International POPs Elimination Project

Fostering Active and Efficient Civil Society Participation in Preparation for Implementation of the Stockholm Convention

Petrochemical enterprise complex in Novopolotsk

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About the International POPs Elimination Project

On May 1, 2004, the International POPs Elimination Network (IPEN http://www.ipen.org) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;

- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;

- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see http://www.ipen.org

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This report is available in the following languages: English language, Russian language

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Introduction

An inventory of dioxins and furan sources has not yet been made in Belarus, but according to data from National Academy of Sciences of Belarus and environmental NGOs, the chemical industry is among the major sources of dioxins, furans and other unwanted persistent organic pollutants (POPs).
Industrial processes within the chemical industry are undoubtedly one of the main sources of PCDDs, PCDFs and Hexachlorobenzene in Belarus.

The amount of dioxin released by industrial processes has not been estimated and PCDD/Fs and HCB and other POPs are not even included into the system of national monitoring due to the lack of technical and financial resources.

Dioxins are the unintended by-products of many chemical and combustion processes involving chlorine. They are emitted into the environment via industrial air emissions, wastewater discharges, disposal activities, and burning materials and products containing chlorine.

Petroleum manufacturing (oil and gas refining) uses and mobilizes chlorine in multifaceted process systems that combine it with petrochemicals, catalysts and heat. Of the industries known to generate dioxin, oil and gas refining is the largest, by mass of material produced, in the world. All refinery processes (reforming, cracking and oil-fired boilers/furnaces) have tested positive for dioxin and the evidence suggests the production of dioxin-like PCBs by the industry.
Dioxins form when carbon deposits are burned off platinum and rhenium used in reforming in order to allow reuse of these expensive metal catalysts, a process called "regeneration." The reforming process is used by refineries to rearrange the structure of partially processed petroleum molecules to make high-value fuels. Chlorinated solvents are added. We can therefore assume that this process can generate significant amounts of dioxins.

The polymers producing industry is also a presumptive source of dioxins because of the presence of chlorine in the process.

This report provides data available on the interrelation between chemical industry and presumptive dioxin sources.

Novopolotsk city is the location of two main enterprises of the Belarusian chemical industry. According to the official statistic, Novopolotsk is the second most polluted city in Belarus after Minsk, which has the unenviable distinction of having the most polluted atmosphere in the country.

A worrying factor in the Minsk pollution situation is (as already mentioned) the amount of dioxin released has not been estimated and the refinery industry is likely to be a major source of dioxins in Belarus.

Physical description of site

Type of site: petrochemical enterprise complex. The refinery and chemical complex of Naftan and Polymir cover an area of more than 1700 hectares and is situated 10 kilometers from Novopolotsk city, Vitebsk region, in the Northern-Western part of Belarus. Its geographical locationis: 55 ^{o} 32 N, 28 ^{o} 39 E.

The surrounding landscape is typical of the Northern part of Belarus. It’s a medium-continental woodland countryside which could be described as a “lake-glacial landscape” with coniferous, fir, and birch woods. The soil is mainly sod-podzol, waterlogged in places with scattered areas of common sands.

The Refinery and Chemical complex of Naftan and Polymir is situated on the river Western Dvina. The pluvial water outlets from the territory of the “Naftan” enterprise go into the river Uszacza which flows into the river Western Dvina.

History of site

In 1958 the foundations were laid for the building of a new town, Novopolotsk, whose population grew quickly with the construction of the two largest Refinery and Chemical complexes in Europe. According to official statistic Novopolotsk is considered as one of the most polluted cities in the Republic of Belarus.

Production association Polymir

At present JSC "Polymir" is one of the largest chemical plants of the Belarus state concern, "Belneftechim".
A complex consisting of 5 plants with 30 main and auxiliary plants covering 800 hectares, the site employs 6.000 specialists. The base of the enterprise technology is hydrocarbon feed cracking of the petrol and light hydrocarbons of the refineries and gas plants. The technology includes multi-staged processing of pyrolysis hydrocarbon cuts and making final products.

Annual foreign trade turnover is about 200 million USD.

"Polymir" began its operations in 1968. The main raw material is naphtha or light hydrocarbons of the gas and oil processing plants. Polymir produce annually the following products: more than 100.000 t of low density polyethylene and composition on its basis, 70.000 t of acrylic fibers, 100.000 t of monomers (acrylonitrile, acetone cyanohydrin, methylacrylate, acetonitrile), 20.000 t of small-scale chemistry (polyethylene waxes, emulsions, pigment superconcentrates, Lans-polymer-polyoil, Vodamin-115-polyamide resin, lfhangas coorosion inhibitor and others).

Polymir list of products

Low density polyethylene: basic grades and compositions on its basic.

Acrylic fiber: Nitron -C, Nitron -D, Nitron -M.

Products of organic synthesis: acrylonitrile, acetonitrile, acetone cyanohydrin and methyl-acrylate.

Small-scale chemistry: polyethylene waxes, emulsions, pipes, pigment superconcentrates, ammonium sulphate, sorbent – carrier, concentrate of lubricating – cooling liquid, silicasol, lans polyester resin, vodamin polyamide resin, ifhangas corrosion inhibitor, sorbitan C, sorbital C-20.

Hydrocarbon fractions: hydrostabilized pyro-condensate, fraction C9, fraction C4, propane fraction, heavy pyrolisis resin.

Consumer goods: film, covers, knitted goods, yarn.

Production association "NAFTAN"

The Refining JSC Naftan was built upon in 1968. The potential crude oil refinery capacity of Naftan Refinery accounts for 12-15 millions tons a year. In 2002 the unitary enterprise was reorganized as join-stock Company. Major company products are:

- Fuels: high duty gasoline and environmentally-friendly, diesel fuel, jet fuel, residual oil, kerosene.
- Lube oils and additives to lube oils: motor, transmission, hydraulic, compressor, industrial oils.
- Aromatics: benzene, toluene, paraxylene, orthoxylene, pseudocumene.
- As well as: solvents, sulfuric acid, bitumens and other products – in all more than 70 denominations.

Chemical characterization

As already mentioned according to official statistic Novopolotsk is considered as one of the most polluted cities in the Republic of Belarus. It is estimated the quantity of pollutants per citizen in 2001 from stationary sources averaged 499 kilograms.

The chemical compounds found in the atmosphere according to the official statistics include: carbolic acid, ammonia, benzapilene, carbon dioxide, formaldehyde, sulfur dioxide, toluol, acetone, benzol, methyl acrylate, acrylonitrile, hydrogen cyanide, hydrogen sulphide, nitrogen dioxide and others.

The following chemical compounds present in the water (according to the official statistics) include: ammonia nitrogen, nitrite nitrogen, nitrate nitrogen, phosphates, iron, copper, zinc, nickel, manganese, oil products, tamol, phenol, molybdenum, chromium, cyanides, thiocyanates, ammonia, silicic acid and others.

In accordance with the official statistics the quantity the amounts of the chemical agents exposed in the water stays within the legal limits.

Results obtained of the monitoring conducted by one NGO provide evidence that the water quality of the river Western Dvina does not come up to the requested standards for the water bodies of cultural, welfare, and fish industry purposes. The concentration of oil products in the river Western Dvina exceeded maximum permissible concentration (MPC) for the water bodies of cultural, welfare, and fish industry purposes (mg/liter). Ammonia nitrogen content in the river Western Dvina also exceeds the maximum permissible concentration (MPC) for the water bodies of cultural, welfare, and fish industry purposes before and after the manufacturing water diversion point.
This is evidence of pollution of the river caused by manufacturing water and sewage diversion plus other factors.

Effluent discharge from "Naftan" and "Polimir" and other enterprises into the river Western Dvina in the area of the Novopolotsk city is a source of high concentration of pollutants, in particular the

concentration of ammonia nitrogen, oil production, nitrates, quantity of suspended substances and common mineralization. The qualitative analysis of water from the river Uszacza revealed a number of organic pollutants, including some standardized by national legislation such as phenol and its compounds, benzaldehyde, amines, sylphonols (polyphenols), piperedine, benzoic acid, derivative substances of benzol) as well as some not standardized such as polyaromatic hydrocarbons, nitriles, biphenyl, diisoctyladipate).

The concern “Naftan” is a large-scale petroleum refinery enterprise. Types and concentration of pollutants in sewage from such enterprises depends on the quality of oil, the quality of oil processing, technique in catalyst operation etc. in compliance with reference data on oil products, phenols, ammonia nitrogen, tamol chlorides, toluol, trisodium phosphate and others. Types and concentration of pollutants in sewage from enterprises producing plastic is determined by the engineering process and quality of the initial store, raw materials and treating chemicals. On the production of ethylene some aromatic hydrocarbons, polypropylene, isopropyl alcohol, aluminum, titanium, chlorides, sulphates (and others) are found.

Unfortunately there is no data available on the effluent discharges of JSC "Polymir".

The production process of polyvinyl chloride (PVC), and the associated production of chlorine, ethylene dichloride and vinyl chloride monomer – from chlorine to finished product – is known to produce highly dioxin-enriched wastes, while PVC products are among the world’s largest single causes of dioxin formation.

There have been many examples of highly dioxin-contaminated wastes from EDC/VCM/PVC plants. For example, in 1995 the European Vinyls Corporation Wilhelmshaven plant in Germany found huge levels of dioxins (up to 700,000 ng ITEQ m-3) in dioxin analyses of sludge samples from the waste treatment plant.

PVC involves the formation and release of dioxins during its production and manufacture, use and ultimate disposal. Industry sources have described dioxin formation as unavoidable during the process of PVC manufacture. Dioxins have been found in the major PVC precursor, ethylene dichloride (EDC) and are found in EDC/vinyl chloride monomer (VCM) production wastes at very high levels. EDC is the principle building block for the most environmental damaging of all plastics, Polyvinyl Chloride (PVC), and is arguably the most polluting stage of PVC manufacturing process/ EDC specifically is a large source of persistent organic pollutant (POPs), including hexachlorobenzene (HCB) and the ultra toxic dioxins and furans. POPs pollution from EDC manufacture is well documented globally. Industry admits that dioxin and HCB production is intrinsic to the manufacture of EDC.

Solvents account for approximately 10% of all chlorine production, and are a correspondingly significant source of dioxins. Dioxins occur in the manufacture, use and disposal of chlorinated solvents. PCDD/Fs have been identified in the manufacture of trichloroethylene, tetrachloroethylene and 1,2-dichloroethane in concentrations of up to 50ppt (sum PCDD/Fs). Hexachlorobenzene has been identified in carbon tetrachloride, trichloroethylene and tetrachloroethane (Rossberg 1986). Heindl et al. (1987) reported such results indicated that the synthesis of short-chain chlorinated hydrocarbons can lead to PCDD/F formation. The uses of chlorinated solvents in metal finishing synthesis/extraction with chlorinated solvents and dry cleaning produces dioxins (Drechler 1992). Dioxin concentrations of 140ppt have been identified in the distillation sludge from the use of perchloroethylene in dry cleaning (Lexen 1992).

Dioxin formation is particularly significant in the oxychlorination process, in which ethylene is combined with hydrochloric acid and oxygen in the presence of a copper catalyst to produce EDC. Dioxins produced in this process follow one of three paths: the majority remains with the EDC product, and smaller amounts are distributed to the wastewater and off gases from the process. Dioxins contained in the latter two fractions enter pollution control devices and are then released to the environment via air emissions, wastewater discharges, ash residues, and treatment sludges. The EDC product fraction is then purified, and much of the dioxin is partitioned into the "heavy ends," wastes that are non- or semi-volatile.

The quantities of dioxin formed in EDC/VCM wastes appear to be very large. Laboratory simulations at the University of Amsterdam demonstrated dioxin formation during oxychlorination at a rate equivalent to 419 grams of dioxin (TEQ) per 100,000 tons of EDC produced (4.2ng/g EDC). A 1994 analysis data of a fully modernized EDC/VCM plant in Germany found dioxins in process sludges at concentrations as high as 414 ppb, refuting the claim that only outdated EDC/VCM technologies produce dioxin. The analysis made by ICI Chemicals and Polymers at its vinyl chloride monomer production plant in Runcorn, UK, found that more than 27g TEQ of dioxins are

produced in solid and liquid wastes each year (per 200,000 tons).

As an example: 75% of U.S. refineries use processes which can generate dioxins. The search of discharger self monitoring reports submitted under the Clean Water Act found dioxin discharges into San Francisco Bay from the Unocal, Tosco, and Chevron refineries. A dioxin compound was detected in their effluents at least 50 times over the six years (1990 – 1996). A Canadian study also found dioxin in refinery air emissions.

We can suppose one of the most probable root causes of refinery dioxin. Dioxins form when carbon deposits are burned off platinum and rhenium used in reforming in order to allow reuse of these expensive metal catalysts, a process called "regeneration." The reforming process is used by about three-quarters of refineries all around the world to rearrange the structure of partially processed petroleum molecules to make high-value fuels. Chlorinated solvents are usually added.

Besides that process units associated with coking, cracking, and refinery heat and energy production operate at temperatures that can form dioxins. The presence of chlorine compounds that are added to these processes or slip through desalting, and metallic catalysts that may aid dioxin formation, only increase the likelihood of these emissions.

Environmental, Socioeconomic, and Health Consequences

Unfortunately, there has been no research on the health consequences of living with a large chemical complex on the community of Novopolotsk city. But according to the statistics of the Ministry of Health the amount of the chronic diseases of the respiratory tract is rising steeply. The total amount of the oncological diseases is higher than average in the Republic, but there are no current investigations on correlations between the amounts of pollutants released by the chemical enterprises and the state of the public health.

It’s very difficult to estimate the effect of this hot spot on the community and economy.

It should also be noted that the majority of the population of the Novopolotsk city are aware of the insecurity of the chemical complexes. The city of Novopolotsk was founded specifically to provide the infrastructure and manpower needed for the complex and enterprises nearby the Polotsk city. For a long time the enterprises have been the main employers in the city. Polymir employs more than 6.000 specialists with a smaller amount being employed on Naftan.

The average salary on these enterprises exceeds the national average for Belarus and consequently people do not want to lose their jobs or move from the city.

The population of Novopolotsk city is 101.3 thousand; Polotsk city's population is 89.1 thousands; and the (approx) number of the countryside population is 6.2 thousand.

Petrochemical and refinery complexes are a major part of the state concern of Belneftehim forming 25% of the industry, 30% of the export and currency proceeds of the Republic. It is also among the top tax payers – contributing something like 20% of all the taxes. So, Naftan and Polymir are among the most important enterprises for the national economy and it would have a massive impact on the country if they were to cease operations making its closure an unrealistic option in the near future.

No data on investigations of the occupational disease in the petrochemical and refinery industry is available. But it is proved that the highest incidence rate was registered for the following diseases: disease of the peripheral nervous system, cerebrovascular diseases (more than 10 times more), myocardial infarction (8,8 times), the disease of blood and circulatory system (4,4 times), malignant neoplasms (3,2 times). The death-rate has grown noticeably (2,2 times), but the official explanation is that the standard of living in Belarus has deteriorated and the drop in production and lowering of industrial emissions has not showed the positive trend in diseases reduction in the region.

Responsible party

Naftan JSC. The main stockholder is the state: 99,8 % belong to the state (foundation of the state property and the state concern BELNEFTEKHIM - 50 % +share) and 0,2 % belong to the employees.

JSC Polymir belongs to the state concern BELNEFTEKHIM.

Plans for cleanup

According to the press service of the JSC Naftan and Polymir they have plans for the reconstruction of the engineering process but there are no concrete data available to date.

The Ministry of the Environment and its institutions conduct a permanent monitoring of the state of the environment, including air, soil and water pollution.
The high concentration of the pollutants in the atmosphere and water are not officially considered to be associated with the activity of the refinery and petrochemical complexes. Official statistics show the presence of such unusual components as acrylonitrile and methylacrylate in the atmosphere, considered by many citizens to be evidence of releases from the petrochemical enterprise.

Recommendations of NGO

The use of chlorinated solvents to recondition certain catalysts means that chlorine is present in amounts which could form dioxin at many steps in the refining process. We believe that it is necessary to:

- Identify all the preventable uses of chlorine in dioxin-producing refinery and polymer producing processes since dioxin cannot be produced without chlorine. To carry out an independent monitoring in the area of Novopolotsk city with the object of confirmation of the presence of dioxins.

- Eliminate the chlorine source in every dioxin-producing reaction in the plants since oil can be refined without chlorine. Find alternatives which prevent the addition of chlorine and chlorinated compounds throughout the processing systems and related activities. For example, remove the carbon buildup from metal catalysts without burning chlorinated solvents and redesign or replace existing chlorine and chloride removal systems, since the original 'desalters' were designed before it was recognized that there is an urgent need to prevent the formation of dioxin from traces of chlorine.

- Take all necessary steps to include community members and plant workers giving them an equal voice in negotiations and decision-making on how quickly the oil company will eliminate dioxin and how it will retain jobs and improve worker health and safety while doing so.

- Ensure that the absolute need for a publicly verifiable dioxin elimination process is honoured. The presence or absence of dioxin and chlorine at a root source is verifiable and public information and verification is fundamental to community power, democracy, and the scientific process.

- In addition, we need to stop oil and gas manufacturers from contributing to other polluting practices when they can no longer sell ethylene to PVC manufacturers; petroleum coke to power plants, foundries and cement kilns; low grade diesel and motor oil that spreads dioxin pollution; etc. Policy should take a preventive, zero-dioxin approach in the petroleum life cycle, which would include its use as a fuel in polluting practices such as those listed above.

- To involve environmental NGOs and local community into the process of monitoring of the hot spot in the Novopolotsk.

- To disseminate the obtained results widely among the public and to inform them about the effects caused by the chemical industry releases on the whole and the releases of dioxins in particular.

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