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Environmental Challenges in the Arctic

Norilsk Nickel:

The Soviet Legacy of Industrial Pollution

BELLONA

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Contents

Preface

The present report is an update of many years of work by the international environmental foundation Bellona to prevent the negative impacts to the environment and public health caused by plants from Norilsk Nickel Mining and Metallurgical Company (MMC).

Since the end of the 1980s, the environmental foundation Bellona has actively worked to search for a solution to problems relating to the degradation of Arctic ecosystems and transboundary pollution, with the intent of drawing the attention of the public and authorities in hopes for a successful solution. The environmental problems that arose in the early 2000s were linked to international agreements on financing mechanisms with the goal of modernizing the Norilsk Nickel enterprise on the Kola Peninsula. Unfortunately, these hopes were not justified.

Today, the environmental situation in regions affected by Norilsk Nickel plants is as bad as it was at the end of last century. For this reason, Bellona believes it necessary to renew efforts to draw the attention from society and the authorities, to solve issues caused by industrial pollution from Norilsk Nickel MMC.

The mining and metallurgical plants that are currently part of Norilsk Nickel MMC have been emitting millions of tons of toxic substances into the atmosphere for almost 75 years, thus imposing unacceptable damage to the environment, and most importantly to the health of people who live in these regions.

In order to understand the necessary course of action to reduce emissions of toxic pollution from Norilsk Nickel plants, it is necessary to know the processes of production, what is disrupting the environment and what the plausible goals and plans of Norilsk Nickel are for introducing helpful environmental programs and technologies to counteract their negative effects. Reporting this information is a complex task, as reliable information about the activity of plants of Norilsk Nickel MMC concerning harmful emissions and waste, is classified. Official information is not easily attainable and usually cannot be trusted. Unfortunately, in cities where Norilsk Nickel plants are located, the environmental and human rights movement is weak. People depend completely on employees from Norilsk Nickel whom are afraid of speaking openly or providing information.

A group of authors from the international environmental foundation Bellona worked on the report. Bellona used materials that were open sources available for the public (the official report of the Russian and Norwegian authorities and research institutions and centers, the Norilsk Nikel MMC website, Russian and Norwegian Newspapers, magazines, internet, etc.).

The authors of the report express their gratitude to everyone who took part in this work, and who provided materials for studies.

Bellona plans that this report will be the first step in a major program directed towards preventing the pollution of the Arctic region with industrial emissions and waste.

Bellona hopes to use its experience to draw the attention of the international community, primarily Arctic nations, to environmental problems connected with the activity of Norilsk Nickel MMC.

A large number of studies required for preparing this report were carried out with the financial support the Norwegian Ministry of the Environment. At the same time, it must be stressed that the contents and conclusions made in this report are independent of the ministry's position, and do not reflect its views.

Information about Bellona's work and blogs on topics of interest can be found at the site of the organization, at the address www.bellona.org.

The industrial pollution caused by Norilsk Nickel MMC is not a well known issue with the people of Russia. To avoid any public interest or concern, the company willingly forgoes disclosure of important safety information regarding toxic substances, understating the environmental threat caused by the emissions from its plants. Due to a lack of coverage in the media and publicly disclosed documents, the public is discouraged to make any informed decisions, allowing the company to continue generating wealth at the cost of people's health and the environment.

To make this issue more transparent to the Russian public, better coverage is needed. For this reason, Bellona has initiated efforts to inform the public and stop the pollution by compiling this report: "Environmental challenges in the Arctic. Norilsk Nickel: The Soviet Legacy of the Industrial Pollution". This is the English translation of the Russian report.

Introduction

The purpose of writing this report is to study the anthropogenic impact Norilsk Nickel MMC plants have on the environment and public health. The report's goal is to provide objective information about the present state of the environment in regions affected by the industrial activity of Norilsk Nickel MMC plants. The aim is to involve the public, the administration and representatives from the industry in a discussion to reach new achievements of improved environmental standards. The ultimate goal is to reduce the negative anthropogenic impact of Norilsk Nickel MMC plants felt in the environment and public health.

The activities of both Norilsk Nickel MMC in production facilities, located on the Kola Peninsula (Kola mining and metallurgic company) and Taymyr (the Arctic branch of Norilsk Nickel), have an enormous anthropogenic impact on the environment. This leads to a disruption in the balance of ecosystems within the Arctic region. Norilsk Nickel MMC, which emits up to ¼ of all Russian emissions of sulfur dioxide, is one of the largest polluters in the country.

Norilsk Nickel MMC's pollution is also responsible for the transboundary pollution problems.

The border territories of Norway and Finland have been regularly subjected to the technogenic impact of the industrial activity of the Pechenganickel plant (located on the Kola Peninsula near the Russian-Norwegian-Finnish border). Previous attempts from Scandinavian authorities to secure a reduction of emissions produced by the Pechenganickel plant have not been met with an appropriate response from either Russian authorities or the management of the plant. One method on part of the Scandinavian authorities was to suggest introducing new technologies and equipment to achieve significant reductions. The issue of solving transboundary pollution is a difficult topic in Norwegian-Russian negociations.

Issues of transboundary pollution within international law are regulated by a series of international documents. One of the most influential regulations stems from the Convention on *Environmental Impact Assessment in a Transboundary Context* (Espoo, 1991) and the *Convention on Long-Range Transboundary Air Pollution* (1979). The Russian Federation has signed the Espoo Convention, but unfortunately has not ratified it.

In accordance with the Convention (1979) the present conditions require a review of the Gothenburg Protocol to *Abate Acidification, Eutrophication and Ground-Level Ozone* (1999) and the inclusion of a large number of pollutants on the list.

In 2011, it is expected that Russia will join this Protocol which will be instrumental in solving the transboundary pollution issue.

Problems connected with the increase of negative effects of Norilsk Nickel MMC plants on the environment and people's health primarily depend on environmental policy and economy of the Russian state. The present economic state of the Russian Federation and the lack of influential environmental policies are currently at fault for the environmental and public health problems caused by Norilsk Nickel MMC plants. This is because the economy has not allowed the company to invest in new technologies and there has been no steady enforcement of environmental regulations due to a lack of national environmental policies. The inadequate presence of environmental policy is precisely characterized by Russian President Dmitry Medvedev at the Presidium of the State Council on ecology, May 27, 2010. Describing Russian achievements in environmental policy, he said: *"If one compares us with other countries, here things are on ice at the moment, so to speak"*.

At this meeting, important decisions were made that would directly affect the activity of Norilsk Nickel. It was decided that companies would abandon temporary norms (limits) of emissions and waste for existing enterprises, and also begin a transition to a new system of norms based on the best

available technology. Now the question is how these decisions will be implemented.

Norilsk Nickel MMC is an important taxpayer to the state budget. The company's capitalization comes to $32.2 billion. The company's turnover for 2009 was $10.2 billion, and pure profit was $2.7 billion. The company accounts for 1.9% of the Russian Federation's entire GDP and 4.3% of all Russian exports. The present government is interested in immediate growth in GDP at any price. This includes the price of the well-being of the present and future generations of Russian citizens. The entire economy of Russia today is primarily built on the merciless use of natural resources. Therefore, an ecological modernization of enterprises such as Norilsk Nickel and throughout the country as a whole could solve the many health and environmental issues for people of Russia. However, it has been made apparent that this is of little interest to the government.

The escalation of problems linked to the activity of Norilsk Nickel is also assisted by the environmental conformism of the population and corruption in society.

Poverty and socio-economic problems have presided importance in Russia, thus reducing the urgency of attending to environmental problems. According to sociological studies, only 13% of the population of Russia calls environmental problem the most significant issue of the moderen society the most significant problem of modern society. In a list of the 25 most important problems of the modern age, Russian public opinion put environmental concern in 18th place.[1] The lack of reputable, readily accessible information regarding the state of the environment lead to an inadvertent ecologically ignorant population contributing passive and poorly informed judgments on urgent issues.

The existing inadequate environmental legislation, based on a system of temporary norms for emissions and waste, enables corruption to flourish and officials to abuse their power.

Recently, Norisk Nickel has been at the center of scandals linked with the non-regulated relations with the main shareholders.

Furthermore, recent accusations have been increasingly made against Norilsk Nickel that the company does not have a long-term strategy of ecological modernization of plants.[2] At the end of 2008, an open letter was published from the main shareholders to the general director of Norilsk Nickel MMC, expressing serious concern about the environmental situation connected with the industrial activity of enterprises that are a part of Norilsk Nickel. The letter noted that the state of the environment in Norilsk was on the verge of catastrophe, and a proposal was made to improve the situation by implementing a large-scale ecological program of modernization of enterprises. In response to this letter, Norilsk Nickel replied that it already had an ecological program that had been developed and approved, and was working on its implementation. However, this program is not available to the public. On Norilsk Nickel's official site, the section "Ecological policy" (2004) does not contain information about a specific program. There are only vague phrases such as: "... priority areas of realizing the ecological policy of the company Norilsk Nickel are:

- step-by-step reduction of pollutant emissions into the atmosphere, above all sulfur dioxide and solid matter (heavy metals);
- gradual reduction of polluted waste water being discharged into bodies of water;
- Improving places of waste storage in order to reduce the technogenic burden on the environment.[3]

[1] http://www.earthcharter.ru/upload/File/Eco_prob_2008.pdf.

[2] http://www.zerich.ru/comments/gmknornikel/109722.

[3] http://www.nornik.ru/development/environmental_policy.

And also, "for the purposes of realizing obligations of the present ecological policy, Norilsk Nickel MMC follows the principles and requirements of international standard ISO 14001:2004".

In the company's CSR report 2009 "Protection of the environment" fails to make any mention about the progression or implementation on the company's own developed and approved ecological program. Only disreputable figures about waste and emissions reductions etc. are given.

The analysis and materials of the studies given in our report do not confirm that Norilsk Nickel is currently implementing an ecological program at its plants. Perhaps subsequent studies will focus on presenting to society an actual strategy that will be used as an example for successful ecological modernization of company's productions.

1. The structure of Norilsk Nickel MMC

Norilsk Nickel is responsible for the search, prospecting, production, refinement and processing of minerals, and the production, marketing and realization of non-ferrous and precious metals. The group has an extensive production network of branches and affiliated enterprises both in Russia and abroad.

Norilsk Nickel MMC is the largest producer of nickel and palladium in the world. Norilsk Nickel accounts for over 20% of world production of nickel and 50% of palladium. Furthermore, the company produces platinum, copper, cobalt, rhodium, silver, tellurium, selenium, iridium and ruthenium. The share of Norilsk Nickel in world production of these metals is shown in table 1.

Norilsk Nickel MMC is among the leading industrial companies of Russia. The company accounts for 1.9% of the GDP of the Russian Federation, and 4.3% of all Russian exports. The total share of Norilsk Nickel in the volume of Russian industrial production is 2.8%, and 27.9% of non-ferrous metallurgy (2003)[1]. In the production of non-ferrous metals, Norilsk Nickel MMC also plays a leading role on the Russian market. The share of production by the company is around 96% of all nickel produced in the country, 55% of copper and 95% of cobalt.[2]

Russian mining and metallurgical divisions of Norilsk Nickel are organized according to a vertically integrated principle, and include the Polar Division (PD) and the Kola mining and metallurgical company (KMMC).

Table 1. Share of Norilsk Nickel MMC in world and Russian production

Norilsk Nickel MMC	
Share of Norilsk Nickel in world production	Nickel 20%
	Palladium 50%
	Platinum 20%
	Cobalt 10%
	Copper 3%
Share of Norilsk Nickel in Russian production	Nickel 96%
	Cobalt 95%
	Copper 55%
Share of Norilsk Nickel in Russian GDP	1.9%
Share in Russian export	4.3%

[1] http://www.metalltorg.ru/analytics/color/?id=132.

[2] http://www.metalltorg.ru/analytics/color/?id=132.

2. Technological cycle of copper and nickel production

Chart 1. Pyrometallurgical method of copper production

ORE ENRICHMENT
By flotation method
Goal: increase of copper content
Result: copper content in concentrate increases up to **11- 35%.**
Percentage of sulfur (S) comes to **45%.**

BURNING OF CONCENTRATE
Goal: removal of sulfur.
The gases that form during burning contain **4-7%** sulfurous anhydride, which after passing through an electrical filter are used to obtain sulfuric acid

MELTING OF CONCENTRATE
Result: intermediate product – liquid matte: and slag, which is what waste rock and a large amount of iron become.
Matte is a liquid alloy consisting **80-90%** of copper sulfides, also containing small percentages of zinc, lead and nickel sulfides, and up to **5%** slag.

AIR BLOWING IN CONVERTER
Result: sulfur burns. Blister copper forms containing **98.5-99.5%** Cu and **1.5%** various mixtures of metals and sulfur.

REFINING PROCESS
By electrolytic method
Goal: purification of blister copper
Result: increase of copper contents to not less than **99.99%.**

Norilsk Nickel plants use raw materials characterized by a low content of commercial components (metals). Due to this, an obligatory stage of the technological process is refinement of ore and production of concentrates, where the content of metals reaches several dozen percent.

The technological cycle of production of nickel from ores includes several stages of processing of raw materials, with a corresponding sub-product received from each of them (nickel concentrate, high-grade nickel matte):[3]

The composition of Ni-Cu sulphide ores varies. Usially sufide ores contains sulfide ores contain from 3 to 5.5% nickel, and the contents of copper (Cu) in rich sulfide ores ($CuFeS_2$ chalcopyrite, Cu_2S chalcosine) reaches 3-5%. The ores mined by the Polar division are partly extremely Cu rich >20%, but the average grades are 1.63% Ni, 2.79% Cu.[4] The ores mined by KMMC contains < 1% Ni and <0.5% Cu. Accordingly to International Mining (2006) the ore composition of underground mining facilities on the Kola Peninsular is 0.67% Ni and 0.31% Cu respectively.[5] Therefore, in order to obtain a finished product, the ore must first be refined.

Today, the production process at Norilsk Nickel MMC involves two main technological cycles: hydro-metallurgic production and pyrometallurgic production.

[3] http://www.geoteka.ru/text.html?page=ecol.

[4] Emissions from the copper–nickel industry on the Kola Peninsula and at Noril'sk, Russia Rognvald Boyd a,*, Sarah-Jane Barnes b, Patrice De Caritat c, Victor A. Chekushin d, Victor A. Melezhik a, Clemens Reimann a, Michael L. Zientek e

[5] Emissions from the copper–nickel industry on the Kola Peninsula and at Noril'sk, Russia Rognvald Boyd a,*, Sarah-Jane Barnes b, Patrice De Caritat c, Victor A. Chekushin d, Victor A. Melezhik a, Clemens Reimann a, Michael L. Zientek e

Hydrometallurgic production is designed for processing pyrrhotite concentrate and obtaining sulfide concentrate and technical sulfur. The hydrometallurgic method is used only for processing oxidized ores, primarily with poor copper content, and for native ores. In the hydrometallurgic method of processing, precious metals are usually not extracted from the ore.[6]

Pyrometallurgical production processes nickel concentrates of enrichment plants, sulfide concentrates of hydrometallurgical production and copper concentrates. 80% of world production of copper is carried out by the pyrometallurgical method.

The pyrometallurgical method of production of copper involves the following technological cycles.[7]

Production of non-ferrous metallurgy in general, and copper and nickel production in particular, is distinguished by high fuel consumption (for 1 ton of production, 50 tons of standard fuel is used) and energy consumption (3,000 kWt/h for refining 1 ton[8] of production). Furthermore, production of non-ferrous metals has a very high material consumption. For production of 1 ton of nickel, 200 tons of ore is used; and for production of 1 ton of copper, around 100 tons of ore is used.[9]

It should be noted that non-ferrous metallurgy is among the industries with the highest amount of industrial waste per unit of production.

Chart 3. Characteristics of copper and nickel production

High energy consumption (up to 3,000 kWt/h for refining 1 ton of production)
High fuel consumption (up to 50 tons of standard fuel per 1 ton of production)
BHigh material consumption (200 tons of ore per 1 ton of nickel; 100 tons of ore per 1 ton of copper)
High water consumption (4000 m3 per 1 ton of nickel; 500 m3 per 1 ton of copper)
Large amount of waste per unit of production
Human impact on environment

Chart 2. Pyrometallurgical method of copper production

ORE ENRICHMENT
Goal: increase of nickel content in concentrate
Before melting, ores must be oxidized
Existing technology: burning of copper-nickel pellets
Introduced technology: briquetting

↓

MELTING OF NICKEL
in reflective electrical furnaces
Goal: increase of nickel content
Result: 10—15% matte obtained with nickel content of **10—15%** and increased content of cobalt and slag

↓

MATTE BLOWING
in oxygen convectors
Result: obtaining of matte
To obtain cobalt, it is separated from nickel by chemical means from a solution at the matte or matte stage. Almost all the nickel remains in the solution, and the black sediment of cobalt compounds is extracted and incinerated to remove water.

↓

GRINDING OF HIGH-GRADE MATTE
after its cooling
Goal: separate nickel and copper concentrate by flotation method.
Result: nickel and copper concentrates with mixture of nickel and copper sulfides. Half of the sulfur from the copper concentrate of high-grade matte flotation is separated in the form of SO_2 with a mixture of copper-containing dust.

↓

METAL RESTORATION PROCESS
Goal: obtaining black nickel by restoring metal in electric furnaces

↓

REFINING PROCESS
by electrolysis
Result: obtaining of pure nickel

[6] Большая энциклопедия нефти и газа (http://www.ngpedia.ru/id469390p1.html).

[7] http://www.geoteka.ru/text.html?page=ecol.

[8] http://www.geoteka.ru/text.html?page=ecol.

[9] Юркова Т. И. Экономика цветной металлургии (http://yurkovs.narod.ru/Ec_otr/ch21.htm).

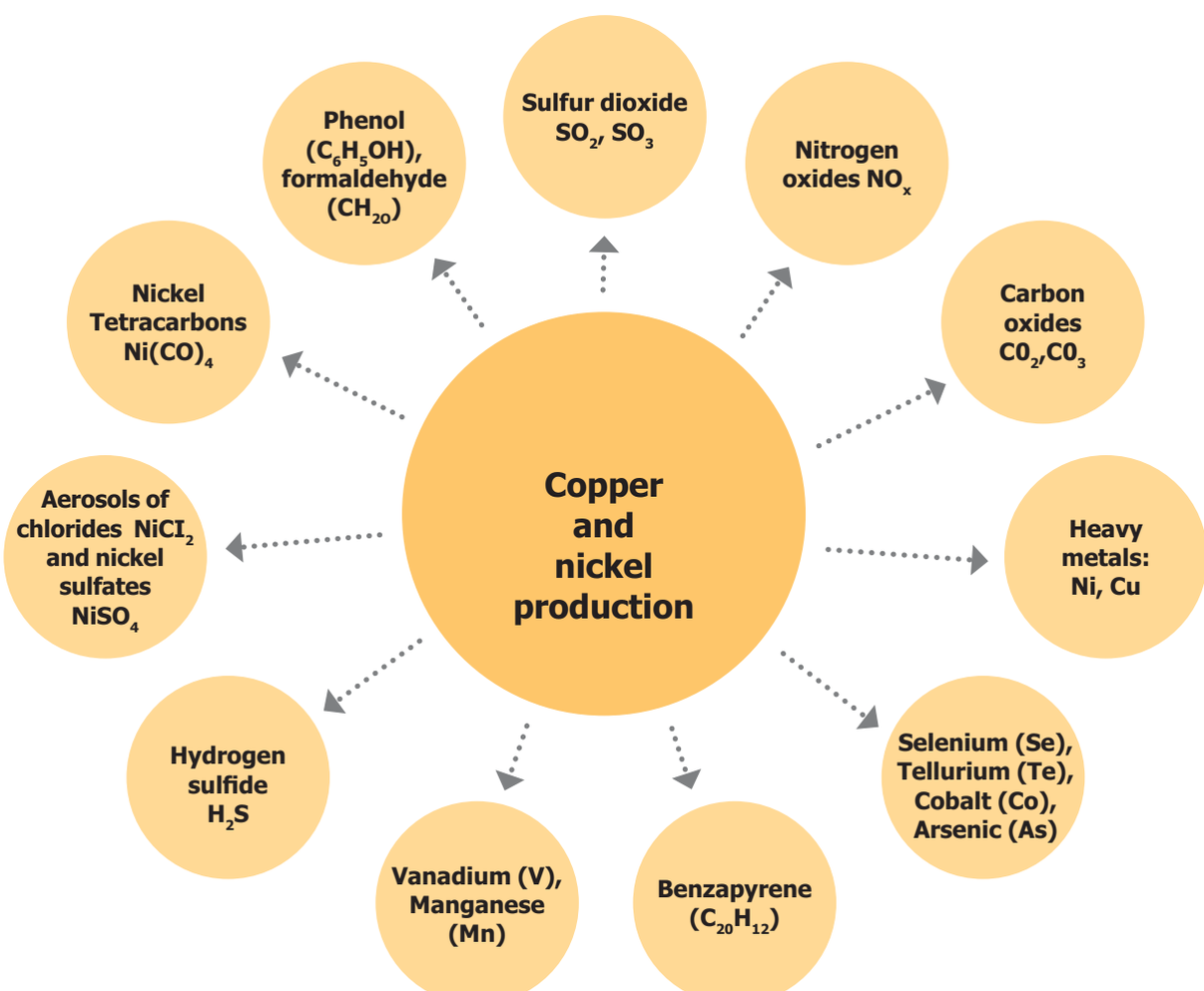
3. Human impact of copper and nickel production

The production process of non-ferrous metallurgy is characterized by emissions of harmful and extremely harmful substances, which are indicated in chart 4.

As a result of these emissions, the atmosphere, surface, underground waters, and land ecosystems are polluted by chemical substances.

The most negative impact on the environment is made by SO_2 sulfur dioxide and heavy metals.

Chart 4. Human impact of copper and nickel production



3.1. Pollution of the atmosphere

Setting norms for emissions

In Russia, protection of the atmosphere is regulated by the Federal Law of the Russian Federation "On protection of the atmosphere" (1999), which sets the legal foundations for protection of the atmosphere. Furthermore, norms of air quality are established in the form of maximum allowable concentrations (MAC) for a certain period of time.

It should be noted that in different countries, maximum allowable concentrations of emissions of sulfur dioxide differ.

For example, in Finland the content of sulfur dioxide in the air should not exceed 125 μg/m³ over the course of 24 hours. It is considered that this limit should not be exceeded more than 3 times over the course of a year. This corresponds to the norms established by directive of the European Union 96/62/EC[10] on air quality, and the subsequent Council directive 19999/30/EC[9] on limit values for pollutants in ambient air that are safe for human health. Furthermore, in EU countries, safe boundaries of contents of sulfur dioxide are determined for ecosystems, which should not be more than 20 μg/m³ on average for one calendar year and one winter (1 October – 31 March).[12]

In Norway, which is not a member of the European Union, the maximum allowable concentrations of pollutants are also determined in accordance with European directives and national legislation. The national level of average daily emissions in Norway is established at 90 μg/m³.

In the Russian Federation, the norms of maximum allowable concentration of emissions are developed and approved by bodies of the sanitary and epidemiological service and environmental state bodies in the field of environmental conservation. The daily acceptable concentration for sulfur dioxide in the Russian Federation is 0,05 mg/m³.[13]

Main emissions of metallurgical production

Copper and nickel production is characterized by large quantities of emissions of sulfur dioxide (SO_2) into the atmosphere, or as it is also called, sulfurous gas, and particles of heavy metals.

Sulfurous gas is an instable compound that spreads in the atmosphere. Sulfur in this compound is in a tetravalent form and remains in this state in the atmosphere from several hours to several days. Compounds of tetravalent sulfur are harmful for foliage, especially for coniferous species.

Compounds of sulfur are among the worst pollutants for their negative impact on the environment. Around 96% of sulfur enters the atmosphere in the form of SO_2, while the remaining amount is made up of sulfates, H_2S, CS_2, COS and other compounds.[14]

Norilsk Nickel MMC accounts for 25% of Russian industrial emissions of SO_2[15]. In 2009, Norilsk Nickel emitted around 975,000 tons of sulfur into the atmosphere.

Besides sulfur dioxide, in the process of industrial activity by Norilsk Nickel MMC, a whole range of heavy metals enter the atmosphere, such as Nickel (Ni), copper (Cu), cobalt (Co) and arsenic (As). The main pollution comes from nickel and copper.

Heavy metals are present in the atmosphere in the form of dusts and aerosols, and also in gas-like form. At the same time, lead, cadmium, copper and zinc aerosols mainly

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[10] Council Directive 96/62/EC of 27 September 1996on ambient air quality assessment and management (http://eur-lex.europa.eu/LexUriServ/site/en/consleg/1996/L/01996L0062-20031120-en.pdf).

[11] Council Directive 1999/30/EC of 22 April 1999 relating to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead in ambient air. Директива ЕС 1999/30/EC (http://europa.eu/legislation_summaries/environment/air_pollution/l28098_en.htm).

[12] Council Directive 1999/30/EC of 22 April (http://europa.eu/legislation_summaries/environment/air_pollution/l28098_en.htm).

[13] http://www.sgu.ru/faculties/geological/departments/geoecology/Reference/sanpin_air.php.

[14] http://www.megaresearch.ru/files/demo_file/1766.pdf.

[15] Норильский проект // Наука в России. 2005. № 4 (http://www.ras.ru/publishing/issues.aspx).

consist of submicron particles of 0.5 – 1 mcm, and nickel and cobalt aerosols consist of large dispersive particles (over 1 mcm). Particles larger than two microns constantly settle on soil, water and vegetation.

Heavy metals and their compounds preserve their harmful qualities constantly, regardless of the form of their state. Tiny hard particles of heavy metals have a negative impact on human health.[16] As directive EC 2004/107 notes, so far a threshold has yet to be established below which the level of contents of heavy metals in the air does not present a threat to the environment or the person.[17]

Pollution by heavy metals is a serious threat for the natural environment of the Arctic.

3.2. Pollution of surface waters

Non-ferrous metallurgy has one of the highest water consumptions in industry. Water use for 1 ton of nickel production reaches 4000 m³, and 500 m³ per 1 ton of copper production.[18]

During the production process, a small percentage of water used returns to the natural environment in distilled form, while the majority of it is discharged into bodies of water in the form of waste water that is polluted by waste production (direct pollution of the water environment).

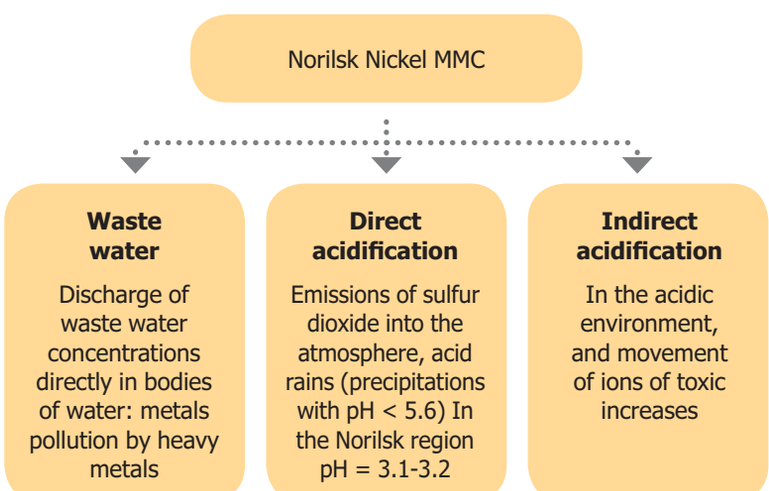
When the capability of eco-systems for neutralization is weakened, which is caused by human impact, an acidification of land and water systems takes place. Acidification takes place as a result of the impact of aerosols, precipitation and dust, imposing a negative impact on all living organisms.

Acidification of surface waters is a global problem at present.

The water systems of the Arctic region, due to their special nature, are the most sensitive to acidification. Norilsk Nickel plants discharge thousands of tons of sulfur dioxide, which as a result of chemical reactions transform into acids and fall to the ground in the form of "acid rains".

"Acid rains" are the name given to all forms of meteorological precipitations – rain, snow, hail, fog and rain with snow – which have a lower pH than the average pH value of rain water (the average pH for rain water is equal to 5.6).[19] Acid rain is formed as a result of a

Chart 5. Paths of pollution of the water system



[16] Директива ЕС 2004/107/ЕС о предельной величине концентрации мышьяка, кадмия, ртути, никеля и полициклических ароматических углеводородов (http://www.epa.ie/downloads/legislation/air/quality/EU_Directive_Air_04-107-EC.pdf).

[17] Директива ЕС 2004/107/ЕС о предельной величине концентрации мышьяка, кадмия, ртути, никеля и полициклических ароматических углеводородов (http://www.epa.ie/downloads/legislation/air/quality/EU_Directive_Air_04-107-EC.pdf).

[18] Девяткин П. Н. Природные водные ресурсы района г. Мончегорска в условиях функционирования ОАО «Кольская горно-металлургическая компания» // Вестник МГТУ. Т. 11. 2008. № 3 (http://vestnik.mstu.edu.ru/v11_3_n32/articles/04_devya.pdf).

[19] http://www.chemistry.narod.ru/razdeli/eco/5.htm.

reaction between water and such pollutants as sulfur dioxide (SO_2). These substances are emitted into the atmosphere as a result of activity by metallurgical enterprises. Pollutants transform into acidic solutions upon contact with atmospheric moisture. Together with rain or snow they fall to the ground. The aquatic environment is particularly sensitive to acidification.

The impact of acidification on aquatic organisms may be direct, i.e. it may take place as a result of an interaction with the acidified aquatic environment and indirectly, i.e. the concentration and mov ement of ions of toxic metals in the acidic environment increases. This exacerbates the negative impacts on living organisms.

Negative impacts on bodies of water are caused by waste water and smoke emissions of copper and nickel production plants. The degree of this impact is manifested depending on the amount of pollutants and the proximity of the water body to sources of wastes and emissions.

In aquatic environments, metals are present in three forms: suspended particles, colloidal particles and dissolved compounds. Dissolved compounds are free ions and dissolved complex compounds are with organic (humic and fulvic acids) and inorganic (halogenides, sulfates, phosphates, carbonates) ligands. Hydrolysis has a major impact on the content of these elements. Hydrolysis is an exchange reaction between a substance and water that leads to a decay of the molecule of the substance into smaller molecules[20]. Hydrolysis in many ways determines the form of the element's presence in aquatic environments.

The problem of the toxification of bodies of water with heavy metals even arises when the concentrations of heavy metals in the water do not exceed established MAC. One of the causes of this is the high accumulative ability of living water organisms. This feature makes living water organisms toxically dangerous.

This overall negative impact leads to a disruption in processes of reproduction, a drop in biological diversity, the disappearance of species sensitive to acid etc., which ultimately leads to a decrease in the durability of ecosystems.

3.3. Pollution of underground waters

In the process of the activity of metallurgical companies, pollution of underground waters takes place. The chemical composition of polluters of underground water depends on many factors, including human factors, such as air pollution, acidic precipitation, leaching of heavy metals and pollution of surface waters, which may impact the quality of underground water.

Direct pollution of underground waters arises when toxic substances enter the water-bearing horizon. This happens when precipitation falls on a very porous surface, which has a good flow capacity.

Indirect pollution of underground waters takes place as a result of leached pollutants from an already polluted surface environment.

The leaching process of heavy metals into underground waters accumulated in the soil may take quite a long time. So an important role is played by long-term and constant monitoring of the state of underground waters.[21] Purification of polluted underground waters is a laborious and expensive task.

[20] http://www.xumuk.ru/biospravochnik/504.html.

[21] http://www.pasvikmonitoring.org/russia/index_en.html.

3.4. Human impact on the land ecosystem

Soil is not only important for nourishing plants with water and minerals, but also an important indicator of the health of the ecosystem.

As a result of the activity of mining plants and the metallurgical complex, a large amount of heavy metal compounds enter the soil, presented mainly as oxides. As a result of the interaction of compounds of heavy metals with the soil, oxides of non-ferrous metals are subject to change, and begin to differ significantly in their stability. The level of pollution of soils determines their degradation, which is caused by the presence of chemical substances in soils exceeding the natural (background) level.

Transformation of heavy metals entering the soil passes the following stages indicated in chart 6[22].

As any elements in the soil are present in the form of various compounds, it is not easy to determine the stage of pollution of soils by heavy metals. These compounds are unstable and may move from certain forms to other forms.[23]

The presence in the atmosphere of high concentrations of SO_2 may cause serious damage to leaves after just several hours (localized destruction of tissue (necroses)), and in sensitive plants, chronic damage may arise in minimum concentrations.[24]

Exceeding the allowable concentrations of sulfur dioxide in air, degradation of soil caused by its acidification and the presence of heavy metals in the soil lead to damage of forest areas around plants of Norilsk Nickel MMC.

Enterprises of the copper and nickel industry as a whole, Norilsk Nickel in particular, are a source of technogenic pollution, which leads to pollution of the atmosphere, surface and underground waters and degradation of the soil. As a consequence to the destruction of the plant cover.

Chart 6. Transformation of oxides of heavy metals

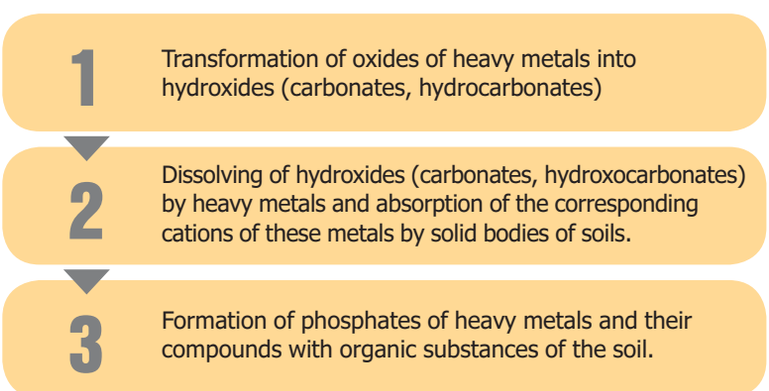


Table 2. Damage to forest covering in regions of activity of Norilsk Nickel MMC

	Subdivision		
Damaged forests	Severo-nickel	Pechenga-nickel	Polar Division
Total damaged areas	47,382 hectares	Precise data lacking	537,100 hectares
Including perished areas	8,924 hectares	3,971 hectares	283,200 hectares

[22] http://www.p0d.ru/news/data_html/aaaaacaad.html.

[23] http://www.p0d.ru/news/data_html/aaaaacaad.html.

[24] http://test.vozdyx.ru/index.php?m=12&a=102.

4. Polar Division of Norilsk Nickel

The Polar Division is located on the Taimyr peninsula (Krasnoyarskiy Krai), and is situated completely beyond the Arctic circle.

The history of the creation of the Polar division of Norilsk Nickel MMC began on 23 June 1935. Today, enterprises of the Polar Division of Norilsk Nickel employ around 56,000 people.

The Mining and Metallurgical Complex of the Polar division of Norilsk Nickel includes five mines where rich, disseminated and cuprous ore is produced. Ores are then enriched at two enrichment plants, where they are processed to produce nickel, copper and pyrrhotite concentrates. The concentrates obtained are then processed at three metallurgical plants: the Nickel Plant, Copper Plant, and Nadezhda.

In 2009, the volume of ore production at the Polar Division came to 15 298 million tons. The volume of nickel production at the division reached 124 000 tons, and copper reached 324 000 tons.[25] By 2025, the Polar Division of the company plans to increase annual ore production by nearly two times as much– from 16 million tons to 30 million tons.[26]

4.1. Raw materials base of the Polar Division

The raw materials base of the Polar Division includes seven mines which produce sulfide copper and nickel ores. Ores of differing value contain nickel, copper, palladium, cobalt, gold and other rare components.

A characteristic feature of Norilsk fields is the difficult washing ability of ores, as Norilsk ores have a thinner dissemination of sulfides in comparison with foreign ores.

The already developed raw materials base of the Polar Division was added in 2009 by the Maslovskoe field of platinum, copper and nickel ores. The field is located 15 km to the south-south-west of the primary industrial site of the Polar Division of Norilsk Nickel MMC. The balance amount of ores is 217 million tons. The Maslovskoe field is considered to be one of the largest platinum, copper and nickel fields. Ore supplies of this field will provide raw materials for enterprises of the Polar Division of Norilsk Nickel for 25 years.[27]

Table 3. Fields of copper and nickel ores of the Polar Division

Field	Mine	Ores
Oktyabrskoe (copper, nickel and sulfide ores)	Oktyarbsky – underground	Rich, cuprous and disseminated
	Taimyrsky – underground	Copper and nickel sulfides, rich
Talnakhskaya (copper, nickel and sulfide ores)	Komsomolsky – underground	Cuprous and disseminated
	Mayak – underground	Disseminated
	Skalisty – underground	Rich
Norilsk-1 (copper, nickel, sulfide)	Medvezhy ruchei – open	Disseminated
	Polar – closed	Disseminated
Maslovskoe	Only placed on the balance in 2009	

[25] www.nornik.ru/our_products/polar_division

[26] http://www.webground.su/tema/2010/05/19/noriljskij_nikelj.

[27] Металлоснабжение и сбыт. 2010. № 3 (http://www.metalinfo.ru/ru/news/41208).

4.2. Technological cycle of the Polar Division

Enrichment of ore for the Polar Division of Norilsk Nickel MMC is carried out at the Talnakhskaya and Norilsk enrichment plants.

At the Talnakhskaya enrichment plant, rich ores from the Talnakhskaya and Oktyarbskoe fields are processed, and the final product obtained is in the form of nickel, copper and pyrrhotite concentrates.

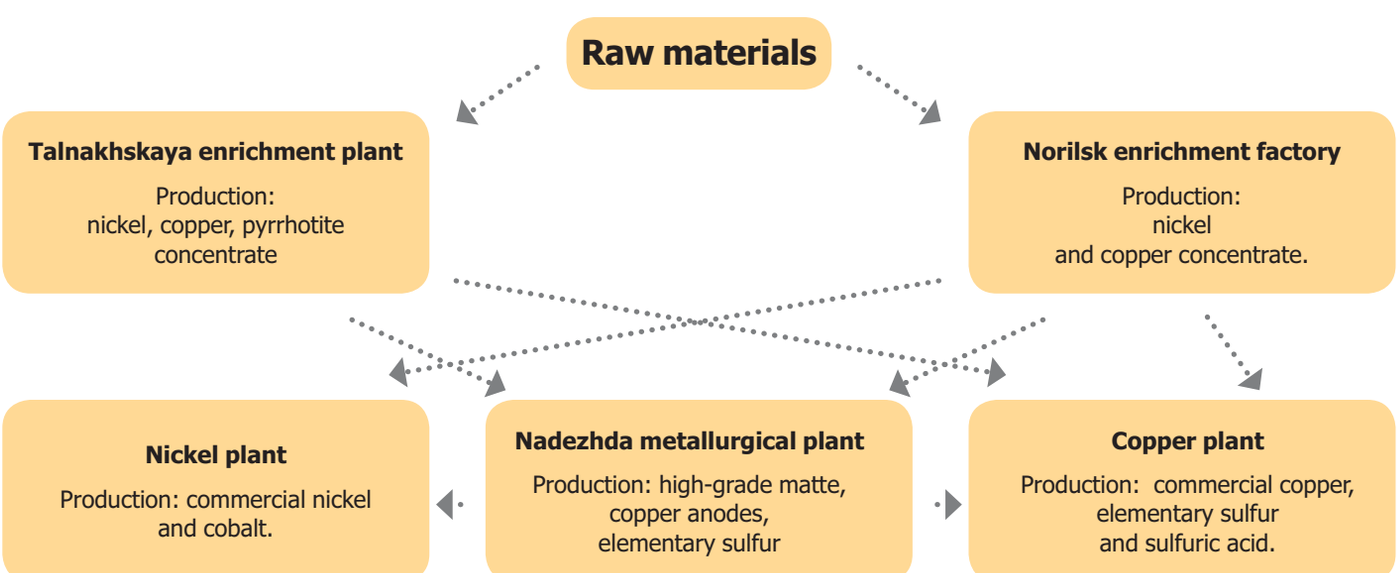
The Norilsk enrichment plant processes the entire volume of disseminated ores and cuprous ores of the Talnakhskaya and Oktyabrskoe fields, as well as aged pyrrhotite concentrate, producing nickel and copper concentrate.

The metallurgical facilities of the Polar Division include the Nadezhda metallurgical plant, and the Nickel and Copper Plants.

The Nadezhda metallurgical plant processes the entire volume of nickel and pyrrhotite concentrates of the Talnakhskaya enrichment plant, part of the nickel concentrate of the Norilsk enrichment plant (around 15%), and the entire volume of copper concentrate of the high-grade matte separation area of the roasting shop of the Nickel plant, producing high-grade matte, copper anodes and elementary sulfur[28].The plant has two production lines – hydrometallurgical, designed for processing of pyrrhotite concentrate, and pyrometallurgical, where nickel concentrate of hydrometallurgical production and copper concentrate of high-grade matte separation area of the nickel plant are processed. The main shops are: smelter shop 1; smelter shop 2; shop for production of elemental sulfur; shop for dehydration and storage of concentrates; shop for preparation of sulfur and fusion mixture; oxygen station.

The nickel smelter processes most of the nickel concentrate of the Norilsk enrichment plant (around 85%), all the enriched stored

Char 7. The production and technological cycle of the Polar Division of Norilsk Nickel MMC



[28] http://www.nornik.ru/our_products/polar_divisions.

pyrrhotite concentrate, and some high-grade matte of the Nadezhda metallurgical plant, to produce commercial nickel and cobalt. The finished product of the plant is: electrolyte nickel; granulated nickel; metallic cobalt; compounds on the basis of cobalt.

Semi-finished product – sludge of precious metals.

Main shops: nickel electrolysis shop; smelter shop; roasting and restoring shop; chloric and cobalt shop.

Main area of reconstruction – move to a hydrometallurgical scheme of leaching of high-grade matte, and an extraction and electrolysis technology for obtaining finished products on the basis of nickel, cobalt and copper.

The copper plant processes the entire volume of copper concentrates of the Norilsk and Talnakhskaya enrichment plants, and copper anodes of the Nadezhda metallurgical plant, to produce commercial copper, elementary sulfur and sulfuric acid.

Main shops: drying shop; smelter shop; copper electrolysis shop.

Main areas of development – reconstruction of the smelter shop, liquidation of the converter production area and subsequent reconstruction of the copper refining production area.

It is understood that all reconstruction works will help to reduce total expenses on production, and improve the environmental situation in the region.

The metallurgical shop of production of precious metal concentrate, which is a division of the Copper plant, processes sludge from the copper electrolysis shop and the nickel electrolysis shop, to produce precious metal concentrate, metallic silver, selenium and tellurium.

Technological production areas: roasting section; hydrometallurgical section; smelter section; selenium section; silver refining section; dust extraction section.

4.3. Technical impact of Polar Division of Norilsk Nickel MMC

4.3.1. Pollution of the atmosphere

The production facilities of the copper smelting and nickel production of the Polar Division are located at opposite ends of the outskirts of Norilsk. Regardless the wind direction the city will be covered with clouds of gas emissions.

The sulfur content in the atmospheric precipitation in Norilsk has the highest level not only in the Siberia region, but of the entire territory of Russia. The average monthly content of sulfur dioxide SO_2 in Norilsk exceeds the background level of the region by 50-60 times.[29] In Norilsk, for around 350 days per year, an excessive level of atmospheric pollution by harmful substances is recorded. Nearly 80% of the time the level exceeds MAC by 5 times. 20% of the time the level exceeds MAC by 10 times, which means the level of pollution may be assessed as "severe" and "very severe"[30].

An analysis shows that the average annual emission (data of 2008) of sulfur at three plants of the Polar Division comes to around:

Cooper Plant (CP)	340-350,000 t/year;
Nadezhda Metallurgical Plant (NMP)	420-430,000 t/year;
Nickel Plant (NP)	250-260,000 t/year.[31]

[29] Открытое письмо генеральному директору ГМК «Норильский никель» Стржалковскому В. И. (http://krsk.sibnovosti.ru).

[30] Открытое письмо генеральному директору ГМК «Норильский никель» Стржалковскому В. И. (http://krsk.sibnovosti.ru/society/56359-otkrytoe-pismo-generalnomu-direktoru-gmk-norilskiy-nikel).

[31] Leontyev. Norilsk Nickel' ecological problems and practical ways to solve them. Moscow Russia March, 2007.

Around 50% of sulfur dioxide SO_2 is formed in the form of rich gases, and the same number in the form of poor gases. For gases with a poor sulfur content, the process of utilization into sulfuric acid is rather difficult and expensive.

One way to reduce sulfur dioxide emissions is utilization.

The problem of SO_2 utilization for the Polar Division plans can be explained by the low requirement of the existing technological cycle for sulfuric acid, and also the impossibility of shipment it, owing to the lack of railway communications with other regions. Furthermore, utilization of sulfur dioxide by obtaining elementary sulfur requires considerable expenses[32]. The plant makes attempts to utilize sulfur dioxide, but these measures do not give effective results.

In 2004, at the Polar Division, SO_2 was utilized into elementary sulfur (for internal use), and sodium bisulphate of a total of 84,000 t/year, i.e. just 7.67% of the total annual emission of sulfur dioxide. In 2005, the amount of sulfur dioxide utilized increased to 122,000 t/year and came to 10.6%. In the program of the Polar Division of Norilsk Nickel MMC to utilize sulfuric anhydride, it is planned to build a storage facility with a capacity of 7 million tons.[33] At present there is no use for sulfuric acid.

At present, the issue of utilization of sulfur from technological gases that are emitted into the atmosphere by the PD of Norilsk Nickel MMC is of primary importance.

At an ecological conference held in October 2010, it was noted that 15 different projects for utilization of sulfur are under consideration, from the simplest – utilization of sulfur into sulfuric acid – to the most ambitious – pumping SO_2 into empty spaces formed after the mining of ore. In the case of successful completion of the entire program for the utilization of sulfur dioxide, by 2013, 82.0% of sulfur should be extracted from gases. An emission of 202,000 t./year of sulfur is expected.[34]

Despite the data provided on reduction of SO_2 emissions, the dioxide sulfur levels in the ambient air of the Norilsk industrial region still significantly exceed MAC.

There is no precise data on pollution in Norilsk by emissions of heavy metals. However, their presence may be judged by the concentration of heavy metals in mushrooms, moss and plants. In one resort zone (the location of the Valek preventative clinic) – resort zones are usually located a long way from the industrial zone – the level of MAC of nickel in honey mushrooms was exceeded by 8 times, zinc and lead by 6 times, cadmium by 46 times, and copper by 25 times.[35]

4.3.2. Pollution of surface waters

The main water bodies into which waste water from Norilsk Nickel flows are Pyasino Lake, located at the foot of the northwestern spurs of the Putorana Plateau, the rivers Ambarnaya, Koeva, Bucheko-Yurekh, Shchuchya, Samoedskaya Rechka and many others that flow into the lake.

The largest tributary is Norilskaya (Talaya) river, which gathers its waters from the extensive mountain and lake region. From the northern end of the river, the river Pyasina issues, which flows to the north and flows into the Pyasina gulf of the Karsk Sea.

Within the industrial areas of Norilsk Nickel, water pollution is seen everywhere with elements that are typical for copper and nickel production: Na, Cl, SO_4, Fe, Ni, Cu, Ti, Ba, Sr, Mn.

The enrichment and metallurgical production includes a number of pits for waste,

[32] http://www.nornik.ru/press/publications/1753.

[33] http://www.nornik.ru/press/news/1171.

[34] http://www.nornik.ru/development/environmental_performance.

[35] http://www.lifenews.ru/news/26194.

concentrates, ponds of reverse water supply and ash disposal areas.

In 2007, the Polar Division of Norilsk Nickel MMC dumped 31.5 million m³ of waste water, including 28.9 million m³ without purification.[36]

In August 2007, on the basis of a letter from residents of Norilsk on the unfavorable ecological situation in the city, the Federal service for supervision in the sphere of natural resource management (Rosprirodnazor RF) carried out an unscheduled inspection of the natural resource activity of the Polar Division of Norilsk Nickel.

In the course of the inspection, an independent laboratory was involved in the collection of samples from waste water emissions. The inspection was recorded using video and photo equipment.

Analyses of the tests showed that the concentration of pollutants discharged at pollution sources (outlets) significantly exceeded the norms of provisionally approved discharges (PAD).

Results of inspections at Copper plant:

Outlet № 40.

(data for 1st, 2nd quarter and in the period from 01.07 to 08.08. 2007)

Water is discharged into Shchuchya river
258 890 m³ of waste water discharged.

Name of indicators ,	Actual data, mg/dm³	PAD, mg/dm³
Synthetic surface-active substances (SSAS)	0.21	0.30
Iron	**14.9**	**0.94**
Nickel	**4.044**	**0.67**
Oil products	**0.4**	**0.16**
Nitrites	Less than 0.001	0.012
Sulfates	66.7	168.5
Lead	0.025	None.
Copper	**5.813**	**0.76**
Ammonia and ammonia ions	0.48	0.59
Chlorides	**47.5**	**16.5**
Nitrates	**19.8**	**0.73**
Calcium	**136.8**	**39.3**
Magnesium	**16.1**	**10.6**
Phosphates	**0.09**	**0.016**
Zinc	**0.124**	**None**

From comparative data of results of analyses of samples of outlet № 40 of the Copper Plant (waste water, domestic waste water), PAD was found to be exceeded for the following ingredients: iron, nickel, oil products, lead, copper, chlorides, nitrates, calcium, magnesium, phosphates, zinc.[37]

Outlet № 39

(data for the period from 01.07 to 08.08. 2007)

Water discharged into the Shchuchya river. 71,589 m³ of waste water discharged

Name of indicators	Actual data mg/dm³	PAD	Actual data at distance of 10 m downstream from control point of outlet 39
Synthetic surface-active substances	Less than 0.025	0,90	Less than 0,025
Synthetic surface-active substances	Less than 0.025	0,90	Less than 0,025
Iron	0.17	0.54	0.43
Nickel	**0.443**	**0.071**	**1.156**
Oil products	0.09	0.17	0.04
Nitrites	Less than 0.001	0.16	0.02
Sulfates	50.6	79.1	96.2
Lead	Less than 0.005	None	Less than 0.005
Copper	**0.243**	**0.19**	**0.095**
Ammonium and ammonium ions	0.2	0.68	0.18
Chlorides	14.3	22.6	40.2
Nitrates	Less than 0.5	0.71	Less than 0.5
Calcium	**33.1**	**28.6**	**31.5**
Magnesium	8.0	6.9	5.9
Phosphates	0.1	0.59	0.01
Zinc	0.01	None	0.029

[36] http://protown.ru/russia/obl/articles/2717.html.

[37] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008: Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

From a comparative data of the analysis results of samples of outlet № 39 of the Copper Plant (waste and domestic waste water), the presence of the following metals was found to be excessive: nickel, copper, calcium, magnesium and zinc.[38]

From comparative data of analysis results of a test taken in an inspection at a distance of 10 m downstream from the control point of outlet № 39, it was found that an additional outflow that is present 5 meters from the control point of outlet № 39 increases the concentration in the total outflow of such ingredients as nickel, sulfates, chlorides and zinc.

Results of the inspection showed that through this outlet, pollutants enter the water unaccounted for by copper plant services, i.e. unsanctioned dumping of waste water.

Outlet № 38

(data for 1st and 2nd quarter of 2007)

Water is discharged into the Shchuchya river.

252,200 m³ of waste water is discharged.

Excess of norms of preliminarily approved discharges (PAD) came to:

Phosphates – 0.072 mg/l, which exceeds the norm by 1.34 times

Nitrates – 0.013 mg/l, which exceeds the norms by 1.16 times[39]

Outlet № 37

(data for second quarter of 2007)

Water is discharged into the Shchuchya river.

68,000m³ of waste water is discharged.

Excess of norms of preliminarily approved discharges (PAD) came to:

Suspended substances – 19.4 mg/l, which exceeds the norm by 2.17 times

Iron – 0.46 mg/l, which exceeds the norm by 1.88 times

Copper – 3.44 mg/l, which exceeds the norm by 1.93 times

Solid residue – 0.39 mg/l, which exceeds the norm by 1.2 times[40]

In accordance with "Methods for calculating the extent of damage caused to bodies of water as a consequence of violation of water legislation", damage has been calculated to any body of water as a result of dumping pollutants that exceed established norms at outlets № 37, 38, 39, 40.

Damage done to any body of water will result in a violation of water legislation. The dumping of pollutants, above the established norms for the current period of 2007 at outlets № 37, 38, 39, 40 of the structural division of the Copper Plant, comes to 40,422, 422.61 rubles.[41]

Data on the Nickel Plant:

The plant is located in the southeast of Norilsk in an industrial zone.

The plan includes:

– agglomerative shop (AS)
– smelter shop
– roasting shop, including gas-generation station (GGS)
– nickel electrolysis shop (NES)
– chloric-cobalt shop (CCS).

Domestic waste water and industrial waste water is discharged at seven outlets:

outlet № 29 industrial waste waster of CCS;

outlet № 30 – domestic waste water of compressor CCS;

outlet № 31 – domestic waste water of NES

outlet № 33 – domestic waste water of GGS, section for preparing main production and slag cars;

outlet № 34 – domestic waste water of cafeteria of NES and AS;

outlet № 35 – domestic waste water of substation № 92 of CCS;

outlet № 36 – domestic waste water of CCS sports complex.

Calculations of discharged waste water volumes, due to the lack of accurate calculation devices, are determined by computational methods.

[38] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008: Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[39] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008: Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[40] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008: Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[41] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008: Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

Outlet № 29

Water is discharged into the Novaya Naledнaya river.

In the period from 01.01 to 31.03. 2007 189,570 m³ of waste water was discharged. Excess of established norms of preliminarily approved discharges (PAD) came to:

Iron – total. 0.08 mg/l, which exceeds the norm by 115.9 times
Cobalt – 0.041 mg/l, which exceeds the norm by 29.28 times

In the period from 05.04 to 18.06. 2007, 155,594 m³ of waste water was discharged. Excess of established norms of preliminarily approved discharges (PAD) came to:

Iron total – 0.004 mg/l, which exceeds the norm by 5.7 times
Sulfates – 12774,6 mg/l, which exceeds the norm by 48.59 times
Copper – 0.003 mg/l, which exceeds the norm by 18.75 times
Solid residue – 18605,7 mg/l, which exceeds the norm by 31.06 times
Sodium – 4006.1 mg/l, which exceeds the norm by 19.3 times

In the period from 01.07 to 08.08. 2007 85,475m³ of waste water was discharged. Excess of established norms of preliminarily approved discharges (PAD) came to:

Iron – total. 0.081 mg/l, which exceeds the norm by 117.39 times
Oil products – 0.07 mg/l, which exceeds the MAC norm by 140 times[42]

Outlet № 31

Water is discharged into the Shchuchya River.

In the period from 01.01 to 31.01.2007, 5,900 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrite – 0.084 mg/l, which exceeds the norm by 280 times

In the period from 01.02 to 31.03.2007, 11,360 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrite – 0.003 mg/l, which exceeds the norm by 10 times
Chlorides – 7.4 mg/l, which exceeds the norm by 46.5 times
Nitrogen ammonium compounds – 2.66 mg/l, which exceeds the norm by 201.5 times
Phosphates – 0.86 mg/l, which exceeds the norm by 373.9 times[43]

In the period from 01.04 to 30.06.2007, 17,450 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrite – 0,14 mg/l, which exceeds the norm by 466.6 times
Phosphates – 0,19 mg/l, which exceeds the norm by 82.6 times
Sulfates – 13,5 mg/l, which exceeds the norm by 28.6 times

In the period from 01.07 to 08.08.2007, 7,479 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrite – 0,19 mg/l, which exceeds the norm by 633.3 times
Nitrogen ammonium compounds – 0.17 mg/l, which exceeds the norm by 12.8 times[44]

Outlet № 34

Water is discharged into the Shchuchya River

In the period from 01.01 to 31.01.2007 17,154 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrate – 0,54 mg/l, which exceeds the norm by 112.5 times
Nitrite – 0,3 mg/l, which exceeds the norm by 272.7 times
Phosphate – 0,078 mg/l, which exceeds the norm by 23.5 times
SSAS – 0,046 mg/l, which exceeds the norm by 30.6 times[45]

[42] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 apport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[43] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 apport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[44] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 apport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[45] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 apport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

In the period from 01.02 to 31.03.2007, 32,528 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

BOD LP – 24.4 mg/l, which exceeds the norm by 248.9 times

Chlorides – 1.5 mg/l, which exceeds the norm by 9.7 times

Nitrogen ammonium compounds – 3.82 mg/l, which exceeds the norm by 272.8 times

Phosphates – 0.078 mg/l, which exceeds the norm by 23.6 times

Solid residue – 2.5 mg/l, which exceeds the norm by 1.4 times

SSAS – 0.095 mg/l, which exceeds the norm by 63.3 times[46]

In the period from 01.04 to 30.06.2007, 50,173 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Nitrite – 0,04 mg/l, which exceeds the norm by 36,3 times

Nitrate – 0,17 mg/l, which exceeds the norm by 35,4 times[47]

In the period from 01.07 to 08.08.2007, 21,902 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Oil products – 0.02 mg/l, which exceeds the norm by 16.6 times

Phosphates – 0.39 mg/l, which exceeds the norm by 118.18 times

Excess of MAC

Iron total – 0.22 mg/l, which exceeds the norm by 16,6 times

Nickel – 0.063 mg/l, which exceeds the norm by 630 times

Copper – 0.024 mg/l, which exceeds the norm by 2400 times

Zinc – 0.015 mg/l, which exceeds the norm by 150 times[48]

Damage done to the body of water as a result of violation of water legislation, dumping of pollutants, above the established norms for the current period of 2007 at outlets № 29, 31, 34 of the structural division of the Copper Plant, comes to 1,961, 330,665.56 rubles.[49]

Data on the Norilsk enrichment plant:

The NEP is located in the area of Norilsk, on the northwest slope of Rudnoi mountain, in the valley of Uglony river. The NEP manufactures copper and nickel concentrates, from which non-ferrous metals are extracted: nickel, copper, cobalt and metals of the platinum group from crude ore.

The Norilsk enrichment plant contains 3 main shops:

crushing shop;

grinding-flotation shop;

shop of hydraulic structures and hydraulic transport (Lebyazhe tailing dump). (SHSHT)

Discharge of domestic and industrial waste water is carried out at four outlets:

outlet № 27 – domestic waste water from the administrative and amenity complex of SHSHT);

outlet № 28 – domestic waste water from pump station 1 A;

outlet № 25 – ndustrial waste water from the sediment tank of nickel concentrate;

outlet № 26 – industrial waste water from the Lebyazhe tailing dump:

Calculation of the volume of dumped waste water, due to the lack of calculation devices, is determined by computational methods.

Outlet № 26

Water is discharged into the Shchuchya river.

In the period from 01.01 to 31.01.2007, 250,000 m³ of waste water was discharged

Excess of established norms of preliminarily approved discharges (PAD) came to:

Chlorides – 67.4 mg/l, which exceeds the norm by 12.7 times

[46] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[47] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[48] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[49] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv).

Sulfates – 413.7 mg/l, which exceeds the norm by 12.8 times

Balanced substances – 22.1 mg/l, which exceeds the norm by 171.3 times

Solid residue – 1144.7 mg/l, which exceeds the norm by 21.2 times

Calcium – 219. 2 mg/l, which exceeds the norm by 36.3 times

Sodium – 265.4 mg/l, which exceeds the norm by 40.79 times

Butyl xanthate – 1.44 mg/l, which exceeds the norm by 232.25 times

Dibutyldithio phosphate – 0.28 mg/l, which exceeds the norm by 45.9 times[50]

In the period from 01.04 to 01.08.2007, 524,400 m³ of waste water was discharged.

Excess of established norms of preliminarily approved discharges (PAD) came to:

Iron total – 0.63 mg/l, which exceeds the norm by 128.57 times[51]

In the process of enrichment, waste is formed – final tailings consisting mainly of barren rock, with a small amount of precious minerals which cannot be separated into concentrate.

Final tailings of enrichment are sent to the Lebyazhe tailing dump, which is operated by the NEP shop of hydraulic structures and hydraulic transport.

The main structures of the tailing dump include a pioneer levee and hydraulic-fill dam, settling ponds, distribute sludge pipes, siphon intakes, and a riverside pump station of recycled water (stationary).

The system of technological water rotation has a discharge of unpurified imbalanced waters from the Lebyazhe tailing dump.

Damage done to the body of water as a result of violation of water legislation, dumping of pollutants, above the established norms for the current period of 2007 at outlets № 26 of the structural division of the Norilsk enrichment plant comes to: 703, 859,274.37 rubles.[52]

According to official data, in 2007 Norilsk Nickel discharged a total of 37 million m³ of waste water from its plants. The mass of pollutants discharged with waste water into bodies of water came to around 25,450 tons.

The Pyasina River, especially its upper course (before it flows into Pyasino lake), is located in the zone of maximum pollution of soils and vegetation of the Norilsk industrial region. Pyasino Lake, which is the recipient of polluted waste water, is almost completely devoid of fish. The lower course of the Pyasina River is also heavily polluted, and fish supplies here are impoverished. Specialists believe that living organisms and ecosystems of the Pyasino-Yenisei interfluvial area, in connection with their proximity to Norilsk, are threatened by a complete transformation and the extinction of many species of plants and animals.[53]

Inspectors of the Yenisei basin department for conservation, reproduction of fish supplies and regulation of fishing have recognized this fact and noted in a document that the river of Naledнaya and Shchuchya have lost their commercial fishing importance as a consequence of pollution.

4.3.3. Pollution of groundwater

Data and information about pollution of groundwater from the Polar Division are insufficient.

Studies carried out in the region of Norilsk industrial zones have shown that near the Smelter shop and Nickel electrolysis shop,

[50] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[51] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[52] Data from documents of an inspection by Rosprirodnazor RF Bellona 2008 Rapport om Norilsk nikkel, utført på oppdrag fra Etikkrådet (finnes i rådets arkiv)

[53] http://oopt.info/index.php?oopt=222

pollution of stream water and groundwater is observed.

This territory is characterized by a lack of permafrost as a consequence of the warming effect the production cycle from the Nickel plant has in the region. According to data taken from samples, the composition of groundwater is characterized as continuously polluted, i.e. pollution of groundwater in this region is of a chronic nature.

Samples show an excess of MAC for SO_4. Results from chemical analyses in recent years show a decrease in mineralization in the filtration period of groundwater due to infiltration from the surface. For the same period there is an increase in content of micro-components (Mn, Sr).

4.3.4. Impact on the ecosystem

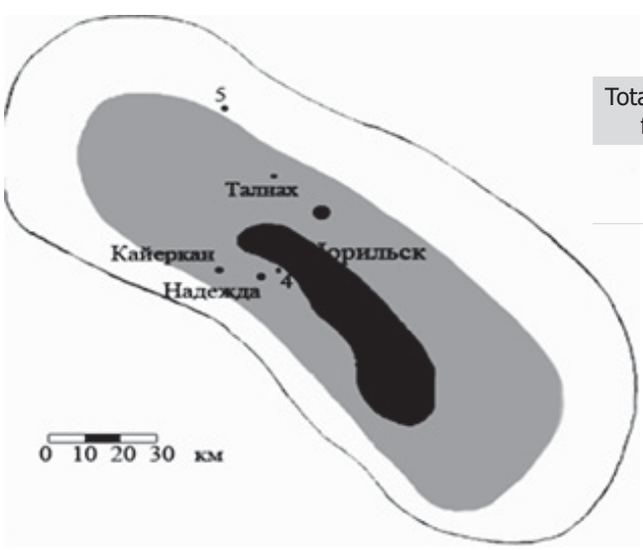
An assessment on the present state of soils in the region where the Polar Division of Norilsk Nickel MCC resides revealed different levels of pollution from heavy metals (HM), the state of vegetation and biological activity, showed that the territory up to 4 km from the city is characterized by a high content of heavy metals, lack of tree vegetation and disruption of mineralization of organic matter, which corresponds to level 5 of deterioration of the natural environment.[54]

The zone 4-16 km from the city corresponds to level 4 of environmental deterioration, and the 16-25 km zone to level 3 of environmental deterioration.

Soils in the 16-25 km zone are characterized by an excessive content of acid-soluble and mobile compounds of metal without exceeding MAC for water-soluble compounds, as well as by a normalization of the microbiological activity of soils.

At the distance of 25 km from Norilsk, the state of the environment is measured to level 2. The percentage of Cu, Ni, and Co compounds in the soil that are mobile and connected with amorphous oxides and hydroxides increases[55].

Chart 8. Damage to forests by emissions from the Polar Division of Norilsk Nickel MMC



Areas of damage

Total area of damaged forest, hectares	Of this area, dead trees, hectares	Area of forest by level of damage, hectares	
		Severe	Medium
537 100	283 200	164 200	89 700

The boundaries of dead forests spread in the southeast direction over a territory of up to 180 km.

- Test area
- Complete damage
- Severe impact
- Medium impact

[54] Оценка и нормирование экологического состояния почв в зоне деятельности предприятий металлургической компании "Норильский никель"А. С. Яковлев, И. О. Плеханова, С. В. Кудряшов, Р. А. Аймалетдинов. Факультет почвоведения МГУ им. М.В. Ломоносова.

[55] Оценка и нормирование экологического состояния почв в зоне деятельности предприятий металлургической компании "Норильский никель"А. С. Яковлев, И. О. Плеханова, С. В. Кудряшов, Р. А. Аймалетдинов. Факультет почвоведения МГУ им. М.В. Ломоносова.

Studies of the soil have shown a high content of heavy metals which decreases the further it is from the source of pollution. However, in the direction of prevailing winds, the nickel content does not reach normal indicators even at a distance of 200-250 km.

Mushrooms and berries that grow in these soils act as indicators of pollution by the ability to accumulate the metals present (up to 100-300 mg/kg of dry weight). Due to their physiological qualities, berries are polluted less (15 mg/kg of dry weight) than mushrooms.[56] High levels of heavy metal pollution have been found in the soil of local gardens and greenhouses. More specifically, heavy metals with an emphasis on nickel have been found in produce such as radishes, spring onions, parsley and lettuce.[57]

Snow cover has served as an indicator to the presence of harmful mixtures in the environment. Studies of snow on city lawns in Norilsk showed the presence of a wide spectrum of metals such as nickel, copper, cobalt, zinc, cadmium, lead, iron and manganese.[58]

According to data for the early 1990s, the pollution zone from the industrial activity from the Polar Division of Norilsk Nickel included to around 300,000 hectares of land covered by trees. The land consisted almost completely of dead trees. Nearly half of all the grass and shrub cover lies damaged in an area of around 380,000 hectares. Lichen cover here exceeds no more than 5%.[59]

Tendencies for a worsened state of the environment on the Taymyr Peninsula continue up to the present. Annually, Norilsk destroys 30,000 hectares of forest, and the boundaries of dead forests are spreading further and further across the peninsula. The situation is worsened by the fact that the forests of Taymyr are classified in the specially protected 1st group, as technology has yet to be invented for restoring forests in permafrost conditions.[60]

Studies held in the Norilsk industrial zone enabled scientists to single out several levels of pollution. In the southern and southeast directions from the industrial center (in accordance with the prevalence of the northeast wind), and within the boundaries of a 70-km zone, tree vegetation had perished completely. Data from the studies showed that the sulfur content in plants exceeded the background level by 3 – 4 times, copper by 4 – 9.5 times and nickel content by 18 – 26 times. Some areas were discovered where the background level for copper was exceeded by 17 – 156 times, and for nickel by 31 – 470 times.[61]

Only at a distance of over 70 km from the city, the percentage of dead tree trunks (deadwood) in the tree layer drops, and juniper appears. At the 80-100 km mark, features begin to be seen that are characteristic of the given bioclimatic zone: around 50% of trees are dead, and undergrowth and moss and grass vegetation are not suppressed.[62]

Scientists detect a zone of low pollution at a distance of 100 – 140 km from Norilsk. The sulfur content in plants there exceeds background indicators by 1.2 – 1.7 times, copper by 1.3 times and nickel content by 1.5 – 2.7 times[63]. At a distance of over 200 km from Norilsk, degradation of vegetation is not observed.

Within the boundaries of the Norilsk region, the acidity from atmospheric precipitation is 3.1 – 3.2 pH, which is destructive for plants. This low pH is caused by the high content of sulfur anhydride in the air.

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[56] Христенко П.П. Пути решения снижения уровня загрязнения атмосферного воздуха г.Норильска выбросами горно-металлургической компании «Норильский никель», 2003 // Здоровье населения и среда обитания, 2003. — № 3. http://www.nrk.cross-ipk.ru/body/pie/body/8/acclim/pollution.HTM.

[57] Христенко П.П. Пути решения снижения уровня загрязнения атмосферного воздуха г.Норильска выбросами горно-металлургической компании «Норильский никель», 2003 // Здоровье населения и среда обитания, 2003. — № 3. http://www.nrk.cross-ipk.ru/body/pie/body/8/acclim/pollution.HTM

[58] http://www.nrk.cross-ipk.ru/body/pie/body/8%5Cacclim%5Cpollution.htm.

[59] http://2001.vernadsky.info/h1/w01348.htm.

[60] http://2001.vernadsky.info/h1/w01348.htm.

[61] Норильский проект. - Наука в России, 2005, N 4 http://dlib.eastview.com/browse/doc/10327939

[62] Норильский проект. - Наука в России, 2005, N 4 http://dlib.eastview.com/browse/doc/10327939

[63] Норильский проект. - Наука в России, 2005, N 4 http://dlib.eastview.com/browse/doc/10327939

5. Kola Mining and Metallurgical Company (KMMC)

The open, joint-stock company Kola Mining and Metallurgical Company (KMMC) is an affiliated enterprise of the Norilsk Nickel Mining and Metallurgical Company, and is a unified mining and metallurgical production plant for the mining of copper, nickel ores and the manufacturing of non-ferrous metals. KMMC is the leading industrial complex of the Murmansk Oblast.

The copper-nickel plants on the Kola Peninsular began working in the 1930s. The Kola Mining and Metallurgical Company was formed on November 16, 1998. The founders of the company were two affiliated groups of the Norilsk Nickel mining and metallurgical company situated on the Kola peninsula: Pechenganickel mining and metallurgical plant, and Severonickel plant.

The Pechenganickel and Severonickel plants, as well as plants of the Polar Division of Norilsk Nickel are town-forming for the population centers of Nickel, Zapolyarny, Monchegorsk and Norilsk. Today over 13,000 people work at Kola Mining and Metallurgical Company.

In 2010, the total volume of production of commercial nickel at KMMC plants was 111,318 tons, 56,378 tons of copper and Co – 2,458 tonn.[64]

5.1. Raw materials base of KMMC

The Kola Mining and Metallurgical Company carries out works at the four major fields of Zhdanovskoe, Zapolyarnoe, Kotselvaara and Semiletka. At three mines, KMMC mines sulfide disseminated ores containing nickel, copper and other commercial minerals. Additionally, KMMC has the fields of Bystrinskoe, Tundrovoe, Sputnuk and Verkhnee on its balance.[65]

Chart 9. Raw materials base of KMMC

Field	Mine	Ores
Zhdanovskoe (copper and nickel sulfide ores)	Central – open	Disseminated
	Severny-Gluboky – underground	Disseminated
Zapolyarnoe (copper and nickel sulfide ores)	Severny – underground	Disseminated
Kotselvaara and Semiletka (copper and nickel sulfide)	Kaula-Kotselvaara	Disseminated

At present, the main area in the development of the mineral raw materials base of the Kola Peninsula is the additional exploration of deep levels of the functioning Zhdanovskoe field, and development of the Severny-Gluboky mine on the basis of this field.

[64] http://www.kolagmk.ru/files/uploads/KN4449.pdf.

[65] Козырев А. А., Жабин С. В., Чуркин О. Е. Состояние и потенциал горно-промышленного комплекса Мурманской области // Вестник МГТУ. Т. 12. 2009. № 4 (http://www.vestnik.mstu.edu.ru).

5.2. Technical cycle of KMMS

The production facilities of Kola MMC are located at three sites in Nickel, Zapolyarny and Monchegorsk.

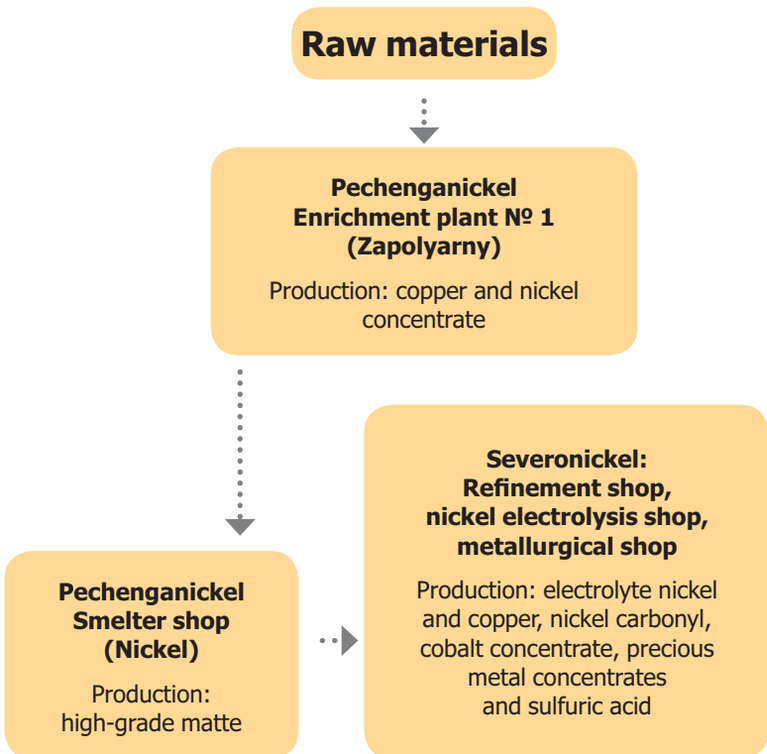
Enrichment plant № 1, which is part of the Pechenganickel (Zapolyarny) processes disseminated ores mined at mines of the Kola Peninsula, to produce copper and nickel concentrate. The production of the plant is rich ores and products from processing the poor ores (in the form of roasted pellets) which are sent to the smelter shop located in Nickel. At present at the industrial site in Zapolyarny, roasting technology is being replaced with briquetting technology.

The smelter shop in Nickel consists of a roasting shop and smelter shop of the Pechenganickel plant. Here, concentrate of enrichment plant № 1 is processed. Production of the smelter shop is in the form of high-grade matte, which is sent for further processing to the Severonickel plant.

Severonickel processes both KMMC high-grade matte and high-grade matte of the Polar Division. The production shops of Severonickel are: refinement shop, nickel electrolysis shop, metallurgical shop (Monchegorsk). Production of the plant is electrolytic nickel and copper, nickel carbonyl, cobalt concentrate, precious metal concentrates and sulfuric acid.

The production and technological cycle of KMMC is represented in simplified form in chart 10.

Chart 10. Production and technological cycle of the Kola mining and metallurgical company



5.3. Technogenic impact of the Kola mining and metallurgical company

KMMC is an affiliated enterprise of Norilsk Nickel MMC, situated in direct territorial proximity to the borders of Norway and Finland. Therefore, the negative impact of the economic activity of KMMC spreads to the border territories of these neighboring countries, and causes serious concerns among them.

5.3.1. Pollution of the atmosphere

Specialists in Norway and Finland constantly carry out observations of air quality and measure impacts the emissions from KMMC have on the environment. The first measurements of average daily SO_2 emissions were made at Norwegian measuring stations in Kirkenes and Svanvik in 1974.

In 1992, Finland joined the Norwegian monitoring efforts. Finland carries out the main observations of atmospheric pollutions from Nickel at a measuring station that is located in Sevettijärvi.

On the Russian side, regular measurements have been carried out since 1980 at stations located in Nikel and Zapolyarny.

Metallurgical shops in Nikel and Zapolyarny were put into operation in the 1930s. For several decades, they emitted to 100,000 tons of sulfur dioxide (SO_2)[66] annually. Until the 1970s, local ore was used for processing with a sulfur content of approximately 6.5%, but since 1971 Siberian ore began to be delivered to KMMC plants from Norilsk, with a sulfur content of almost 30%. This led to a drastic increase in emissions of sulfur dioxide (SO_2). In 1979, the annual emission of SO_2 came to around 400,000 tons.[67]

In the mid-1990s, the volume of sulfur dioxide emissions dropped. The cause of this was the economic slump in Russia, and also the increase of use of ore with lower sulfur content in production.

Therefore, it is obvious that the reason for the significant in sulfur dioxide emissions in comparison with the 1980s is not an improvement due to improved technological processes or the observance of environmental legislation, but rather due to the economic slump and the use of ore with lower sulfur content.

At present, the level of emissions in the area of industrial activity of the Pechenganickel plant is lower than in the 1980s, but the concentration of SO_2 in the air near Nickel is still higher than the critical level. Sulfur dioxide emissions by the Pechenganickel plant alone in 2005 came to around 106,800 tons (according to official data of Kola MMC), which is 23,300 tons higher than sulfur dioxide emissions for the whole of Finland (83,500 tons) in 2004[68] and approximately 5-6 times higher than the total SO_2 emissions of Norway.[69] In 2009 the emmision of sulfur dioxid was around 102,670 tonn.[70]

Since 2005, a joint project of natural resource administrative bodies and scientific research institutions called set out to take regular observations of SO_2, heavy metal and aerosol content emitted into the atmosphere by the plant. Three countries, Norway, Russia and Finland, took part in the project's research efforts.

The goal of the project was monitoring the environment, and obtaining reliable information about the present state of the environment within the transboundary territory.

Observations were carried out by the Norwegian Institute for Air Research[71] (NILU), the Finnish Meteorological Institute[72](FMI) and the Murmansk Meteorological Office[73].

Measurements were carried out at different locations with varying distances around the Pechenganickel plant. The Norwegian measuring station in Svanvik was located at a distance of 9.2 km to the northwest of Nikel. 300 km to the southwest of Nikel was the Finnish measuring station Matorova (Pallas). Two stations were located in Nikel, one operated by the Murmansk Meteorological Center and the second by the NILU.

The territory located northeast of the plant, due to meteorological conditions, is subject to the most negative effects of harmful emis-

[66] http://finnmark.miljostatus.no/msf_themepage.aspx?m=1240)

[67] Pasviprogrammet Oppsummeringsrapport (http://finnmark.miljostatus.no/msf_themepage.aspx?m=1240).

[68] http://www.ymparisto.fi.

[69] Grenseområdene Norge-Russland. Luft og nedbørkvalitet, april 2008-mars 2009. Rapport 1054/2009.

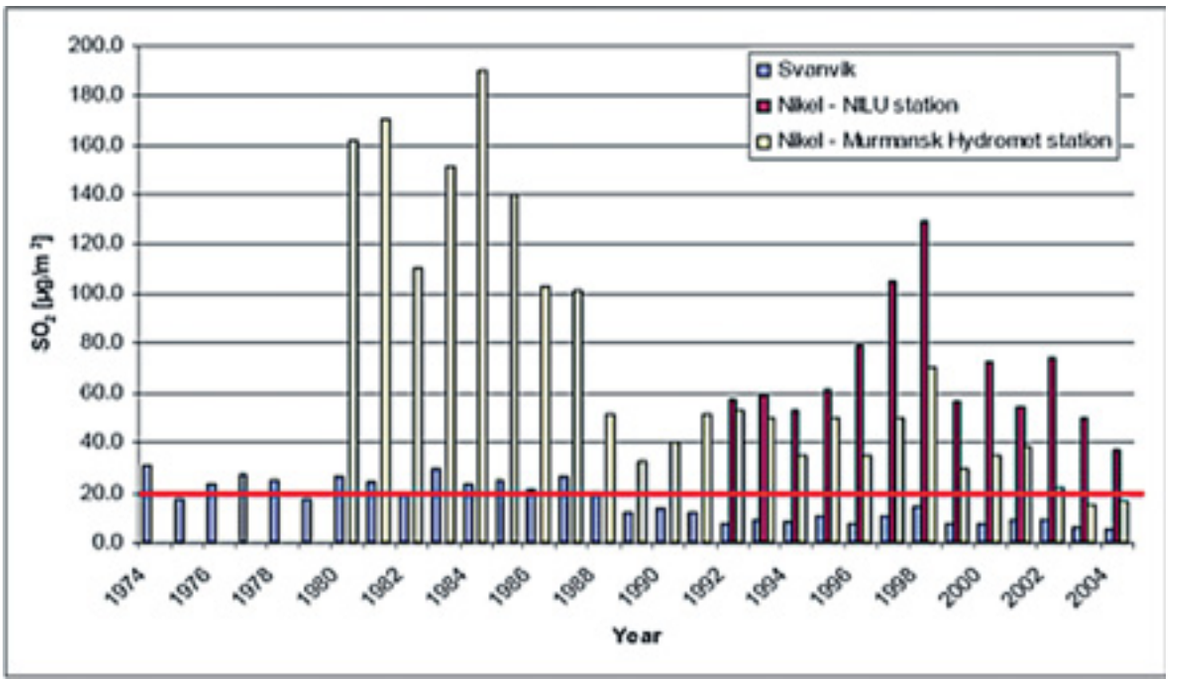
[70] http://www.kolagmk.ru/ecology/monitoring

[71] http://www.nilu.no.

[72] http://www.fmi.fi.

[73] http://www.kolgimet.ru.

Diagram 1. Annual concentration of SO_2 in the region of Nikel and Svanvik[74]



sions from the Pechenganickel plant (see Diagram 1).

The diagram shows the annual concentration of SO_2 in the area of Nikel and Svanvik.

The red line is the maximum indicator of sulfur dioxide (20 µg/m^3), which should not be exceeded in the course of the calendar year. The color blue shows SO_2 emissions in Svanvik, yellow shows emissions of sulfur dioxide registered in Nikel by the Russian measuring station, and dark red shows the amount of sulfur dioxide emissions in Nikel registered by the NILU measuring station.

According to data of observations by NILU and the Murmansk Meteorological Center, it is clear that in Nikel the SO_2 content is unacceptably high. The monitoring data of both the Russian and the Norwegian side show similar tendencies.

As a result of the direction of prevailing winds, Svanvik is able to escape most of the harmful impacts from emissions, at times only exposed to pollution for short period of time. Considering this knowledge, the average indicators of sulfur dioxide content in the air are lower. However, during those short periods when winds blow in from the east, the SO_2 content regularly exceeds the background level by 10 times.[75]

Along with studies as part of the Pasvik Program, the NILU carry out regular measurements of the air quality and atmospheric precipitation for the Norwegian-Russian border zone. This monitoring is carried out as part of a State program responsible for monitoring pollution. In the last NILU report published on November 23, 2010, an analysis was given from results obtained for the period from April 2009 to March 2010. Monitoring for the presence of sulfur dioxide in the atmosphere was carried out at measuring stations situated in Karpdalen and Svanvik.

According to data from monitoring conducted at the measuring station in Karpdalen, a high content of sulfur dioxide in the air is observed when the south wind blows. Karpdalen is located to the north of Nikel, therefor a high content of SO_2 is recorded there when the south wind is blowing. At the same time, it is also noted that Karpdalen also receives a share of pollution from production facilities in Zapolyarny, which is located further to the east.

[74] http://www.pasvikmonitoring.org/russia/index_en.html.

[75] http://www.pasvikmonitoring.org/russia/index_en.html.

Svanvik is mainly subject to the negative impact of the operations of the Nikel industrial site.

Careful analysis showed one excess of the acceptable hourly concentration of sulfur dioxide (350 μg/m^3) in Svanvik for the report period. The hourly MAC was also exceeded by 19 times in Karpdalen, where the maximum concentration came to 579 μg/m^3. The majority of times that hourly MAC was exceeded were recorded during the winter.[76]

On the Russian territory, in the region of activity of plants of the Pechenganickel, an excess of hourly MAC takes place much more often.

In the period from January 2008 to 31 August 2008, 414 instances of exceeding daily MAC were recorded, while the norms for exceeding MAC established by the European Union are not more than 24 times a year (see diagram 2).

The maximum indicator of SO_2 for the period from January 1, 2008 to August 31, 2008 was recorded at the level of 5071 μg/m^3 (21.03.2008 at 7 a.m. Moscow time).[77]

Last year, exceeding daily MACs were not recorded in Svanvik, according to MAC established by the European Union (125 μg/m^3), while the national MAC for Norway of 90 μg/m^3 was exceeded 2 times, and the maximum excess came to 113 μg/m^3.[79]

In Karpdalen, an excess of daily MAC established by the European Union (125 μg/m^3) was recorded 5 times[80] for the period of April 2009 – March 2010. Maximum daily indicators for sulfur dioxide in Karpdalen came to 204 μg/m^3.[81] In diagram 3 it is clearly visible that in Nikel, excesses of daily MAC occurs significantly more often. In 2008 this excess was observed around 60 times. Data on this for 2009 is not available to the Norwegian side.

Regular measurements of SO_2 levels and their comparison with the wind direction shows that the main sources of sulfur dioxide are the Pechenganickel plants located in Nikel and Zapolyarny.[83]

Diagram 2. Number of times hourly MAC of sulfur dioxide was exceeded, with MAC of 350 μg/m^3 [78]

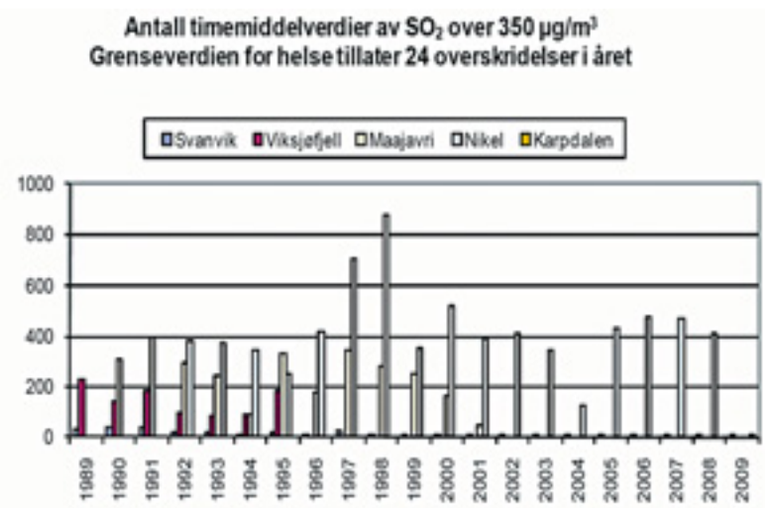
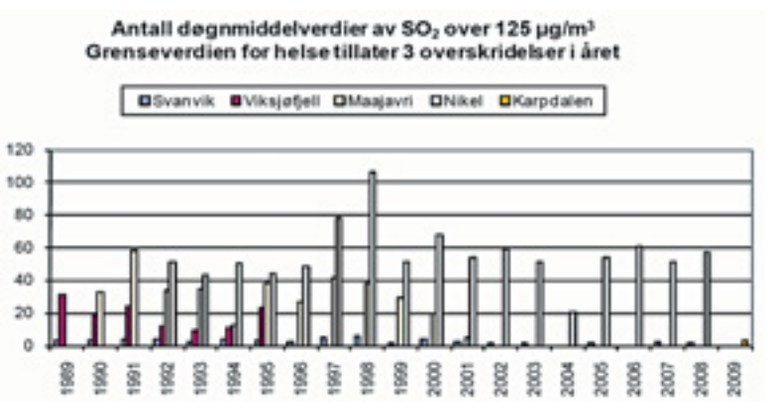


Diagram 3. Number of times daily MAC of sulfur dioxide was exceeded with MAC of 125 μg/m^3 [82]



[76] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[77] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010..

[78] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[79] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[80] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[81] http://www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[82] www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010.

[83] www/klif.no/45333 Statlig program for forurensningsovervåking Rapport 1082/2010

5.3.2.Atmospheric pollution by heavy metals

In 1977, the annual emission of nickel at the plant came to 539 tons and 232 tons of emissions from copper. In 1990 the annual emission of Ni was registered at level 301 tons and Cu 180 tons. In 2009, nickel emissions came to 330 tons, and copper emissions to 157,6 tons.[84] (according to official data provided by the Kola MMC).

A report by Norilsk Nickel MMC on Corporate Social Responsibility (CSR) notes that emissions of metals (nickel, copper, cobalt) at the Zapolyarny and Nikel site dropped by 24.9 tons (by 4.8%) compared to 2008[85]. This was caused by changes in the technological cycle at the roasting and pelletizing section, and at the smelter shop.

According to monitoring data carried out by NILU, which is part of bilateral Norwegian-Russian cooperation in the field of environmental protection, as part of the state monitoring program, it was found that the heavy metals nickel, copper, cobalt and arsenic are emitted by the smelter factory in Nikel.

The Norwegian side carries out an analysis of air samples and sampling for the presence of heavy metals in precipitation.

The NILU report emphasizes the fact that pollution by heavy metals, despite a significant reduction in emissions of solid matter compared with the 1980s, remains a serious problem of border territories.

An analysis of samples showed that high concentrations of heavy metals – nickel, copper and arsenic – are observed in the region of Svanvik in Norway. The summer period of 2009 demonstrated an increase in the amount of heavy metals present in atmospheric precipitation in Svanvik, compared with summer 2008: Ni (nickel) by 30%, Cu (copper) by 40%, Co (cobalt) by 87%, and As (arsenic) by 93%. During the winter period, over the last year an increase of heavy metals was also observed in precipitation by the following ratios: Ni by 44%, Cu by 52%, Co by 43%, and As by 30%.[86] The content of heavy metals present in precipitation from 2009-2010 increased in comparison with the period until 2004.[87]

On the whole, the data obtained as a result of monitoring at the station in Svanvik shows the presence of heavy metals in emissions which exceed indicators by 50-100 times of the presence of solid matter recorded at stations located at Spitzbergen and in Birkenes (southern Norway).[88]

Observations showed that the zone of maximum concentrations of metals in the air spread up to 2 km from the source. In this zone, the content of metals in the bottom layer of the atmosphere exceeded the local geochemical background by 100-1000 times, and in snow they exceed this background by 500-1000 times.[89]

At a distance of 2-4 km, a second zone is located, where the content of metals in the air is approximately 10 times lower than in the first.[90]

In the third zone of 4-10 km, only a handful of samples show an excessive content of metals.[91]

An analysis of monitoring data also showed that the content of heavy metals in the Svan-

[84] http://www.kolagmk.ru/ecology/monitoring.

[85] По материалам отчета по КСО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

[86] Grenseområdene Norge-Russland. Luft og nedbørkvalitet, april 2009-mars 2010. Rapport 1082/2010 (www.klif.no).

[87] Grenseområdene Norge-Russland. Luft og nedbørkvalitet, april 2009-mars 2010. Rapport 1054/2009.

[88] Grenseområdene Norge-Russland. Luft og nedbørkvalitet, april 2009-mars 2010.Rapport 1082/2010.

[89] Беспамятнов Г. П., Кротов Ю. А. Предельно допустимые концентрации химических веществ в окружающей среде. Справочник. Л.: Химия, 1985.

[90] Беспамятнов Г. П., Кротов Ю. А. Предельно допустимые концентрации химических веществ в окружающей среде. Справочник. Л.: Химия, 1985.

[91] Беспамятнов Г. П., Кротов Ю. А. Предельно допустимые концентрации химических веществ в окружающей среде. Справочник. Л.: Химия, 1985.

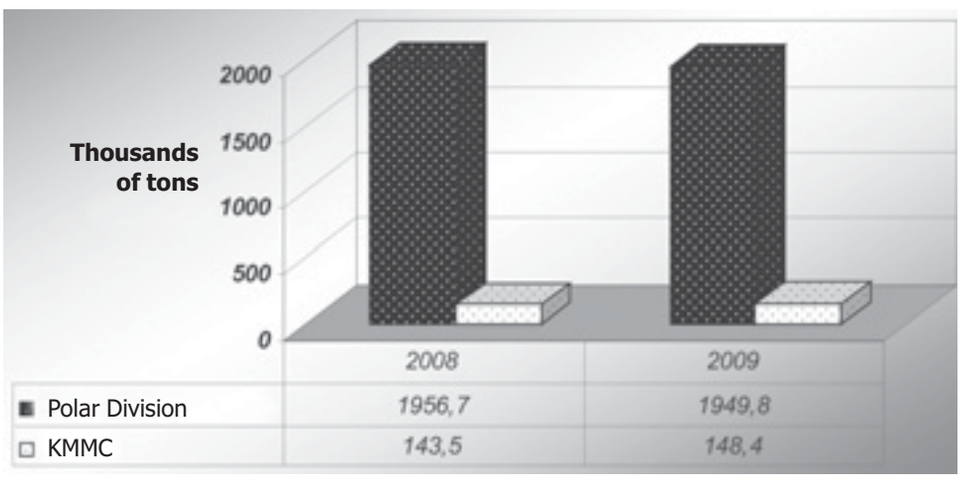
[92] Grenseområdene Norge-Russland. Luft og nedbørkvalitet, april 2009-mars 2010. Rapport 1054/2009.

vik region in 2008 was approximately the same as in 1990-1991[92], i.e. the data of this monitoring does not confirm the information of KMMC about a reduction of emissions in recent years.

It should also be kept in mind that Svanvik is located at a distance of 9.2 km from the Pechenganickel plant, which is classified as the third distance zone of concentration of heavy metals (4-10 km).[93] Data on the content of heavy metals directly in the region of the Pechenganickel zone and to the northeast of it (the most frequent wind direction) is not available to the Norwegian side.

In general, the picture of emissions of toxic substances produced by the plants of Norilsk Nickel MMC in 2009 looks as follows:

Diagram 4. Emissions into the atmosphere of pollutants by plants of Norilsk Nickel MMC



According to this diagram, which was compiled on the basis of official data from Norilsk Nickel, it is clear that in the time frame from 2008 to 2009, Norilsk Nickel industrial sites reduced emissions by only 2,000 tons. And this reduction took place because of a reduction of emissions at plants in the Polar Division (6,900 tons, of this 2,548.0 tons of it SO_2[94]), while KMMC plants, according to this diagram, increased emissions in 2009 by 4,900 tons.

5.3.3. Pollution of stream water

Regular monitoring of water quality in freshwater bodies present amongst border territories was carried out as part of the realization of the Pasvik Program.

Observations showed the following: the ecosystem of the Pasvik river basin is subject both to direct pollution from waste water of the Pechenganickel plant and negative impact that takes place as a result of acid rain.

The water system that is not linked with the Pasvik river valley is only subject to negative atmospheric impact. The consequences of in-

[93] Беспамятнов Г.П., Кротов Ю.А. Предельно допустимые концентрации химических веществ в окружающей среде. Справочник.-- Л.: «Химия»,1985.

[94] По материалам отчета по КСО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

dustrial pollution are observed most clearly in direct proximity to the source of pollution, the Pechenganickel plant.

For conducting studies, the method of the acid-neutralizing capacity of the water was used.

Method for determining buffer capacity of water.

To determine the buffer capability of the water system, or its capability of neutralizing acid, the acid-neutralizing capacity indicator, ANC, is used.

Acid is gradually added to water in small portions, and the difference in the pH value is observed. The amount of acid required to reduce the pH value to a certain level is the buffer capacity indicator. From the viewpoint of acidification of the body of water, a level of ANC of 0.05 mmol/l is considered critically. If the ANC level is lower than this level, the buffer capacity is very weak.

Data from the Pasvik Program[95]

The feature of the majority of the territory on which monitoring was carried out is the presence of alkaline materials in geological rocks, which makes it possible to cope with acid burdens. It was discovered that acidification happens most frequently during rain and melting of snow. In this period, a change is observed in the ratios of the main ions in the chemical composition of water, and the total buffer capacity of stream water dropped.[96] Elevations and waterside territories of the region are represented by acidic geological rocks (mainly granitic gneiss), and so the resistance of their ecosystems to the impact of acids is very low.[97]

As a result of the discharge of waste water by KMMC, significance pollution of bodies of water with heavy metals takes place. The consequences of sedimentation of heavy metals are most serious near sources of emissions.[98]

Pechanganickel industrial site (Nikel)

Waste water and smoke emissions from the Kola MMC plant (Nikel site) have a negative impact on bodies of water nearby. The degree of this impact depends on the amount of pollutants discharged and the proximity of the water body to the source of the pollution.

The most polluted zone is in the Kolosioki river basin, where water from the plant is discharged directly into the water. In all samples taken at the river mouth (Nikel industrial site), nickel content reached a level of high pollution (HP). In five samples of water taken during the autumn and winter periods, a level of extremely high pollution (EHP) was recorded.[99]

Nickel pollution in water from regions effected by the industrial activity of KMMC is of a chronic nature. This was the conclusion made on the basis of monitoring held at various times, which did not detect a seasonal dynamic in the distribution of nickel.

A comparative analysis of content of copper and nickel ions in sediments both from the riverbed and suspended in the water shows that nickel compounds predominate, while at waters near the Zapolyarny industrial site have predominantly copper compounds present.[100]

In the bottom sediments of the back and mouth locations, nickel content is higher than copper, showing the chronic nature of pollution of the river as a whole. This creates a threat of secondary water pollution of the riv-

[95] http://www.pasvikmonitoring.org/russia/index_en.html.

[96] «Пасвик-программа» (http://www.pasvikmonitoring.org/russia/index_en.htm).

[97] «Пасвик-программа» (http://www.pasvikmonitoring.org/russia/index_en.htm).

[98] «Пасвик-программа» (http://www.pasvikmonitoring.org/russia/index_en.htm).

[99] Report on the state and protection of the environment of the Murmansk Oblast in 2009. Committee of Natural Resources Management and Ecology of the Murmansk Oblast. http://www.gov-murman.ru/envcond/2009.pdf.

[100] Report on the state and protection of the environment of the Murmansk Oblast in 2009

Diagram 5. Seasonal dynamic of nickel and copper content in water and bottom sediments at the mouth of Kolosioki River

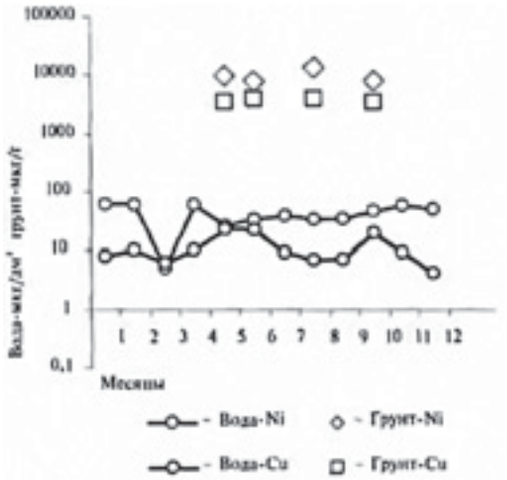
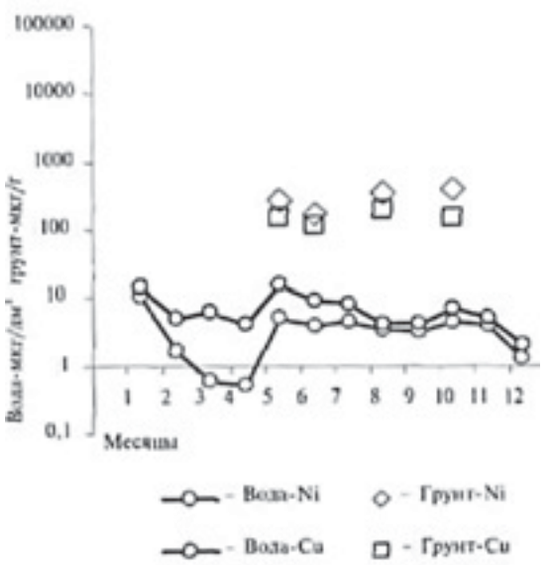


Diagram 6. Seasonal dynamic of nickel and copper contents in the water and river bottom of Kolosioki River at 14,7 km from Nickel site[102]



er when heavy metals are washed away from the river bottom (see diagram 5, 6).[101]

From an analysis of a diagram it is visible that in the waters of the Kolosioki River throughout the entire calendar year, a significant presence of copper and nickel is observed. The concentration of these metals in river bottoms is even higher.

The Kolosioki River, at the mouth of which Nikel is located, is the most polluted river of the Patsoioki basin, where the average annual concentrations of copper compounds exceeds MAC (maximum allowable concentration) by several times.[103]

In the tributary between Salmijarvi and Kuetsjarvi lakes, which are linked with the basin of the Barents Sea by the River Paz, an excess of MAC of copper and nickel was recorded in all samples taken.

In 2009, 11 cases of a high level of water pollution with nickel were registered. In individual tests, an excess of maximum allowable concentration was observed for content of manganese, total iron, molybdenum, mercury and organic substances for biochemical oxygen consumption and chemical oxygen consumption.[104]

The quality of water of the tributary is significantly affected by the Kolosioki River flow, which is polluted by emissions of the plant.

Observations were held regularly at five locations on the River Patsoioki. The location above the Kaitakoski hydroelectric station is the backmost, and the location below the village of Borisoglebsky is the last on the river. Samples showed that for the river an increased content of copper ions is characteristic, the concentrations of which varies from 1 to 6 MAC. Content of nickel in 3 of the 30 samples was significantly higher than the minimum determined values.[105]

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[101] Report on the state and protection of the environment of the Murmansk Oblast in 2008. Committee of Natural Resources Management and Ecology of the Murmansk Oblast.

[102] Materials of the Committee of Natural Resources Management and Ecology of the Murmansk Oblast. Report on the state and protection of the environment of the Murmansk Oblast in 2008.

[103] http://www.arctictoday.ru/region/ecology/713.html.

[104] Report on the state and protection of the environment of the Murmansk Oblast in 2009. Committee of Natural Resources Management and Ecology of the Murmansk Oblast.

[105] Report on the state and protection of the environment of the Murmansk Oblast in 2009. Committee of Natural Resources Management and Ecology of the Murmansk Oblast.

Pechenganickel industrial site (Zapolyarny)

The Pechenga river basin is located in the zone of activity of the Kola MMC plant (Zapolyarny site). The most polluted river in this basin is Khaukilampiioki River, as it receives quarry water from the central mine, and mine drainage water from the Severny mine. Specific pollutants in the basin are nickel, copper, manganese, sulfates, nitrite nitrogen, iron and zinc. In 2009, 12 cases were recorded in Khaukilampiioki river (in all 100% of samples) of HP of water with nickel, 4 cases of HP of nitrite nitrogen, 3 cases if HP and EHP of river waters with mercury, and 3 cases of EHP of waters with dithiophosphate.[106]

The average concentration of copper in the river was 10 MAC, nickel 22 MAC and nitrite nitrogen 7 MAC.[107]

The quality of water of Luottnioki River is negatively affected by the Khaukilampiioki River flow, as well as mine drainage water from the Bystraya River flow from the Central and Severny mines of the Kola MMC plant (Zapolyarny site).

In 2009, in samples taken from Luottnioki River, six cases of HP of water with nickel were recorded and 2 cases of EHP of water with dithiophosphate, and the average concentration of dithiophosphate for the year came to 17 MAC. The average annual content of metals compared with 2008 showed practically no change.[108]

During the period of spring flooding and rainwater floods, polluted water enters Namaioki River from the tailing pit of the enrichment plant of Kola MMC plant (Zapolyarny site). In 2009, 2 cases were recorded of extremely high content of dithiophosphate in Namaioki River, and two cases of high nickel content. However, compared to 2008, a reduction in the average annual concentration of dithiophosphate from 9 to 5 MAC has been noted.[109]

Observations on the Pechenga River were carried out at two locations: 0.5 km below the influx of the Namaioki River and 0.35 km to the west of the Pechenga station. Monitoring data showed that along the entire stretch of the river, the water was polluted by metals: nickel, copper, iron and manganese. At the location of the Pechenga River below the influx of the Namaioki River, one case was recorded in April 2009 of an extremely high content of dithiophosphate, with a concentration of 60 MAC, and at the two locations, there were cases of high nickel content – 12 MAC.[110]

Severonickel industrial site

The Travyanaya and Kumuzhya Rivers are also located in the zone of negative impact from the Kola MMC plant (Monchegorsk site), and are characterized by a high content of copper and nickel combines at the HP and EHP level.[111]

The most polluted body of water of the basin is the Nyuduai River. Consistent pollution for a whole range of indicators is observed in the river. Over the course of 2009, six cases of EHP and 22 cases of HP were recorded, characterized by the pollutants: copper, nickel, sulfates, molybdenum, xanthogenate and by pH value. The average copper content for the year, 30 MAC, was extremely high, nickel content was 25 MAC, content of sulfates exceeded MAC by 6 times, and sodium by 3 times.[112]

Moncheozero is a source for drinking water. It is located in a zone of technogenic impact of emissions into the atmosphere by Kola MMC (Severonickel). In 2009, cases of HP (high pollution) and EHP were not recorded. The average annual concentration of copper exceeded MAC by 12 times, and nickel was higher than the established MAC.[113]

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[106] Materials of the Committee of Natural Resources Management and Ecology of the Murmansk Oblast. Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[107] Report on the state and protection of the environment of the Murmansk Oblast in 2009. Committee of Natural Resources Management and Ecology of the Murmansk Oblast.

[108] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[109] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[110] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[111] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[112] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

[113] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

The majority of pollutants that enter bodies of water accumulate in river bottoms. A large number of pollutants emitted by the Severonickel plant enter Imandra Lake and accumulate in river bottoms. Silts have an extremely high intensity of accumulation of metals.[114]

In Monche-guba, gray-black silts accumulate plant waste. The highest concentrations of heavy metals in Monche-guba have been found in silts near the mouth of the Nyuduai river. It is waters of this river that carry waste water from the Severonickel plant to Imandra Lake.

In 1990, the joint Soviet-Canadian enterprise Line carried out a chemical inspection of the water and bottom sediments of the southern part of the Moncha Lake. Water samples were taken from three levels – at 0.5 m, from the middle depth of the body of water, and around the bottom. The data of the studies showed that at the bottom, concentrations of all elements were tens and hundreds of times higher than at the top.[115] A similar study was repeated again in 1992. In this study, it was found that in the water of Moncha Lake, the Cd2 concentration exceeded MAC by 20 times, Ni by 1-2 times, and lead (Pb) by 1-8 times.[116]

In the mid-1990s, the head hydrogeologist of the Central Kola geological surveying expedition, V.N. Ananiev, carried out an inspection of the bottom sediments over the entire area of Nyudyarv Lake, confirming the amounts of non-ferrous metals were present in an amount which could have industrial significance.[117]

The most toxic substances for ichthyofauna and flora, as the inspection by A.G. Gusev conducted together with Severonickel plant showed, are cations of copper, nickel and cobalt. The maximum concentration of copper ions in the study was determined at 0.01 mg/l, and cobalt at 0.01-0.02 mg/l[118], and it is primarily the kidneys, liver and blood of fish that are damaged.[119] It was also discovered that nickel and copper content in the organisms of fish increases closer to the sources of pollution.

The highest concentrations of toxins were observed in fish in Kuyetsyarvi River, which is located near copper and nickel plants. The fish that live in this lake were found to have a number of pathological changes in organs and tissues (cirrhosis of the liver, hemorrhages of the spleen and gills, depigmentation of the skin). Scientists concluded that the widespread nature and high degree of these problems show a clear correlation with the proximity of the plant.[120]

Data obtained on the state of bodies of water make it possible to conclude that the ecosystems of rivers and lakes, located near KMMC plants, are subject to constant anthropogenic impact. This is manifested in the acidification and the chronic nature of pollution of these bodies of water with heavy metals. All living organisms are greatly affected.

5.3.4. Pollution of groundwater

With the participation of Norwegian researchers in the mid 1990s, studies were carried out on the quality of groundwater, with the aim of determining the impact of pollution carried through the air from copper and nickel factories. In a study on the quality of groundwater, four stations took part: one in the northern part of the Monchegorsk region

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[114] Семенович, 1975; Кондратова, Горшков, 1980; Fornster, 1982; Нахшина, 1985 (http://www.lapland-nature.info/ru/7.html).

[115] Каширин и др., 1991 (http://www.lapland-nature.info/ru/7.html).

[116] Берман и др., 1993 (http://www.lapland-nature.info/ru/7.html).

[117] http://www.lapland-nature.info/ru/7.html.

[118] http://www.lapland-nature.info/ru/7.html.

[119] Моисеенко Т. И., Яковлев В. А. Антропогенные преобразования водных экосистем Кольского Севера. Л.: Наука, 1990.

[120] Моисеенко Т. И., Яковлев В. А. Антропогенные преобразования водных экосистем Кольского Севера. Л.: Наука, 1990.

and three stations in the southern part of the Shelbbeken region.[121]

As a result of the study, it was discovered that groundwater in the Monchegorsk region is acidified under the impact of industrial emissions containing sulfur. However, it was proven that their acid-neutralizing capacity is not exhausted, due to the mafic nature of minerals in the soil and sediment rocks.[122]

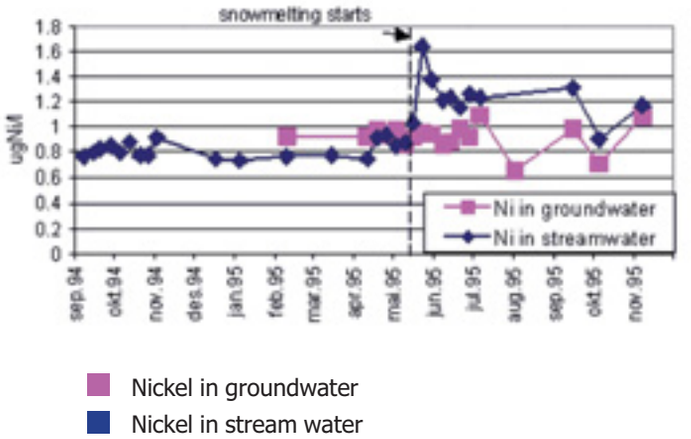
In Shelbekken, groundwater is not acidified and has a very high neutralizing capacity.

The concentration of Ni (nickel) in Shelbekken shows that the maximum negative impact of heavy metals on groundwater arises during the snow melting period. For groundwater, this peak period begins approximately one and a half months after the peak for surface currents.[124] This conclusion partially served as the basis for carrying out monitoring of the quality of groundwater at border territories as part of the Pasvik project (2003-2006).

Monitoring was conducted by the Norwegian geological institute (NGU) and the Lapland regional Center for the environment in Finland, and was carried out without the participation from the Russian side.

In Norway, as part of the project the quality of ground water was monitored at three sections in quaternary deposits at various distances from the Pechenganickel copper and nickel plant. The monitoring did not find particular acidification of groundwater on the territory of Norway. At all the stations, significant variations in concentrations of Ni were not found. Nevertheless, a tendency is observed for an increased concentration of Cu in groundwater in Svanvik (Norway) during the period of active snow-melting (from April to October 2005).[125]

Diagram 7. Concentration of nickel in groundwater in Shelbekken [123]



Samples of snow showed a high amount of copper (Cu) in Karpdalen (Norway), but groundwater at this station contains very little Cu. The highest concentration of Ni and Cu in groundwater is observed in Svanvik, which was perhaps caused by the proximity of the station to factories or the entry of these substances from fluvioglacial sediments.[126]

The high Cu concentration in Svanik (almost 10 times higher than background indicators) may be a sign of the anthropogenic impact on groundwater on the territory of this station.[127]

As the process of pollutants entering groundwater is spread out over time, it is necessary to conduct regular studies of the chemical composition of soil moisture at various levels. The composition of soil moisture may serve as an indicator for a timely determination of pollution of groundwater.[128]

[121] Caritat, P. Groundwater composition near the nickel – copper smelting industry on the Kola Peninsula, central Barents Region, 1998.

[122] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[123] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[124] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[125] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[126] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[127] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

[128] Based on monitoring materials http://www.pasvikmonitoring.org/russia/index_en.html.

5.3.5. Impact of industrial activity of KMMC on the land ecosystem

For Russian border regions on the Kola Peninsula a soil horizon with a thin layer of organic matter on top is characteristic.[129] Soils in regions of industrial activity of KMMC are heavily polluted by heavy metals, as heavy metals are closely linked with organic substances. So a falling of heavy metals is preserved at present, they stay and accumulate in organic substances.

This is one of the main problems of the border territory – even if emissions drop or stop altogether, heavy metals will remain in the soil and take part in the circulation of substances in the ecosystem for tens and hundreds of years.[130]

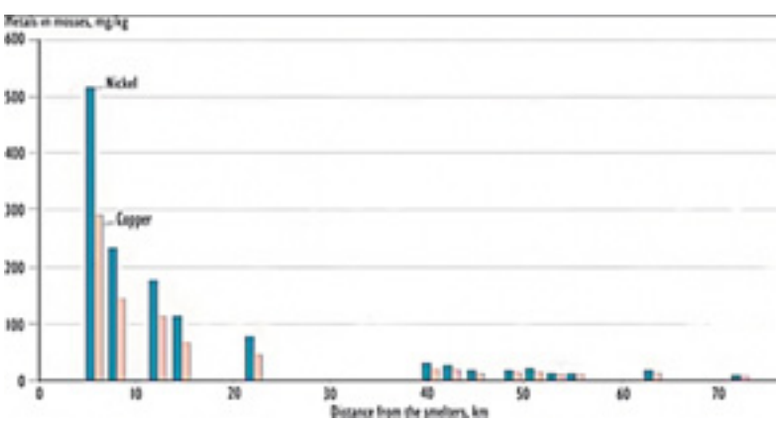
As part of the Pasvik program to determine the level of negative impact industrial emissions have on land ecosystems, monitoring was carried out by a work group of researchers from Norway (NINA and Skogforsk, the Svanhovd ecological center), Russia, (Priroda scientific research institute in Moscow and the Institute of Problems of Industrial Ecology of the North of the Kola Scientific Center of the Russian Academy of Sciences) and Finland (METLA). Epiphytic lichen sensitive to pollution were chosen for monitoring, because of their high sensitivity to sulfur dioxide (SO_2).[131]

Forest mosses and lichens live for many years. They nourish themselves with rainwater and melting snows. Due to these features, lichens and mosses accumulate heavy metals extremely effectively. An analysis of the presence heavy metals have on lichens and mosses, and the presence of compounds of heavy metals in the soil, is an effective method for monitoring pollution.

Studies held as part of the Pasvik Program showed that the territory in the region of the Pechenganickel plant is a complete lichen wasteland, i.e. there is a complete absence of epiphytic lichens growing on tree trunks here. However, in regions that are further away and less subject to pollution, birch tree trunks are abundantly covered in epiphytic lichens.[132] During monitoring it was established that the concentration of heavy metals decreases as the distance from non-ferrous metallurgical plant increases.[133]

The diagram shows the quantitative dependency on the concentration of copper and nickel in mosses in relation to distance from the smelters.

Diagram 8. Concentration of metals in mosses, mg/kg[134]



The report "On the state and on conservation of the environment of the Murmansk Oblast in 2009" notes that 72.2% of soil samples studied in the region of Monchegorsk (Severonickel industrial site), an excess of MAC for nickel and copper was observed. In the Pechenga region, this excess for copper and nickel came to 83.3%.[135]

Plants that receive water and nourishing substances from the soil reflect the level of pollutants in the soil.

During the course of the studies, in some areas of the border territories, visible damage to leaf tissue was found, which was caused by

[129] http://www.pasvikmonitoring.org/russia/index_en.html.

[130] http://www.pasvikmonitoring.org/russia/index_en.html.

[131] http://www.pasvikmonitoring.org/russia.

[132] http://www.pasvikmonitoring.org.

[133] http://www.pasvikmonitoring.org.

[134] http://www.pasvikmonitoring.org.

[135] Report on the state and protection of the environment of the Murmansk Oblast in 2009.

a high sulfur dioxide content. Sulfur dioxide also affects photosynthesis of plants.

During the course of the project as part of the Pasvik Program, it was discovered that the level of photosynthesis of leaves of birch trees and blueberry plants near plants was anomalously low.[136]

As the report "On the state and protection of the environment of the Murmansk Oblast" for 2008 states, areas that are damaged by the industrial emissions of the Severonickel and Pechenganickel plants cause a serious environmental problem.

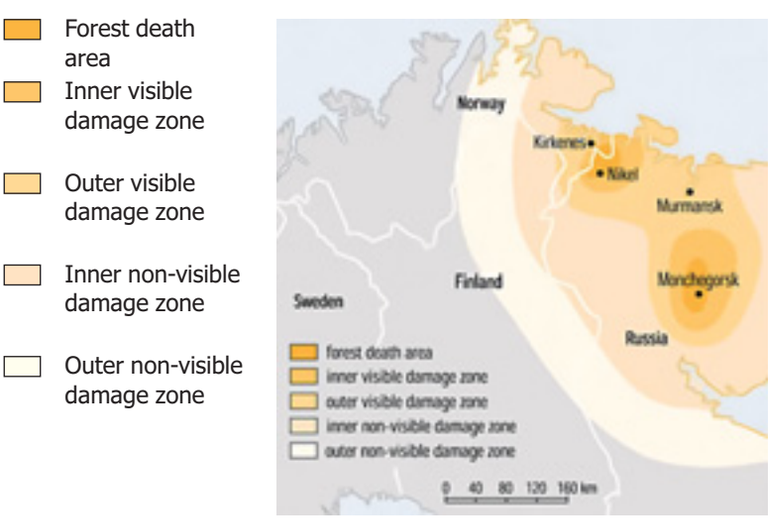
Restoring and creating new vegetation on affected and polluted lands is a difficult task, as these lands are located in a zone of active economic activity. In the northern climate, the task is further complicated by difficulties of a natural and biological order.

In the course of the study conducted by the forestry management of the Monchegorsk forestry board on 2002, 47,382 hectares of areas were found which were damaged by industrial emissions of Severonickel plant, including 8,924 hectares of dead trees, 2,834 hectares of severe damage, 5,796 hectares of medium damage, and 29,828 hectares of low damage. At the Pechenga forestry board, the area of dead forest, a result of emissions from the Pechenganickel plant, came to 3,971 hectares in total.[138]

The zone of harmful impact as a result of emissions from the Pechenganickel plant also spreads to the territory of neighboring countries, Norway and Finland, where damage to vegetation cover was also observed.

Picture 1. Birch tree leaves damaged by sulfur dioxide (photo by D. Aamlid)[137]

Chart 11. State of forest and tundra ecosystems on the territory around the copper and nickel complexes in Nikel and Monchegorsk[139]



(Институт исследования леса Финляндии (METLA)

[136] http://www.pasvikmonitoring.org/russia/index_en.html.

[137] http://www.pasvikmonitoring.org.

[138] Доклад «О состоянии и об охране окружающей среды Мурманской области в 2008 году». Комитет природопользования и экологии Мурманской области (http://www.gov-murman.ru/envcond/2008.pdf).

[139] http://www.pasvikmonitoring.org/russia/index_en.html.

6. Industrial activity of Norilsk Nickel MMC and human health

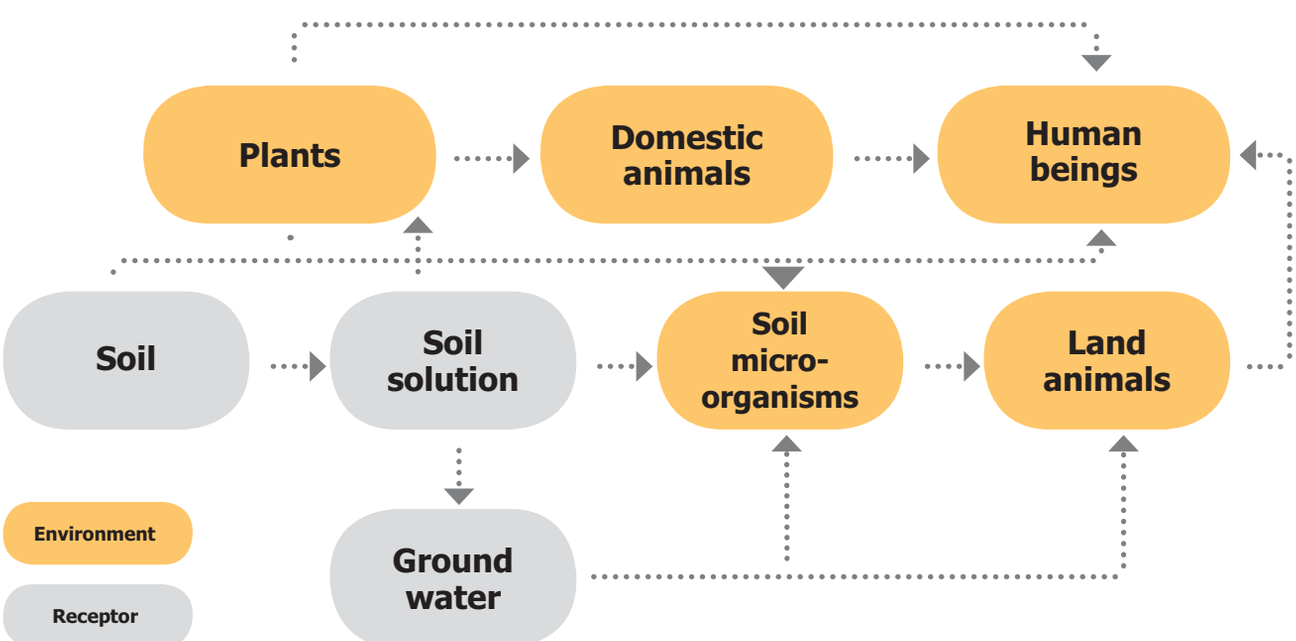
A human is an integral expression on the state of the environment. As can be seen from the chart,[140] a person is the final link in the bio-geochemical chain. Eco-toxins accumulate in the body when they are present in the environment as a result of technogenic pollution. A worsening in the ecological situation leads to an increase in the disease rate.

High concentrations of sulfur dioxide and heavy metals have a negative impact on the health of people living in direct proximity to Norilsk Nickel MMC plants.

According to data of the studies, the following areas of the negative impact of the industrial activity of Norilsk Nickel MMC on human health may be singled out:

1. high percentage and frequency of respiratory illnesses
2. growth in number of oncological diseases
3. weakening of immune system: growth in number of diseases and chronic pathologies
4. negative impact on the reproductive system
5. growth in disease rate among children
6. appearance of professional illnesses
7. reduction in life expectancy

Chart 12. Simplified diagram of the bio-geochemical food chain in land ecosystems



[140] http://vsesnip.com/Data1/45/45877/index.htm.

6.1. Respiratory illnesses

The high percentage and frequency of illnesses of the upper respiratory tract are caused by emissions and high concentrations of sulfur dioxide in the air.

The population of Norilsk, which is near 200,000 people, lives in a region surrounded on three sides by factories. No matter the direction of the wind, the city is consistently shrouded in toxic smog. An increase in the number of diseases and pathologies among the people who live here is a direct result of this toxic pollution in the air.

An analysis of indicators of illness in Norilsk and Dudinka (control region of observation with identical climate and geographical factors of habitation) showed that data for the growth of illness in the Norilsk industrial zone was 27.6% higher than this data for Dudinka and 42.1% higher than for the Taymyr autonomous district.[141]

In 2007, residents of the Norilsk industrial zone, in a letter to deputies of the Russian State Duma and supervisory conservation departments, which was signed by 15,000 people, expressed their concern over the ecological situation in the region and the state of people's health:

"The presence in atmospheric pollution of heavy metals leads to a drop in the immunity of city residents, which is so vital in our climactic conditions. The main manifestations of immune insufficiency are children's proneness to frequent ARVI, repeated ailments of pneumonia, bronchitis and considerable prevalence of allergic diseases. Sulfur dioxide, which is the most significant polluting factor, when its content in the atmosphere is excessive, gives rise to the appearance and development of chronic diseases of the lungs, irritates the mucous membranes of the eyes and the respiratory tract, and assists and aggravates the course of chronic gastritis, bronchitis, laryngitis, and may lead to lung cancer. Tiny drops of sulfuric acid are formed when it reacts with atmospheric moisture, which burns our lungs every day, and the rain kills plants. It has become common practice to cancel children's walks at pre-school institutions because of the severe gas pollution of the air… we are falling sick and dying…"[142]

The data from the study also confirmed that the increases in sickness rates near KMMC activity were directly connected with the high level of pollution of atmospheric aid.

In Monchegorsk, where the production facilities of Severonickel plant are located, a relationship was found between sulfur dioxide air pollution and the development of diseases in the upper respiratory tract. The results of studies showed that the rates of respiratory organ diseases among children was 1.5 times higher than the average level among 80 Russian cities.[143]

In a comparative analysis on children's health in Monchegorsk and children in Olenegorsk, it was found in Monchegorsk the illness rate of children with bronchial asthma, asthmatic bronchitis, anemia, gastritis and also rickets was considerably higher in Monchegorsk.[144]

B.A Revich concludes in his studies that with an increased amount of SO_2 in the atmosphere of 10 mkg/m3, a corresponding increase in the mortality level from diseased respiratory organs and cardiovascular system of 0.9% was possible.[145]

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[141] http://www.nrk.cross-ipk.ru/body/pie/body/8%5Cacclim%5Cpollution.htm.

[142] http://www.osanor.ru/?id=154.

[143] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[144] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[145] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

The consequences of the impact of sulfur dioxide on the health of the population in Russian cities is hard to assess, as the levels of sulfur dioxide content in the atmospheric air of Russia cities are clearly underestimated, and require clarification, or an improvement of analytical methods of control.[146]

6.2. Increase in number of Oncological diseases

The development of oncological tumors in the human body is caused by heavy metal emissions and particles created from the industrial activity by Norilsk Nickel MMC. Nickel and its compounds are especially toxic.

Nickel and its compounds have the second highest impact on living organisms, after sulfur dioxide. The World Health Organization calls this element an eco-toxicant, an extremely dangerous pollutant to the environment. The mutagenic, allergenic and carcinogenic effects of the impact of nickel differ. The international agency for cancer research classifies nickel in the 1st group of substances that are undoubtedly carcinogenic for humans. It is thought that the carcinogenic effect of Ni is connected with its entry into the cells, where it causes disruptions to enzymatic and metabolic processes, as a result of which carcinogenic products may form.[147]

For example, studies have shown the frequency of lung cancer among men in Norilsk is significantly higher than the figures for Krasnoyarskiy Krai.[148] There are not any equivalent findings in any other regions of Russia.[149] Additionally, it is frequently difficult to diagnose development of lung cancer among nickel refinement workers, as the latent period for cancer varies from 9 to 27 years.[150] Workers in the nickel refinement industry, a high level of cancer of the respiratory organs is observed, including cancer of the epipharhynx.[151] On the whole, oncological diseases among residents of Norilsk 1.65 times greater than the average for Russia, and 2.7 times greater among people who live in the center of the Norilsk industrial zone.[152]

Studies carried out in Monchegorsk showed that the frequency of oncological diseases among people working at the plant were three times higher than average for Monchegorsk residents.[153]

Nickel compounds are carcinogenic. Nickel sulfate and chloride cause skin disease and respiratory system disease. Damage to the mucous membranes of the nose, formation of ulcers and destruction of the nasal septum are also commonly experienced side effects. Aerosols, tiny particles of nickel salts in the air, are an especially active form of these compounds.[154] The impact of nickel from aerosols is 25 times more toxic than the impact nickel has when it enters the body through inges-

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[146] Ревич Б. А. Загрязнение окружающей среды химическими веществами и экологически обусловленные изменения состояния здоровья населения в городах России (http://erh.ru/n_pub/n_pub01.php).

[147] Юревич Е. А. Никель и его токсические соединения (http://www.vitaeauct.narod.ru/005/tcs/0300.htm).

[148] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[149] Писарева Л. Ф., Пешкова Е. А., Горячев С. М., Детцель А. Е. Особенности онкологической заболеваемости в Заполярье // Эпидемиология, профилактика и ранняя диагностика злокачественных новообразований. Томск, 1987.

[150] Соленова Л. Г., Дымова Е. Г., Каспаров А. А. Онкологическая заболеваемость работающих (http://www.medkit.ru/therapya/onkology/fragment_gl_6_nkologicheskaya_zabolevaemost_rabotayushchih).

[151] Соленова Л. Г., Дымова Е. Г., Каспаров А. А. Онкологическая заболеваемость работающих (http://www.medkit.ru/therapya/onkology/fragment_gl_6_nkologicheskaya_zabolevaemost_rabotayushchih).

[152] http:/www.osanor.ru/?id=154.

[153] Последствия загрязнения природной среды // Бюллетени Центра Госсанэпиднадзора в Мурманской области за 1980-2000 гг. (http://www.lapland-nature.info/ru/5.html).

[154] Сидоренко Г. И., Ицкова А. И. Никель. М.: Медицина, 1980.

tion of food and water.[155] Nickel sulfate and chloride aerosols are emitted from ventilation systems in nickel electrolysis shops. Furthermore, they form in the atmosphere as a result to a reaction of oxides and sulfides coming into contact with sulfuric acid.[156]

The average annual concentrations of non-soluble nickel compounds detected in the air above or near Nikel and Zapolyarny can sometimes reach 12-20 mkg/m^3. This is 12-20 higher than MAC.

Nickel has cytotoxic and genotoxic qualities. A study to detect cytogenetic indicators was conducted out among workers employed in the town of Nikel who are involved in processing pyrometallurgically sulfide copper and nickel ores. An inspection of the nickel workers revealed genotoxic consequences from exposure to this industrial environment. These findings include high levels of micronuclei and inhibition to repair DNA synthesis in lymphocytes. Furthermore, nickel was found in the hair of smelter shop workers in excess by 2.3 times, equal to 15.1 mkg/g, when compared with a group of workers from auxiliary professional backgrounds.[157]

In recent decades, the issues of Pechenganickel emissions and their negative impacts on the environment and the health of people living in the border regions of have been very serious.

Between 1994 and1995, studies were carried out in the following locations: the town of Nikel, the town of Zapolyarny and at the border of Norway and Russia. The goal of these studies was to detect a presence of nickel in people there. It was found that nickel levels were higher in urine samples taken from people living on the Russian side of the border than in towns across the border in Norway. The highest nickel content was found in the urine of people living in the town of Nikel, which shows a serious local effect atmospheric pollution has in this area.[158]

In addition to studies responsible for finding toxic levels of copper and nickel in the bodies of local residents, a number of oncological and epidemiological studies were carried out as well. It was documented that death rates from malignant tumors among workers was significantly higher than among management personnel of the hydrometallurgical and pyrometallurgical industries.[159]

The results of the studies also showed that risks to develop oncological respiratory diseases among workers of the nickel industry depended on the technology used. It is thought that pyrometallurgical smelter departments processing sulfide ores are most at risk.[160]

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[155] Сидоренко Г. И., Ицкова А. И. Никель. М.: Медицина, 1980.

[156] http://www.lapland-nature.info/ru/3.html.

[157] Перминова Е. В. Эколого-генетическое обоснование защиты генома при профессиональном воздействии никеля с помощью аскорбиновой кислоты: Дисс. канд. биол. наук. Апатиты, 2003.

[158] Ревич Б. А. Экологически зависимые изменения состояния здоровья населения, связанные с загрязнением окружающей среды городов Европейской части России (http://www.ecfor.ru/pdf.php?id=books/revich/05).

[159] Нибур Э., Томассен И., Чащин В., Одланд Й. Ю. Оценка профессиональной вредности металлов. Barents Newsletter on Occup Health and Safety 2006; 9:12-16 (http://www.ttl.fi/en/publications/electronic_journals/barents_newsletter/pages/default.aspx).

[160] Нибур Э., Томассен И., Чащин В., Одланд Й. Ю. Оценка профессиональной вредности металлов. Barents Newsletter on Occup Health and Safety 2006; 9:12-16 (http://www.ttl.fi/en/publications/electronic_journals/barents_newsletter/pages/default.aspx).

6.3. Weakening of the immune system: increase in number of diseases and chronic pathology

The poor environmental conditions create harmful effects on the immune system on people living in direct proximity to the industrial sites of Norilsk Nickel MMC. In response to this situation, there is an immense number of people seeking medical assistance. Data from the Norilsk Center of the State Sanitary and Epidemiological Inspection Service shows a tendency of disease in the Norilsk industrial zone.[161]

A letter from residents of the Norilsk industrial zone states that every year they **"increasingly seek aid from doctors for various reasons. For every 1,000 people, the number of visits to the doctor came to 1,369.8 times in 1995, 1,591.8 times in 1999, and 1,668.5 times in 2001. And this tendency continues".[162]**

Increase in number of diseases in 2002.	
General disease rate	increase of 1.7% compared to 2001
Primary disease rate	increase of 2.3% compared to 2001
Children's disease rate	increase of 5.1% compared to 2001
General disease rate	increase of 19.9% compared to 1996
Primary disease rate	increase of 3.3% compared to 1996
Diseases of the endocrinal system	three times the level for 1996
Diseases of the circulation system	83% of the level for 1996
Number of tumors	63.8% of the level for 1996
Number of congenital abnormalities	58.8% of the level for 1996

According to assessments of recent years, pollution of the atmospheric air causes up to 37% of newly diagnosed diseases of children and 21.6% of the adult population of the town.[163]

The increase in the growth of the general disease rate shows the weakening of the immune system, and an increase in the percentage of chronic pathologies in the Norilsk region.[164]

6.4. Negative impact on the reproductive system

A polluted environment is a serious threat to the health of pregnant women and newborn babies.

Statistics show that the threat of interrupted pregnancy among women in Norilsk is higher than among woman in Dudinka. There are also more frequent cases of toxicosis of the second half of pregnancy and premature births.[165]

Anthropometric indicators of newborn babies in the Norilsk industrial zone are lower than indicates for the average group of newborn babies which were born to a lesser polluted zone:[166]

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[161] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[162] http://www.osanor.ru/?id=154.

[163] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[164] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[165] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[166] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

Average weight of newborn babies	Polluted zone	Less	Dudinka
	3000g	3250g	3430g

In 2009 G.F. Yankovskaya conducted a study on the "Reproductive health of women from different age groups living in the conditions of the Kola Polar region". In her work, Yankovskaya, a PhD in medical science, concludes on the basis of her data that "teenage girls living in the Kola polar region are in the risk group for disturbance of menstrual function, dysmenorrhea, and also high frequency of somatic disease: iron deficiency anemia, pathology of the thyroid gland, diseases of the ear nose and throat, and the gastro-intestinal tract".[167]

In her study, Yankovskaya proves that industrial factors have a significant impact on the risk of various complications during pregnancy among women working with non-ferrous metallurgy.[168]

6.5. Increase in children's disease rate

Emissions by non-ferrous metallurgy plants have strong negative impacts on children.

Health indicatorions of children living within the Norilsk industrial zone were analyzed and compared with children's health from a different polar town, Dudinka. Dudinka does not have any major sources of pollution. The results showed that more children in Norilsk have chronic tonsillitis, diseases of the gastro-intestinal tract, bile passages etc.[169]

Studies conducted in Monchegorsk and a comparative analysis showed that skin diseases among children in Monchegorsk exceed the average level for Russia by two times.[170]

In the Murmansk Oblast in general, a high frequency of developmental defects among children is registered. The child mortality rate from oncological diseases in this region exceeds the general Russian rate by 1.9 times.[171]

6.6. Emergence and increase of occupational diseases

The particular dangers employees from of non-ferrous metallurgy plants face coming into contact with toxic substances are occupational diseases and loss of ability to work.

According to data of official state statistics, the Murmansk Oblast holds 4th place for level of occupational disease in the Russian Federation. Indicators of occupational disease for the Murmansk Oblast are higher than equivalent figures for the Russian Federation.[172] The ministry for health and social development of the Murmansk Oblast notes in its report that the growth of newly diagnosed occupational diseases in 2009, is mainly accounted for by workers of Kola MMC. They have worked under harmful labor conditions simply due to the nature of their work. The average age of these people suffering from occupational disease is 45-55, and the average record of their work activity in harmful conditions is 10-20 years or more.[173]

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[167] Янковская Г. Ф. Репродуктивное здоровье женщин различных возрастных групп, проживающих в условиях Кольского Заполярья: Диссертация, 2001 / Российский университет дружбы народов. М., 2009.

[168] Янковская Г. Ф. Репродуктивное здоровье женщин различных возрастных групп, проживающих в условиях Кольского Заполярья: Диссертация, 2001 / Российский университет дружбы народов. М., 2009.

[169] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[170] Ревич Б. А. «Горячие точки» химического загрязнения окружающей среды и здоровье населения России (http://www.ecfor.ru/pdf.php?id=books/revich02/gor_t).

[171] http://www.nestor.minsk.by/sn/2007/48/sn74825.html.

[172] О состоянии тяжелого производственного травматизма и профессиональной заболеваемости в Мурманской области в 2009 году (http://minzsr.gov-murman.ru/plan/files/20100208_1537.pdf 08.02.2010).

[173] О состоянии тяжелого производственного травматизма и профессиональной заболеваемости в Мурманской области в 2009 году (http://minzsr.gov-murman.ru/plan/files/20100208_1537.pdf 08.02.2010).

Along with primary occupational disease, there is also a growth in the total number of occupational diseases.

Occupational disease, as the report notes, is formed over a long period of time, and so it is not possible to bring about a drastic drop in the number of occupational diseases at once. Even if productions are modernized, many people will remain working harmful labor conditions, potentially leading to a surge of occupational disease.[174]

6.7. Reduction in life expectancy

Living and working in poor environmental conditions not only causes an increased frequency of disease, but it also leads to a significant reduction of life expectancy.

The life expectancy of workers of Norilsk Nickel plants is 10 years less than the average for Russia.[175]

The situation is aggravated by the climatic features of the region.

Drinking water on the Kola Peninsula is characterized as ultra-soft, which may raise the absorptive capacity and toxic impact of chemical elements, including nickel. Furthermore, people living in northern latitudes often suffer from disruption of metabolism, which manifests itself in a deficit of iron. The qualities of erythrocyte red blood cells are characterized by a short lifespan, greater size and more intensive formation process, which aggravate the metabolism process.[176]

It has been proved that the causes for a worsened state of health, reproductive functions in particular, extending to the entire population, are unfavorable social, economic and environmental factors. The greatest impact on human health is caused by a polluted environment.

The World Health Organization (WHO) confirms the relationship of disease and death rates in relation to the state the environment is in. According to WHO data, the death rate in cities with high levels of air pollution is 15-20% higher than the death rate for people living in cities with a favorable environmental situation.[177]

All of this allows us to conclude that despite the improvement of official indicators of pollution of the environment, the negative impact on living organisms does not decrease. This is explained by the duration of impacts pollutants have on the environment, the rate of heavy metals decaying in soil and water, as well as the inadequate assessment of calculating the MAC's impact on human health.

The increased frequency of disease and low life expectancy among people working at Norilsk Nickel MMC plants and living near the industrial activity are indicators of poor environmental conditions. These findings are the direct consequence of the industrial activity from Norilsk Nickel MMC.

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[174] О состоянии тяжелого производственного травматизма и профессиональной заболеваемости в Мурманской области в 2009 году (http://minzsr.gov-murman.ru/plan/files/20100208_1537.pdf 08.02.2010).

[175] Голубчиков С. (http://www.ng.ru/science/2009-02-11/11_ecoimage.html).

[176] Янковская Г. Ф. Репродуктивное здоровье женщин различных возрастных групп, проживающих в условиях Кольского Заполярья: Диссертация, 2001 / Российский университет дружбы народов. М., 2009.

[177] http://www.who.int/mediacentre/factsheets/fs313/en/index.html.

7. Norilsk Nickel MMC and corporate social responsibility (CSR)

Corporate social responsibility is the social responsibility of business, according to which companies take into account the interests of society. They must take responsibility for the influence their activities impose not only on workers and shareholders of their company, but on the environment and people living within areas affected by its industrial activity.[178]

CSR is the voluntary decision by companies to take part in improving the life of society and protecting the environment. Correct policy in the CSR sphere is closely connected with the company's reputation for increasing its investment attractiveness.

When selecting the company's strategy within the sphere of CSR, the company must take into account the opinions of all interested sides, i.e. not only take into account the point of views and requirements of company heads and representatives of bodies of power, but also the local community – representatives of civil society.

In forming a CSR strategy, three foci are singled out: economic, social and ecological.

7.1. Ecological responsibility of Norilsk Nickel MMC

The management of Norilsk Nickel MMC views environmental conservation activity as an integral part of business. The company strives to make a contribution to the stable development of Russia by observing requirements of environmental legislation, rational use of natural resources and constant improvement of environmental conservation.[179]

From the Report on corporate social responsibility of Norilsk Nickel MMC

The ecological responsibility of the company is characterized by the amount of secondary raw materials used, energy-saving technologies, reduction of emission of greenhouse gases, control of emission of pollutants into the atmosphere, rational use of fresh water, initiatives to reduce the impact of the company's industrial activity on the environment, and other measures directed towards protecting the environment.[180]

Environmentally responsible companies carry out audits, monitor their industrial activity for impacts to reduce the occurrence of harmful complications, and compensate all affected by damages.

The concept of ecological responsibility must under no circumstance be replaced by

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[178] http://ru.wikipedia.org.

[179] Отчет о корпоративной социальной ответственности ОАО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

[180] Материалы семинара «Предупреждение чрезвычайных ситуаций в Арктике и координация работы по их ликвидации, включая экологические последствия» (http://www.nornik.ru/_upload/news_lang/filename_document1_107.pdf).

"greenwashing" – otherwise known as "cheap" tricks that create the illusion of environmental responsibility. This in fact leads to even greater problems and additional risks.[181]

7.1.1. Reducing emissions of harmful substances, introducing new technologies

Measures carried out by Norilsk Nickel make it possible to gradually reduce the level of emissions of pollutants into the atmosphere. In 2009, compared to 2008, the level of emissions at the Polar Division dropped to almost 7,000 tons. Over the last ten years, emissions dropped by 10%, including solid matter by almost double.

From a report on the results of work by the general director of Norilsk Nickel MMC Vladimir Strzhalkovsky[182]

At the same time, we can see a huge amount of harmful substances which the Polar Division annually emits into the atmosphere. According to official data alone that is contained in the Norilsk Nickel MMC report on CSR, plants of the Polar Division emitted 1,949,800 tons into the atmosphere.[183] Compared with this figure, reducing emissions by only 7,000 tons seems quite insignificant.

At industrial sites of Norilsk Nickel located on the Kola peninsula, sulfur dioxide emissions dropped by 2.5 times over the period from 1997.

Из отчета по итогам работы генерального директора ОАО «ГМК «Норильский никель» Владимира Стржалковского[184]

However, this comparison of emission reductions from 2009 with those from 1997 is not accurate. As we noted earlier, reductions of emissions from KMMC plants took place because of the increase since the mid-90s in local ore used in production with lower sulfur content, and not because of new technologies or environmental protection measures.

At the same time, the data of Norilsk Nickel MMC on CSR also indicates an increase in emissions of pollutants from KMMC plants: 143,500 tons in 2008 to 148,400 tons in 2009.[185]

Norilsk Nickel MMC announces that it is making efforts to modernize the industrial process, with the goal of reducing emissions.

A comprehensive program of measures has been developed that are directed towards a cardinal reduction of emissions (sulfur dioxide) in Zapolyarny and Nikel. Modernization of the enrichment and metallurgical plants will make it possible to reduce the level of emissions of sulfur anhydrate significantly. By 2014, SO_2 emissions in Nikel will be reduced to 78,000 tons a year (at present emissions come to 110,000 tons).

Sergei Selyandin, general director of Kola MMC

According to experts' assessment, a reduction in sulfur dioxide emissions after modernization of the roasting shop in Zapolyarny will be achieved by increasing emissions in Nikel. During roasting, sulfur used to burn and enter the atmosphere in the form of sulfur dioxide with emissions from the industrial site in Zapolyarny. With the introduction of a new briquetting technology, it will remain as a concentrate of ore. Because of this physical nature, at this stage of the manufacturing process, a reduction of SO_2 emissions will indeed be achieved. At the industrial smelting site in Nikel, this sulfur will continue to enter the atmosphere in the form of sulfur dioxide, SO_2.

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[181] http://www.ecowiki.ru/index.php?title.

[182] http://www.krasrab.com/archive/2010/06/17/11/view_article.

[183] Отчет о корпоративной социальной ответственности ОАО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

[184] http://www.krasrab.com/archive/2010/06/17/11/view_article.

[185] По материалам отчета по КСО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

KMMC management states that "the majority of gases will be processed into sulfuric acid at the sulfuric acid production facility", and additionally it is planned to "reconstruct the smelter section"[186] at the Nikel industrial site.

Utilization of sulfur at the industrial site in Nikel plays an important role in ensuring environmental safety for the region. With the aim of preparing smelter production for processing copper and nickel bricks with high sulfur content, KMMC has started renovations at the section for the production of sulfuric acid. According to KMMC management, the renovations will help to increase the volume of utilized sulfur gases to 7000 nm^3/hour without a reduction in the degree of utilization.[187] Renovations works include cleaning the tower equipment, the gas ducts and pipes, works on restoring the chemical protection of equipment, and replacing the nozzles of Raschig rings, which have not been replaced for 23 years, and also a complete replacement of the contact mass at contact apparatus № 1 of the first stage, and partial replacement of the mass of contact apparatus № 2.

In 2001, with the aim of modernizing production and reducing emissions at Pechenganickel, an intergovernmental agreement was signed between Norway and Russia. The key stages of modernization were supposed to be the introduction of three new technologies:

1. enrichment of ore by briquetting instead of roasting of copper and nickel pellets (Polar industrial site)

2. autogenic smelting in the smelter shop, making it possible to separate and strip slag in the smelting process

3. bringing the concentration of sulfur gas to a level that allows it to be utilized into sulfuric acid.[188]

Although Pechenganickel received a target grant and signed a loan agreement for the sum of $30 million, it did not start the agreed upon modernization at the time. After receiving the grant, Norilsk Nickel MMC turned down the loan, violating the conditions of the agreement that had been previously reached. Modernization of the briquetting section in Zapolyarny began much later. Modernization of the Nickel industrial site was limited only to overhaul repairs and replacement of old parts.

It seems doubtful that in the brief period given for overhaul of equipment, KMMC will be able to solve the task of utilization of sulfur, which will be delivered in even greater quantities with production from the briquetting shop, or to reduce emissions of sulfur gas.

A vague answer to this question was given by Alexei Tolstykh, deputy general director of Kola MMC on technical issues: "as far as emissions of pollutants into the atmosphere in Nikel are concerned, we will keep strictly within the limits of Russian legislation."[189]

Does this mean that at present KMMC does not regard the significant emissions of sulfur dioxide, which at the Nikel site alone exceed the annual SO_2 emissions for the whole of Norway[190], as a violation of Russian legislation on emissions of toxic substances?

The sum of 11,229.2 million rubles spent by Norilsk Nickel MMC on environmental measures in 2009 comes to over $376 million US dollars. During this period, the reduction of emissions from all industrial sites of Norilsk Nickel MMC was just 2,000 tons. In 2009 in comparison with 2008, the mass of pollutants discharged into bodies of water dropped by 1.2% for the group in total.[191]

Carrying out environmental protection measures is impossible without technological overhaul of equipment, and using new technologies. The expenses on scientific research, design of experiments, and technological works and studies in 2009 came to 126.0 million rubles, which was just a tiny part of the combine's turnover (0.06% of turnover).[192]

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[186] Pechenga newspaper http://pechenga-gazeta.ru/?view=article&id=3421.

[187] http://pechenga-gazeta.ru/?view=article&id=3540.

[188] Ministry of economic development and trade of the Russian Federation http://bibliofond.ru/view.aspx?id=21141.

[189] Pechenga newspaper http://pechenga-gazeta.ru/?view=article&id=3421.

[190] http://www.bellona.ru/articles_ru/articles_2009/1261564898.17.

[191] По материалам отчета по КСО ГМК «Норильский никель» (http://www.nornik.ru/_upload/editor_files/file1381.pdf).

[192] Кричевский Н. (http://www.novayagazeta.ru/data/2010/110/19.html).

During this report period, the general director of Norilsk Nickel Vladimir Strzhalkovsky earned $24.8 million in 2009[193], taking into account salary and bonuses, which was approximately 7% of the sum that the company spent on solving ecological problems.

7.1.2. Measures for rehabilitation of territories and recultivation of vegetation

Since the start of the 2000s, KMMC has been restoring lands which have suffered for several decades from the negative impact of combines in Monchegorsk, Zapolyarny and Nikel. The peak of recultivation came in 2009, when works were carried out to plant 21 hectares of technogenic wasteland. However, the amount of planting for 2010 was much more modest. On the whole, as the KMMC reports note, over 100 hectares were planted – a tiny figure compared with the total area of plant life killed and damaged by industrial emissions from the plant.[194]

Table 4. Area of killed and damaged forests, and recultivated areas

	Plant		
Damaged forests	Severonickel	Pechenganickel	Polar division
Total damaged areas	47 382 hectares	Precise data lacking	537 100 hectares
Including killed areas	8 924 hectares	3 971 hectares	283 200 hectares
Recultivated areas	81.5 hectares	18.5 hectares	Data lacking

As it is widely known, in Arctic conditions the biological productivity of flora and fauna is very low, and so to restore the balance of the environment of the polar region that was violated by industrial production, it may take decades, if not centuries.

7.1.3. Observance of environmental legislation

In August 2010, a large-scale inspection of observance of ecological legislation at the Kola mining and metallurgical company was completed. Emissions into the atmospheric air were checked, and also observance of norms in storage of waste of production and consumption – so-called tailings, scrap metal and mercury-containing materials. Inspectors from the regional office of Rosprirodnadzor carried out an inspection at all three of the KMMC sites – in Monchegorsk, Nikel and Zapolyarny.

In an inspection of five waste water outlets from industrial sites of KMMC, the Center of laboratory analyses and technical measurements for the Murmansk Oblast was brought in, the only center of independent analysis. Although KMMC has its own laboratory with five sections that is accredited and certified at the federal agency of metrology, in carrying out checks, a conclusion of independent experts is required.

"As a result of the checks, violations were found, in accordance with which 16 administrative cases were opened under individual articles of the Administrative violations code)".[195] An analysis of water samples showed that for a number of substances, such as nickel and fluorides, the indicators were exceeded.

For control over emissions by plants, there are maximum allowable concentrations (MAC) and norms for acceptable emission.

Controlling bodies that see that a plant cannot reduce its emissions/discharges to established norms introduce so-called norms for provisionally approved discharged (PAD). Provisionally approved discharges/emissions allow a greater content of harmful substances in the waste water and emissions of plants.

[193] Based on materials of the site http://www.pbwm.ru/articles.

[194] Доклад «О состоянии и об охране окружающей среды Мурманской области в 2008 году». Комитет природопользования и экологии Мурманской области (http://www.gov-murman.ru/envcond/2008.pdf).

[195] http://nord-news.ru/main_topic/?mtopicid=119

Valentin Khachin, the deputy head of the department for supervision of water and land resources at Rosprirodnadzor for the Murmansk Oblast, explains this as follows: "But still, a plant that receives these norms develops a plan to reduce concentration of harmful substances to MAC. In Russia, the maximum allowable concentrations are very high compared with international experience. This is primarily due to the fact that the documents were developed 50 years ago, and have yet to be reviewed".[196]

Based on the results from five different outlets of three different sites in KMMC, an excess of MAC was found, and 10 administrative cases were opened under article 8.13 of the administrative violations code (5 for a legal person and 5 for an official). The legal person was charged a fine of 140,000 rubles, and the official was charged 15,000 rubles.[197]

KMMC, as the main source of anthropogenic pollution of the Kola Peninsula, does not observe environmental legislation strictly. It has successfully made use of the legislation's weak points to avoid paying ecological fines. After 2000, an initiative from KMMC sought to make Russian companies exempt from several years of payments owed for environmental pollution. The Kola MMC was able to lobby this decision by bringing in a group of specialists from the liquidated Federal environmental foundation. This disregard for the law and non-observance of environmental requirements was called "envirnmental dumping" by the director for environmental policy of the Russia World Wildlife Fund (WWF), Yevgeny Shvarts.[198]

Environmental inspections are conducted periodically, or can be prompted from complaints by city residents. After an open letter from residents of Norilsk in 2007, Rosprirodnadzor carried out an inspection on the industrial activity from the Polar Division of Norilsk Nickel from 02.08 to 31.08. The results and inspection documents are given in point 4.3.2 of the present report.

The importance of this inspection is difficult to overestimate – for the first time in the entire history of Norilsk Nickel, there was an official calculation of their damages rendered to bodies of water alone. This came to 2,705,612,362.54 rubles.[199] At the same time, the damage was calculated for certain short periods indicated above in 2007, and only at seven emission outlets of a total number of 86. One is forced to conclude that if the damage for the entire year from all emissions of Norilsk Nickel were calculated, the damage would come to hundreds of billions of rubles. A calculation of damage caused by Norilsk Nickel as a consequence of emissions of harmful substances into the atmosphere was not made; there are no precise methods for these calculations.

Based on the results of the inspection, the deputy head state inspector of the Russian Federation called for for control and supervision of the use and conservation of water bodies. In early 2008, and on behalf of the Federal service for supervision in the sphere of natural resource management (Rosprirodnadzor) to the Arbitration Court of Krasnoyarskiy Krai, Oleg Mitvol filed a law suit on compensation for damage done to the environment.

In June 2008, the Arbitration Court of the Krasnoyarskiy Krai placed an administrative fine on the division of Norilsk Nickel for discharging waste waters into rivers on the basis that it was illegal, and rejected the lawsuit from Rosprirodnadzor. The arbitration court, without disputing the fact that waste water and pollutants were discharged into bodies of water, found the inspection conducted by Rosprirodnadzor to be illegal, as Rosprirodnadzor violated the terms and periodicity of inspections.

Oleg Mitvol, who initiated the inspection of Norilsk Nickel, was dismissed from Rosprirodnadzor.

It should be mentioned that the governor of the Krasnoyarskiy Krai, A. Kholoponin, at the time was the former involved with Norilsk Nickel productions. He is the presently the presidential representative in the North Caucasian federal district.

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[196] http://nord-news.ru/main_topic/?mtopicid=119

[197] http://nord-news.ru/main_topic/?mtopicid=119

[198] http://www.ecoindustry.ru/news/view/25639.html.

[199] Data from materials from Rosprirodnadzor inspection

During investigations, it was also discovered that not all the permissions for emissions of harmful substances were received legally. The deputy head of the Yenisei inter-regional department of technological and ecological supervision at Rostekhnazdor illegally issued Norilsk Nickel MMC with permissions to emit pollutants into the atmosphere. The official was charged with responsibility for damages to an extent of around 1 billion rubles. The investigative bodies of the prosecutor's office and investigative committee for the Krasnoyarskiy Krai opened a criminal case under article 286 p.1 of the Russian Criminal Code (abuse of office).[200]

Representatives of Norilsk Nickel were not charged, although Norilsk Nickel MMC was involved in a corruption scandal based on the illegal issue of permissions for the emission of harmful substances.

The decision by the Krasnoyarsk Court is a clear demonstration of the fact that Russian courts are subject to strong administrative pressure. It is quite problematic for Russian courts to make fair decisions.

A system of ecological payments does exist in Russia. This norm was established by the Law "On protection of the environment"[201] Payment for negative impact on the environment is made by organizations and persons whose actions cause negative impacts to the environment. This is a kind of compensation for damage done by pollution to the environment. However, the size of fines are miniscule and do not justly correspond to the scale of the damage done. For example, a ton of carbon sulfur emitted costs a business 410 rubles, a ton of mercury costs 6,833 rubles, and for a ton of ammonia that enters the environment, a company pays just 52 rubles.[202]

For this reason, it is more advantageous for big business to pay ecological fines and taxes than invest in real modernization of technological processes and construction of new treatment plants.

7.1.4. Ecological management system (EMS), presentation of non-financial report

Proper policy in CSR not only leads to a rise in the company's rating, but also its investment attractiveness. In response to the demands of the international sales market, Norilsk Nickel MMC introduced an ecological management system (EMS), in accordance with the requirements of international standard ISO14001:2004. This establishes requirements for the environmental management system, but it does not establish criteria for ecological performance.[203]

Norilsk Nickel MMC was one of the first Russian companies to deliver annual Social reports, or in other words non-financial reports, and have been doing so for several years.

However, an expert assessment on the achievements of Norilsk Nickel MMC in CSR shows an ambiguous picture.

In November 2009, the State pension fund of Norway (also known as the Norwegian sovereign fund) announced the exclusion of Norilsk Nickel from its investment portfolio, as the Norilsk Nickel mining and metallurgical company neglects environmental activity and damages the environment, which goes against the fund's principles. Following this, the Norwegian Foreign Ministry confirmed this decision on the basis of the fact that the company's activity involves emissions of an unacceptable amount of sulfur dioxide and heavy metals, which irrep arably damages the environment and threatens human health.

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[200] http://www.bcs-express.ru/digest/?article_id=3658.

[201] Federal Law of the Russian Federation "On protection of the environment" http://www.ecoline.ru/mc/legis/zoos2002.html.

[202] http://infosud.ru/legislation_publication/20100529/250176526.html.

[203] http://www.ecoindastry.ru/news/view/22048-html.

7.1.5. Environmental initiatives of Norilsk Nickel MMC

Recently (since Vladimir Putin visited Norilsk at the end of August 2010), Norilsk Nickel MMC has announced increased activity in the environmental sphere. In October 2010, on the initiative of Norilsk Nickel MMC, the regional conference "Conservation of the environment and industrial activity in the North" was organized, where regional and municipal bodies of power, scientific research, educational institutions of Russia and public ecological organizations took part.

At the conference, the director of the Polar Division of the company, Yevgeny Muravev, announced that Norilsk Nickel MMC would spend 27 billion rubles, almost 1 billion dollars, over the next five years on implementing environmental projects on the Taymyr peninsula.

Measures have been announced in the environmental sphere at plants of the Polar Division.

Over 50% of all investments in the ecological program are planned to be directed to utilization of sulfur dioxide.[204] Problems that currently involve the utilization of sulfur and sulfuric acid along with its removal are to be solved by introducing new technology. One such strategy would be to pump sulfur instead of cement (the existing practice) into rock cavities after extracting ore.

Testing the new method of utilization of sulfur was planned before the end of 2010.

Norilsk Nickel is also examining the issue of introducing the hydrometallurgical technology ActivOx, which makes it possible to obtain metal with the use of chemical processes instead of firing, which accordingly also reduces the impact on the environment. The equipment that costs $100 million has already been acquired for this (note: equipment was acquired in 2006).

Thus, by 2014, the Polar Division hopes to reduce the anthropogenic load on the environment by 10 times.[205]

They are planning to create a sanitary protective zone of the nickel plant.

Attempting to measure up to the requirements of the time, Norilsk Nickel MMC has developed a program that would help modernize the company. After coordination with the Krasnoyarskiy Krai administration it will be sent for approval to the Russian ministry of regional development. The program was supposed to be approved by 30 October 2010.

On 31 August 2010 in Norilsk, an agreement was signed on cooperation between the Federal supervisory service for natural resource management and Norilsk Nickel MMC. The agreement prescribed in detail the obligations of the company to reduce emissions of pollutants over the next three years. It also included plans to modernize specific shops of the combine. According to the agreement, controlling functions over the implementation of agreements should be carried out by Rosprirodnadzor.[206]

The policy of Norilsk Nickel MMC in the conservation sphere today looks as follows: Ideally, the company implies that it has an interest into solve environmental issues caused by their industrial activities(official statistics of Norilsk Nickel MMC). However, the reality of the situation and objective data show the negatively affected environmental conditions and the health threats on people that result directly from the actions of Norilsk Nickel MMC.

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[204] http://www.ecoindustry.ru/news/company/view/26140.html.

[205] http://www.ecoindustry.ru/news/company/view/26140.html.

[206] Соглашение о взаимодействии между Федеральной службой по надзору в сфере природопользования и ОАО «ГМК «Норильский никель» по сопровождению плана мероприятий по снижению негативного воздействия выбросов загрязняющих веществ в атмосферу города на ЗФ ОАО «ГМК «Норильский никель» (http://rpn.gov.ru/node/1857).

Conclusion

Plants of the Norilsk Nickel company group, with their outdated technologies, are another severely detrimental ecological legacy that Russia inherited from the Soviet Union.

According to information from the Russian Ministry of Natural Resources, for two decades Norilsk Nickel has been among the most serious ecological polluters in Russia as well as the greater Northern Eurasia area. Not only is the air harmed by the activity from Norilsk Nickel MMC, but the nickel mining also harms the Arctic seas. The activity of the Kola branch harms the environment of the neighboring territories in the countries of Norway and Finland.

In the past, during the time of industrialization and the late Soviet period, damage to the environment was not assessed and little money was spent to clean technologies.

The history of Norilsk Nickel and the manufacturing non-ferrous metals shows a complete lack of environmental concern, proving that they were never an environmentally or socially responsible enterprise. They always had another agenda, which lacked the responsibility of protecting the environment and public health. Norilsk Nickel, the heir and successor of NorilLag (a plant built by the former Norilsk labor camp prisoners under Stalin's ruling), retained their predecessor's historic attitude towards people and nature – one of exploitation.

Human or environmental exploitation is no longer an acceptable means of production by any standards. Companies like Norilsk Nickel should take a responsibility and behave ethically.

The Russian Federation should introduce new environmental protection standards. Since Norilsk Nickel is active in the international market, it must comply with the international standard ISO 14001: 2004. This standard regulates environmental protection activity. In the section of the report about corporate social responsibility (2009), "On protection of the environment", Norilsk Nickel announces that it "…aspires to observe requirements of environmental legislation and international agreements…" However, it is evident from this report where industrial activity from Norilsk Nickel MMC plants exists, environmental conditions remain unfavorable.

According to the company's CSR report, Norilsk Nickel pays a great deal of attention to developing a proper environmental management system in accordance to international standards and requirements of the market. However, judging from Bellona's environmental assessment results, the main goal of developing this area is not one that reduces negative effects in the environment, but rather company's interest in raising their competitive ability in the domestic and more importantly foreign markets. The extent of the company's "environmental management" scheme only goes so far as to appear environmentally concerned in order to increase investment attractiveness and receive additional opportunities, i.e. profits.

The ecological transparency of the company is low. The public has little to no access to reports or findings from inspections carried out for domestic and international auditing purposes. The public also does not have access to documents relating to the environmental protection activity of Norilsk Nickel MMC, through which monitoring of implementation of ecological tasks is carried out.

Norilsk Nickel claims that it spends large sums of money on ecological training of personnel, corporate seminars, programs and courses to educate employees and improve production methods. While Norilsk Nickel attempts to improve the quality of their work through educational trainings and programs, they fail to resolve the pollution problem at the source of the issue. The company continues the use outdated technology, mainly old industrial equipment for its productions. It is useless to train personnel in "clean production" if old, dirty technology and equipment is used in production.

The company management has announced on several occasions that it is implementing an "ecological program of modernization of the enterprise", and at the end of 2010 a completely new program of modernization for the Norilsk Nickel enterprise was supposed to have been approved. However, the plans, processes and results of action from the above-

mentioned programs are not available to the public, thus making it impossible to assess the effectiveness of results.

The biggest problem which the company has so far been unable to solve is emissions of such pollutants into the atmosphere as sulfur dioxide and multiple heavy metals. Although Norilsk Nickel announces an annual reduction of these emissions, they still significantly exceed acceptable levels amongst the Russia Federation and neighboring countries. In 2009, Norilsk Nickel limited itself to carrying out project and scientific research works directed towards a step-by-step process to achieve acceptable emissions. At the same time Norilsk Nickel MMC deployed harmful emissions of pollution and toxic substances into the atmosphere, which were carried out in accordance with provisionally approved emissions even though the amount significantly exceeded maximum allowable levels.

The amount of pollution also concerns the waste which Norilsk Nickel discharges in various local bodies of water. The volume of this waste is nearly impossible to assess because it is commonly undocumented.

In reports, Norilsk Nickel provides comparative figures usually from the previous year, documenting only short-term progress on reductions of harmful emissions and waste. This documentation does not make it possible to assess overall long-term trends of the emissions and waste Norilsk Nickel discharges into the atmosphere and bodies of water. In order to assess the environmental impacts properly and understand of the precise amount of pollution that is being discharged by the company, longer time frames and comparisons are more important for assessment of overall trends than are short-term comparative results.

Pollution from metals are mobile and persistant in the environment, especially in the Arctic region. Their harmful effects persist as they continue to reside in the environment, exposing the public in contact with these toxic pollutants to illnesses and other health related issues.

Results from scientific studies prove that the negative impacts of the heavy metals have on ecosystems and public health do not decrease. This is explained by the constant exposure to these pollutants, the decay period of heavy metals that pollute the soil and water, and also perhaps the inadequate assessment of impact of maximum allowed concentrations on people's health.

Due to the climate, the Arctic flora and fauna have naturally low biological productivity. For this reason, the Polar region may take decades, if not centuries, to restore a natural balance back to many environmental processes as a result of many years of disruption from industrial pollution.

Degradation of the ecosystem, high increase of illnesses and a low life expectancy among people working and living within the zone of industrial activity from Norilsk Nickel MMC are all environmentally conditioned indicators that nickel mining is harmful to the environment and the people's health. These existing conditions indicate that productions from nickel mining are not being properly regulated and are having devastating effects on the surrounding regions.

Taking into account the calculated supplies of ore and the current level of production of industrial metals, the company has supplies of ore to last for over 25 years.[207] Taking into even further account, the indication of field developments that have yet to be begun, the period may be even longer.

This means that if production methods are not modernized, then the current rate of harmful substances entering into the atmosphere will continue and their harmful effects to the environment and public health will only increase in the future. There needs to be an instated policy implementing preventative regulations and enforcing environmental protection upon the Norilsk Nickel MMC.

On account of the findings set forth in the report, the authors come to the following conclusions:

1. Plants of the Norilsk Nickel company group do not measure up to the status as an environmentally or socially responsible company as they inflict harm to nature and people's health. This was what the Russian Prime Minister had in mind when he called upon the company to "become greener" at the last meeting in Norilsk.

[207] Based on materials of the Independent Information Agency http://www.24rus.ru.

2. Norilsk, from which the company Norilsk Nickel acquired its name, remains one of the dirtiest cities in the world[208]. Although Nikel, Zapolyarny and Monchegorsk are not globally recognized as cities troubled by unacceptable levels of pollution, the ecological situation there is not much better than in Norilsk.

3. Norilsk Nickel is a company that operates behind closed doors. They do not disclose to the public the harms they impose on public health and into the environment. Public reports are of a declaratory nature and are intended more as propaganda, creating an ideal image, one which does not correspond to the reality of the situation.

4. Norilsk Nickel does not aspire to cooperate internationally with the the intent to modernize its company's technologies. This is shown by the rejection of cooperation with the Norwegian authorities on the Kola peninsula. For a constructive solution of the transboundary pollution issue, it is necessary above all to receive accessible and open information about the state the environment is in. To do this, the Norwegian monitoring station in the Nikel region must start working again.

5. Norilsk Nickel uses administrative resources in order to preserve the status quo in applying temporary norms (limits) on emissions and waste for functioning plants. Norilsk Nickel is the most active lobbyist against adopting European system of norms and specifications in Russia.

6. Norilsk Nickel is part of the group of lobbyists which are opposed to Russia ratifying the Convention on Environmental Impact Assessment in a Transboundary Context (Espoo, 1991) and Protocols to the Convention on Long-Range Transboundary Air Pollution (1979).

7. Both the state and the government share the majority of the blame for the fact that one of the largest enterprises in Russia is among the most serious environmental polluters not only in Russia, but in all of Northern Eurasia. For a solution, or at least a reduction in the number of problems raised in the report, it is necessary to change the state's approaches in order to act responsibly with regards to environmental policy in the following areas:

- changes in existing environmental legislation which would balance approaches to issues relating to the use of natural resources and protection of the environment;
- separation of the functions of natural resourse management from the functions of natural resourse use;
- a balanced policy in issues of social welfare and protection of the health of the population;
- ecological modernization of industry, which would help to make the economic activity of industrial enterprises less environmentally detrimental, without stopping production;
- liberalization of legislation on NGOs, formation of a developed civil society, and raising the ecological awareness of the population.

For decades, the Soviet state emphasized obtaining the greatest amount of production possible, including strategic production; at any cost to the environment or public health. Russia is also following along the same path today.

Based on the objective need for improvements of environmental conservation, today it is necessary to unite efforts and take new measures to create change within the activity of industrial enterprises. This can be done by creating conditions in which clean production will ultimately become beneficial to the environment as well as economically beneficial to the company.

Only a balanced approach will make it possible to secure sustainable economic development which is environmentally responsible.

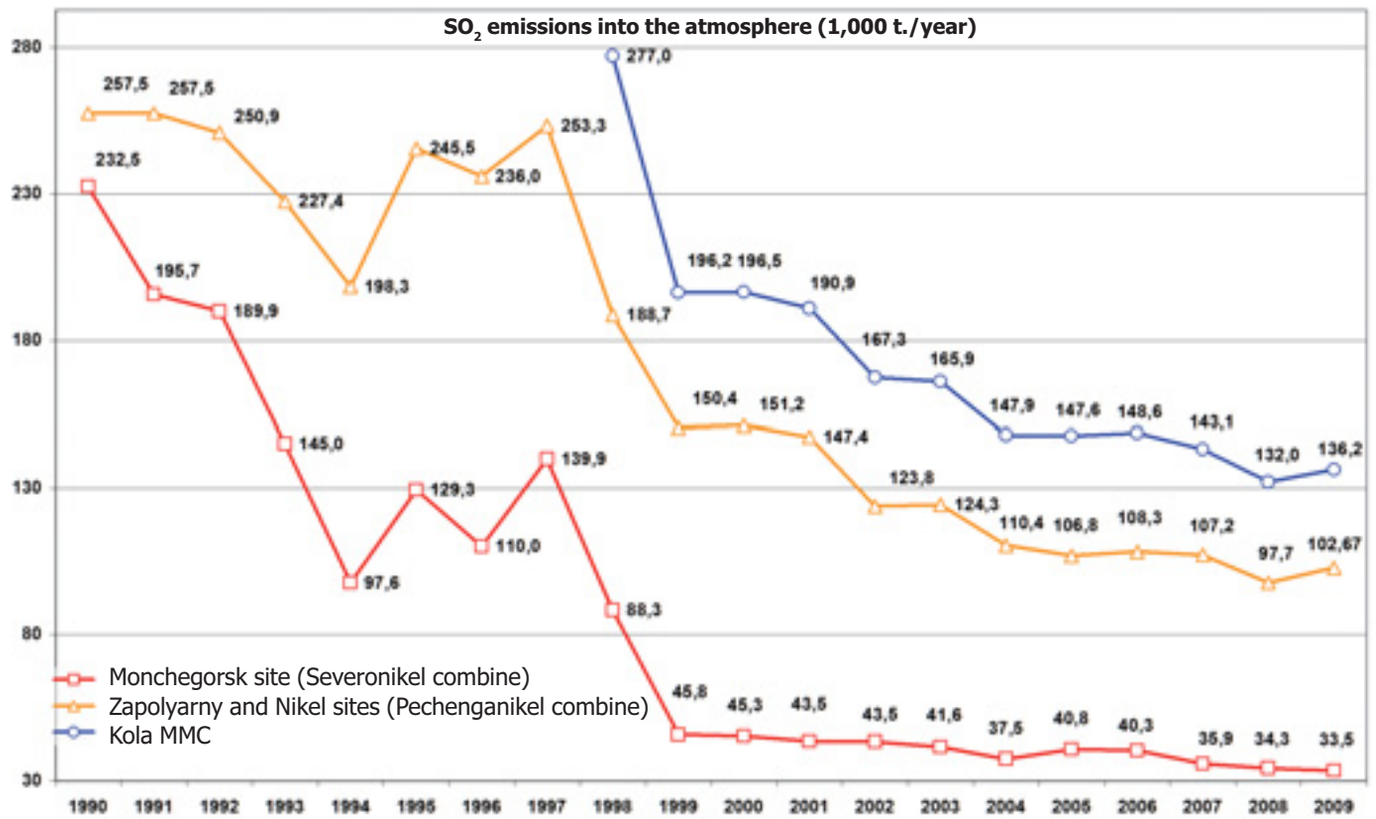
[208] Based on materials of the Blacksmith Institute, www.worstpolluted.org.

Afterword

After the presentation of the Bellona report in Murmansk on 14.12.2010, Kola MMC placed information on the company site about monitoring of the environment in regions of operations of Kola MMC enterprises.

http://www.kolagmk.ru/ecology/monitoring

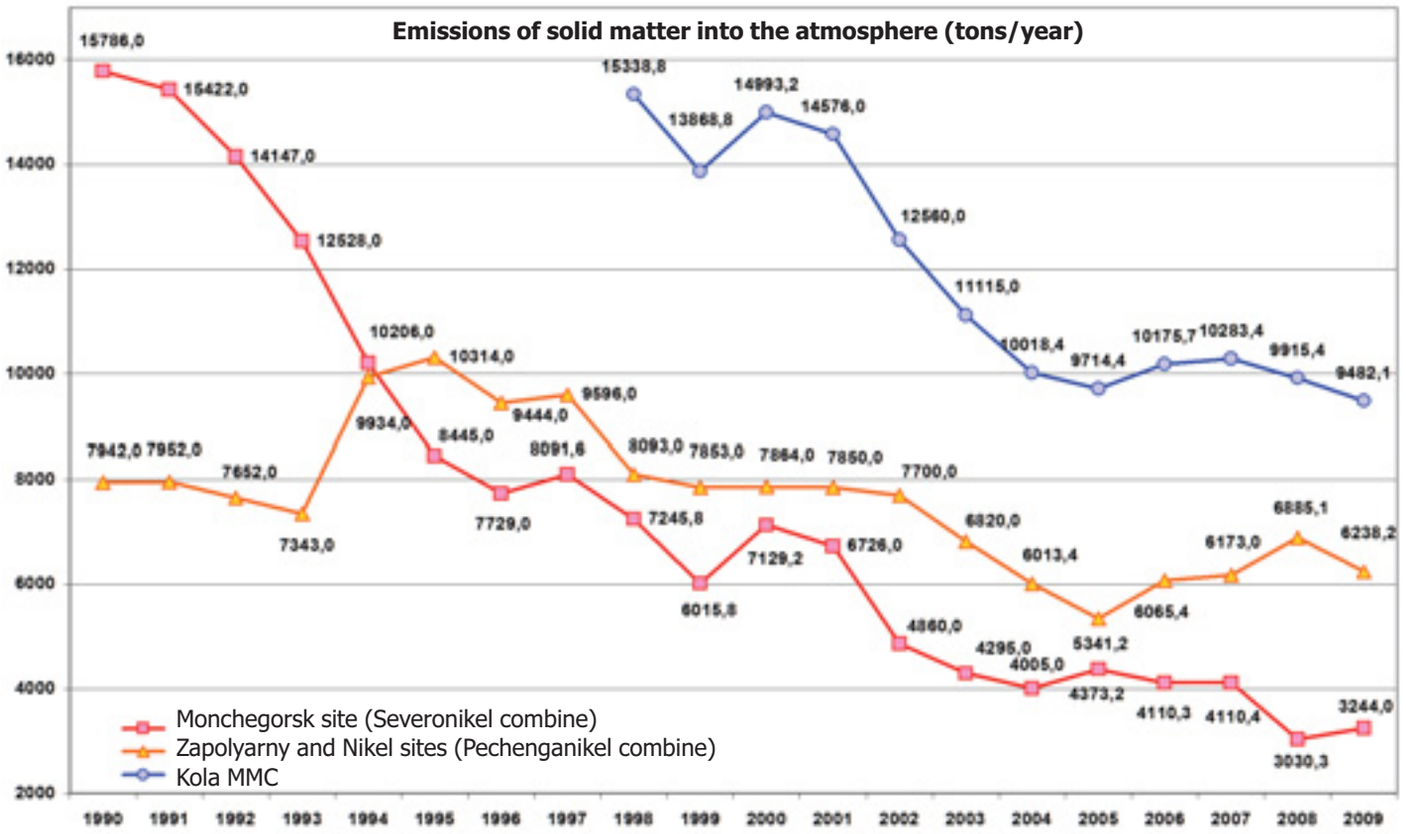
The graphs of emissions of harmful substances presented below are official materials from monitoring of the environment provided by Kola MMC.

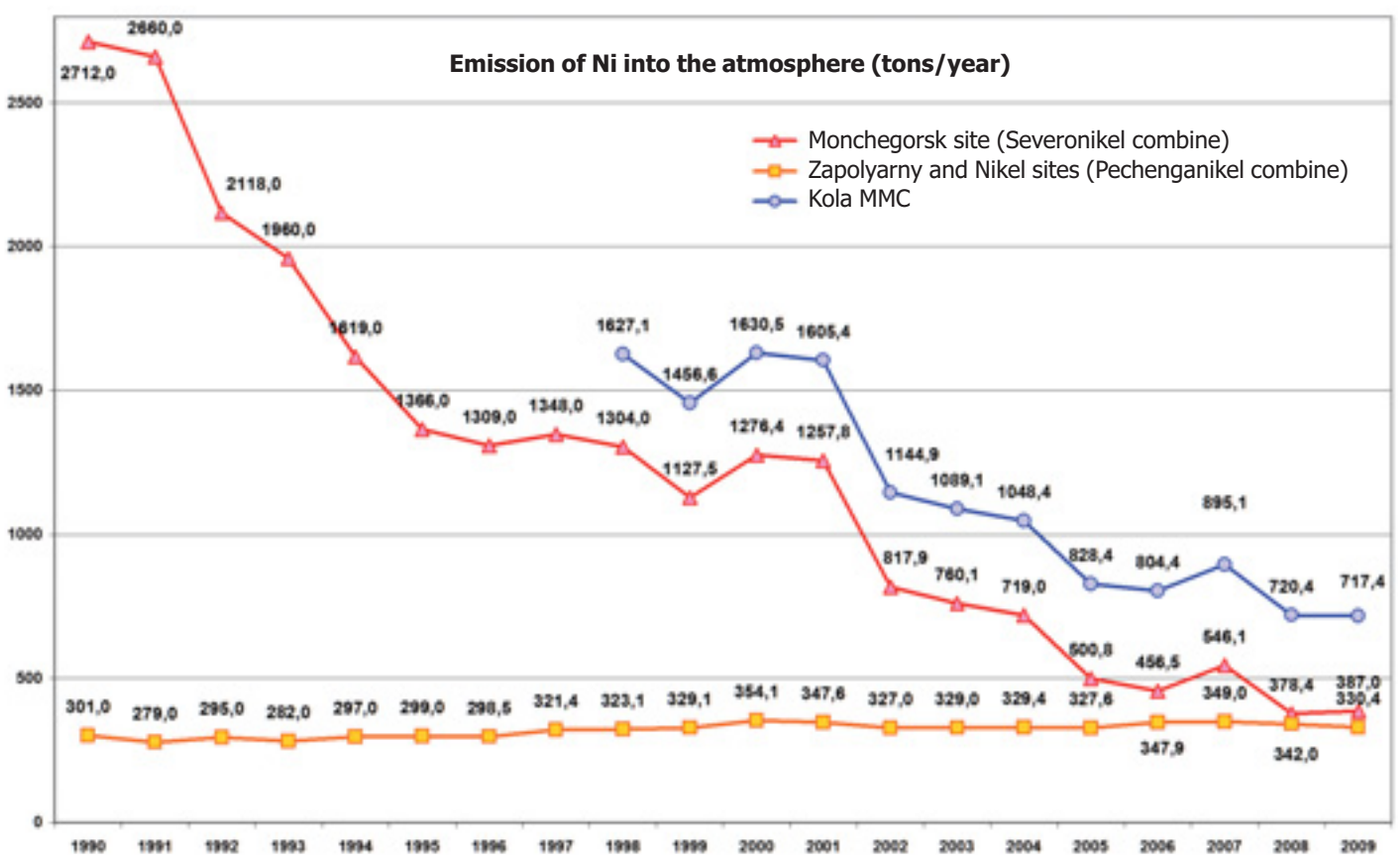


Commentary by Bellona

Emission of sulfur dioxide from the Pechenganikel industrial site in 2009 came to 102,670 tons, 5,000 tons more than in 2008.

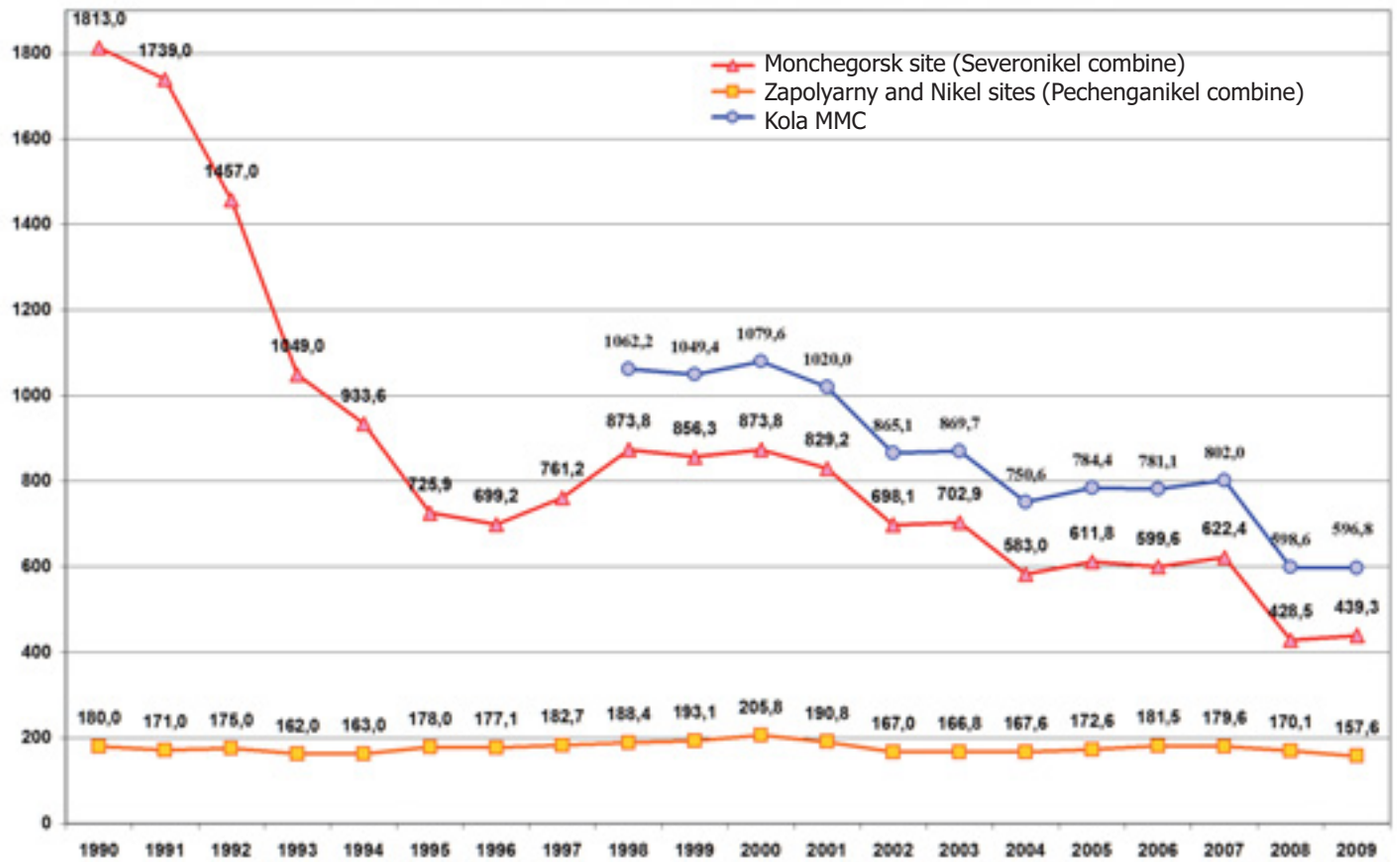
The Norwegian monitoring station in Nikel was closed by the Russian side on 31 August 2008, so data on MAC of sulfur dioxide are not accessible to the Norwegian side.





Increase of nickel emissions into the atmosphere from Pechenganikel industrial site compared with 1990: 330 tons against 301 tons in 1990.

Emission of Cu into the atmosphere (tons / year)



Reduction of emissions of heavy copper particles by Pechenganikel combines by 22.4 tons in comparison with 1990.

Commentary by Bellona

The conclusions made on the basis of studies conducted by the Norwegian Institute of Air Research that emissions of heavy metals by Pechenganikel combines are practically the same as they were in the 1990s are not at variance with official data from Kola MMC. Furthermore, the Norwegian side registers the increasing presence of particles of heavy metals in atmospheric precipitation (see Report page).

Representatives of Kola MMC do not admit the obvious negative impact of their plants on Norwegian territory. In monitoring materials, they present conclusions made by NII Atmosfera. Studies by NII Atmosfera were carried out by the order of Kola MMC.

Assessment of the impact of sources of Kola MMC atmospheric pollution on the environment of Norway

In March 2010, NII Atmosfera (an institute subordinate to the Ministry of natural resources and ecology of the Russian Federation), by order of Kola MMC, carried out experimental works to determine the level of atmospheric pollution in the region between industrial sites (Nikel and Zapolyarny) and the Russian-Norwegian border, using analysis equipment with all necessary meteorological certifications. The measurement data did not detect an excess of existing Russian norms for quality of atmospheric air. According to the data of NII Atmosfera, in the period from 15 to 30 March 2010, the concentration of sulfur

dioxide determined at measurement points by instruments was from 0 to 0.00513 mg/m3, which is significantly lower than Russian hygienic norms of quality of atmospheric air, which comes to 0.05 mg/m3 (average daily MAC) and the level determined as acceptable by the Norwegian side in general for the entire ecological community (fauna, flora), which comes to 0.04 mg/m3.

The device installed in the village of Rayakoski, which constantly recorded the average daily concentrations of sulfur dioxide over the course of 11 days (from 20 to 30 March 2010), recorded an average daily concentration of 0.004 to 0.007 mg/m3, and only on 28 March recorded an average daily concentration of 0.024 mg/m3 under unfavorable meteorological conditions, and the direction of emissions from the smelter plant in Nikel towards Rayakoski.

NII Atmosfera also carried out modeling of pollutants moving into and falling on to the territory of Norway, which were caused by emissions of Kola MMC. For calculations, the unified model EMEP was used, which has been officially recognized as an instrument of the UN EEC Convention on transboundary air pollution over large distances, of which Norway and Russia are members. These calculations found an excess of critical loads in just one cell of the analysis grid, which did not exceed the size of a territory of 50 by 50 kilometers around plants of Kola MMC. This zone of excess indeed covers an insignificant part of the territory of Norway, which can under no circumstances be interpreted as a case of the dominant negative impact of the Russian Federation on the environment of all of Norway. In accordance with the finding of NII Atmosfera, **in an assessment of the influence of Russian sources of atmospheric pollution on the environment of Norway, it is necessary to take into account that exceeding critical loads takes place as the consequence of the summary impact of all sources located in the transboundary regions of Russia and Norway and other EU countries, and not just emissions from Kola MMC.**

Commentary by Bellona

In other words, representatives of Kola MMC are trying to shift the responsibility for the negative impact on the eco-system of transboundary territories to neighboring countries.

Открытое акционерное общество
«НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ
ОХРАНЫ АТМОСФЕРНОГО ВОЗДУХА»
(ОАО «НИИ Атмосфера»)

УТВЕРЖДАЮ
Ген. директор
ОАО "НИИ Атмосфера"
канд. техн. наук
_____А.Ю. Недре
«___» _____2010 г.

ОТЧЕТ

по договору № 23/9-10 от 10.03.2010 г.

на оказание услуг по теме:

«Проведение экспериментальных и расчетных оценок влияния выбросов диоксида серы от источников ОАО «Кольская ГМК» на территорию Норвегии»

(модельная часть)

Ответственный исполнитель:
нач. отдела
_____И.А. Морозова
«_____» _____2010 г.

Санкт-Петербург
2010

Open joint-stock society
SCIENTIFIC AND RESEARCH INSTITUTE
OF PROTECTION OF ATMOSPHERIC AIR
(OAO NII Atmosfera)

APPROVED BY

Gen. director
OAO NII Atmosfera
PhD

_____A.Yu. Nedre

«_____» _____2010

REPORT
on agreement № 23/9-10 of 10.03.2010

for services provided on the topic

"Carrying out experimental and calculation assessments of the influence of emissions of sulfur dioxide from sources of Kola MMC on the territory of Norway"
(model section)

Executive agent:
Head of department

_____N.A. Morozova

«_____» _____2010

St. Petersburg
2010

PS.

Bellona Oslo sent several official requests to the management of Kola MMC to be given the data of studies carried out by NII Atmosfera.

After not receiving a reply, Bellona St. Petersburg sent an official request on the basis of article 29 of the Russian Constitution, articles 3 and 8 of the Russian Federal Law "On information, information technologies and protection of information", and also articles 38, 39 and 40 of the Law of the Russian Federation "On the media".

The reply from Kola MMC received within the indicated period, with a reference to Russian legislation, states that the information constitutes a commercial secret, and that the company itself has the right to determine access to disclosure of this information.

Expansion of the mining complex and the future of transboundary territories

Norilsk Nickel is not only increasing its profit, but also plans expansion into the central part of Russia, the Voronezh Oblast, where the two latest major copper and oil fields are located.

If Norilsk Nickel wins the tender for development of the fields in the Voronezh Oblast, it may report on the production of the first ton of ore by 2018. It is proposed to process the copper and nickel oil at the industrial sites of the Kola mining and metallurgical company, an affiliated enterprise of Norilsk Nickel MMC. It is planned to supply pellets for smelting to the smelting shop of Pechenganikel, which is located near the Russian-Norwegian border.

Data on the percentage of sulfur contained in the ore of these fields is not in public access. If the percentage content of sulfur in this ore is identical to the content of sulfur in the cooper and nickel ore on the Kola peninsula, and if the status quo is preserved at industrial sites, the emission of sulfur dioxide from industrial sites of Pechenganikel will increase.

№ 34930-69 of 26.01.2011
to № 006 of 18.01.2011

Editor-in-chief
Bellona.ru
N.I. Rybakov

Suvorovsky pr. 59, lit. A
St. Petersburg, 19015

Dear Nikolai Igorevich,

In response to № 006, I may inform you:

Current regulatory control (the Civil code of the Russian Federation, the Federal Law of the Russian Federation of 27.07.2006 № 149-FZ "On information, information technologies and protection of information") does not unconditionally oblige the holder of information received as part of a civil transaction to impart this information to third parties. Only bodies of power may oblige a holder of according information to impart it, in cases stipulated by law, and if there is a reasonable necessity to do so.

Information on the nature and results of according studies and works carried out in the interests of Kola MMC constitutes a commercial secret, and accordingly, the company has the right to determine the procedure and conditions of access to it independently (the Federal Law of the Russian Federation of 27.07.2006 № 149-FZ "On information, information technologies and protection of information", and the Law of the Russian Federation of 27.12.1991 № 2124-1 "On the media").

Furthermore, the indicated regulatory documents determine the possibility of receiving according information (the form of imparting the information is determined by its holder), and not the specific document (in this case, a copy of the report "Conducting of experimental and calculated assessments of the influence of emissions…" prepared by NII Atmosfera as part of the agreement of 10.03.2010 № 23/9-10 is not subject to unconditional implementation).

I should bring to your attention the fact that the information contained in the report was reported to interested persons at a conference held by Bellona in Murmansk on 14.12.2010, at a coordination council of heads of municipal bodies of the Pechenga region held on 20.01.2011 in the town of Nikel, and was also published on the Kola MMC website (http:/ www.Kolagmk.ru/ecology/monitoring).

Yours faithfully,
General director **S.V. Selyandin**

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