, nickel is widely used in over 300 000 products for consumer, industrial, military, transport, aerospace, marine and architectural applications. The biggest use is in alloying – particularly with chromium and other metals to produce stainless and heat-resisting steels. These are used for pots and pans, kitchen sinks, etc. as well as in buildings, food processing equipment, medical equipment and chemical plants. About 65% of the nickel which is produced is used to manufacture stainless steels. Another 20% is used in other steel and non-ferrous alloys – often for highly specialized industrial, aerospace and military applications. About 9% is used in plating and 6% in other uses, including coins, electronics, and in batteries for portable equipment and hybrid cars. In many of these applications there is no substitute for nickel without reducing performance or increasing cost⁹. Russia is the world largest producer of the ore (235 000 t or 21% of annual world production), ahead of Canada (10%) and Australia (7%). Thanks to New Caledonia, France is present in the global market of nickel (6% of annual world production)¹⁰. Indonesia, Cuba, Colombia and South Africa supplement a small list of major world manufacturers.

There is an opinion that the reserves of nickel in certain locations in Serbia are large, and that the idea of exploitation of nickel at Mokra Gora and on the moves Topola – Arandjelovac and Vrnjacka Banja – Trstenik are quite justified. It is estimated that in the bowels of earth, in the territory of Serbia ‘lie billions of euros’ so it is completely normal that natural resources are used in order to increase economic activity and employment of people. In addition, nickel is produced wherever possible, and it achieves a good price. On the other hand, Serbian Academy of Art and

Sciences (SANU), as the highest scientific and arts institution in Serbia, reminds that several years ago Serbia threatened with the opening of nickel mine in Mokra Gora, Lipovica and Vrnjacka Banja, therefore, a scientific analysis was done to remove the threat, however it appeared again at present. Especially because all the companies that have licenses for nickel exploitation in Serbia will practically be able to start the job and no one will be able to prevent them from doing so. Approval for mining and geological research is issued by the Ministry itself, as long as the issue does not fall under jurisdiction of local governments and institutions for the protection of environment and cultural monuments. Actually, the Law of Mining and Geological Research, which was adopted by the Serbian Parliament on 4th December 2015, municipalities and other institutions that are able to prevent this dangerous ore exploitation in a particular territory, stripped of all powers they had under the old law¹¹.

At the same time, as a result of raising the environmental awareness of the citizens of Serbia in their pursuit for a healthier and better life, there was a fierce resistance of scientific, cultural and general public, calling the Government to think more about preserving a healthy natural environment rather than certain profit, which would turn into a lifeless desert for all times. Exploitation of nickel in Serbia would leave horrible consequences to the protection of environment, health of people, vegetation, soil, ground and surface waters. Eminent scientists point out that under no circumstances should be allowed exploitation of nickel ore in Serbia in the next 50 years or until its processing technology progressed to the point when it would not pose such a great danger to human health and environment. For the time being, there are no clean technologies for the nickel exploitation because the technologies are dirty.



Fig. 1. National Park 'Mokra Gora' – an area which represents natural heritage (protected by the state) and where the exploitation of nickel is announced¹²

RESULTS AND DISCUSSION

Scientists and politicians often mistake terms of environmental safety and ecological safety. Environmental safety refers to threat to political stability due to degradation of the environment, while the ecological safety refers to creating conditions in which physical environment meets the needs of the community without reducing natural reserves¹³. Underdeveloped countries or countries which have not built ecological standards and place environmental and ecological safety into background and subordinate it to profits, in the past few years, due to rising prices of nickel became the target of big foreign companies which tend to move processing of nickel into such countries.

It is indisputable that nickel is highly toxic metal that can adversely affect the environment. Method of nickel exploitation, among other things, takes place in a manner in which the forests are first cut, and then the sulphuric acid is dispensed over a large area. Sulphuric acid 'eats' everything except the nickel ore, and would therefore be devastated for the natural benefits of Serbia. Exploitation of nickel releases much sulphur, which creates acids with the liquids from the air, and enters into food chain over underground waters and therefore contaminates plant and animal world.

In this context, it is sufficient to consider the accidents in Talvivaara nickel mine in Finland (2012), where the concentration of sulphate in waste waters was 60 times higher than allowed and the lake was left without oxygen in the water (Fig. 2). Polluted water started passing through the protective barrier in five to six cubic meters per hour. Water in radius of several kilometers was poisoned by nickel¹⁴.



Fig. 2. Impurities from the nickel mine in eastern Finland poisoned the water in the environment and caused the largest ecological disaster in the history of Earth¹⁵

The flagrant example is the nickel mine in New Caledonia (Fig. 3), where 40 waterways were polluted due to wasted waters, which often discharge and pollute agricultural land and there can also be found heavy metals in the air¹⁶.

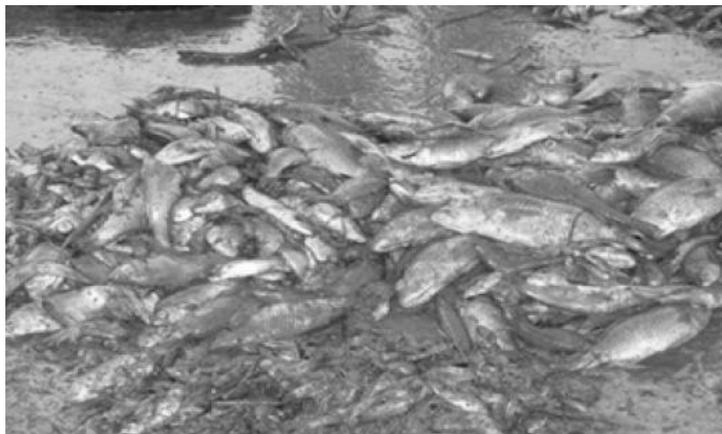


Fig. 3. Dead fish cooked live in sulphuric acid spilled from the factory for processing of nickel – New Caledonia (2009) (Ref. 17)

From the human health aspect, there are no reasonable scientific analyses on harmful effects of nickel. First described immune-allergic reactions in the literature were observed in women who wore bras with nickel buckles. Later, it was determined that nickel is dangerous because it has allergenic and carcinogenic properties and that it is at the same toxicity level as uranium, mercury and chromium. Respiratory tract, kidneys and liver, are mostly exposed to changes in the exposure to nickel. Best described changes to these organs are nickel pneumoconiosis, chronic rhinitis and tumors of the nasal cavity and transient renal nephropathy. Non-specific symptoms encountered in injured by CNS nickel are in the form of headaches, nausea and vomiting. Certain nickel compounds, in addition to extreme toxicity exhibit carcinogenic effects to human¹⁸. A higher concentration of nickel in the longer period destroys defense forces of the body and may cause numerous autoimmune diseases and progressive genetic damage to tissue cells, leading to the emergence of malignant tumors.

For the purposes of this study, in the period from 15.11.2015 to 01.02.2016, there was carried out a research that involved 450 adult citizens of Topola, Arandjelovac, Vrnjacka Banja and Trstenik, that is, those places that were designated as important for research and exploitation of nickel. The survey was conducted by investigative technique 'face to face', or by a direct contact with the interviewers. Previously trained interviewers – assistants took care to include unemployed people only in a random sample. The survey retained four questions as follows: (1) Is nickel dangerous for human health and environment? (2) Would your surrounding have more benefit than harm of nickel mine? (3) Would you accept a job in a company that deals with the exploitation of nickel ore? (4) Would you express or support civil protest concerning the exploitation of nickel in your surrounding? The first question was answered affirmatively by 65% of the respondents, 14% of respondents said that it is not, 11% said they did not know, and 10% did not answer. The second question – 54% responded

that they would have more damage, 26% answered that they could benefit more, 12% said they did not know and 8% did not answer. The third question – 72% responded negatively, 17% responded affirmatively, while 11% did not know. The fourth question – 68% responded affirmatively, 25% did not know and 7% did not answer the question.

This survey, although conducted on a sample that is not representative, suggests that young people, regardless of their unenviable financial position and unemployment status are largely aware of the need to protect the environment and consequently their own health.

CONCLUSIONS

It is very clear today that environment safety is a threat to ecological degradation for political stability, while ecological safety means creating conditions for physical surroundings which enable community to meet their needs without reducing natural reserves. In order to improve his quality of life, man has selfishly and carelessly used natural resources, which resulted in the demolition of balance in nature and creation of a series of problems which, paradoxically, now affect the quality of life for which so many have fought. In such an environment, it has become clear that the anthropocentric approach must be replaced with biocentric one, or that culture is necessary to be understood not as a means of alienation from nature but rather as a means of approaching it. Therefore, formation of ecological culture is imperative to overcome consumerism of a man in relation to natural resources. Ecological culture stems from the ecological view of the world that is based on ecological and critical evaluation of attitudes towards environment. Debate on geological exploitation of nickel in Serbia, despite the fact that nickel is one of the most toxic metals in range with uranium, chrome, lead and mercury, therefore excessive exposure to its certain quantities causes allergies, autoimmune diseases, cancers of all organs and tissues, is still on. In this work, the starting hypothesis on harmfulness of nickel has been confirmed by a conducted survey. Human health and environmental protection shall have primacy over insatiable drive for profit, which is a paradigm of a bad quality of life of a modern man.

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