POPs HOTSPOT INFOLIST:
Former copper plant, Rubik, Albania

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WHAT ARE PERSISTENT ORGANIC POLLUTANTS (POPs)?

Persistent organic pollutants (POPs) are highly toxic, organic comounds. They include pesticides used to protect plants from insects (aldrin, dieldrin, endrin, heptachlor, mirex, and toxaphene) and in control of vector-borne diseases (DDT) or to protect seeds (HCB); heat resistant compound used primarily in electrical equipment such as trnasformer (PCBs); and substances generated as a by-product of incomplete combustion and chemical processes (dioxin and furans). POPs can persist in the envrionment for decades. They are semi-volatile and can be circulated across country boundaries and globally. POPs resist breakdown in water and readily disolve and accumulate in fatty tissue (in lipids). In a process known as *bioconcentration*, animals can absorb concentration of POPs at levels many times higher than those found in the environment. POPs can *bioaccumulate* exponentially up the food chain, reaching the greatest magnitudes in predatory birds, mammals and humans.

This infolist is focused on a former copper plant in Rubik in Albania - as a potential source of dioxins contamination. Copper is considered to be the most potent catalyst for dioxin formation providing surface upon which dioxins can form. This was also approve in case of copper slag “Kiselrot” (Germany), where high concentrations of PCDD/F was found.

COPPER PLANT IN RUBIK

Rubik is a mining town in the mountainous Mirditë District, Lezhë County, northwest Albania, about 10 km east of the regional capital city of Lezhë and about 90km north of Albania’s capital Tirana. Rubik is located on the River Fani, approximately 10 north of it’s confluence with the River Matit which provides drinking water to local inhabitants. About 2500 people live in Rubik. The mean temperature of the year is 13.70C, and the average precipitation is 1895 mm.

In the late 1930s the copper smelting plant producing refined copper products for wiring was built in Rubik. After more than 60 years of production the factory was closed in 1998. During its more productive years, it generated approximately 30,000 tons of mineral residues annually which have been deposited in surrounding area.

The annual production of industrial copper in Rubik (in 1000 t)								
Year	1992	1993	1994	1995	1996	1997	1998	1999
Copper blister	2,27	2,31	1,52	2,9	1,42	-	1,63	1,28

Source: Fida, Baraj (eds.) 2004. "Albania's Technology Needs Assesment." UNDP-GEF. http://unfccc.int/files/meetings/seminar/application/pdf/sem_albania_sup2.pdf

Source: www.strabag.com

Area of the factory

The area of the former copper plant lies on both banks of the River Fani in a narrow valley surrounded by high mountains and can be divided into three sub-areas:

- The old copper mine and residual stockpile on the western bank of the river (cca approximately 2ha).
- The copper smelting plant area on the western bank of the river (cca 6 ha).
- The "dump site" (or "disposal area") on the eastern side of the river (cca 4.4 ha).

Disposal area
Source: Documentation for "Tender for the envrionemntal clean-up and siposal of hazardous waste in selected "HOT SPOTS" in Albania. 2007. EU.

Geological, hydrological and technical conditions

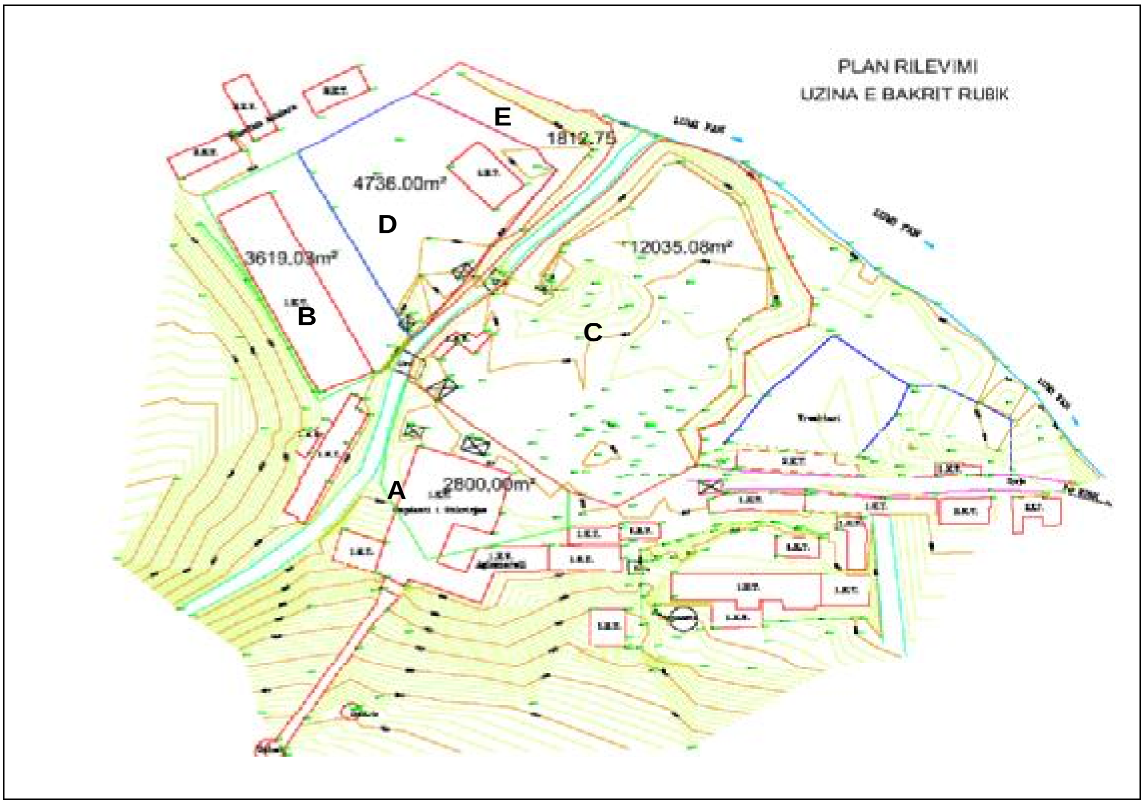
The main production units of the plant are partly built on the mountain slope and on a narrow plateau at an elevation of approximately 5m above the normal river level. The area is traversed by a small stream. The area between the copper production units and the river is filled out to the same elevation as the production units. The filling masses north of the small stream are defined as 'inert' and those to the south as slag. Slag and other wastes are deposited on more or less continuous thin alluvium overlying igneous and metamorphic rock. Up to 7m of processing wastes overly varied sands and gravels down to 10m.

The dump site on the eastern side of the river is a 4.4 ha area constructed on the river bed only slightly elevated above the normal river level. It was built without previous preparation of the soil or a protective lining underneath and there is also no drainage system to capture leachates. The dumpsite is surrounded by a gravel dam of approximately 4m in height and on the eastern side a 10m high railway bank. The dam seems to be in good condition. However it is strengthened with concrete on the outside to protect it from erosion during flood periods and part of this present concrete is in bad condition due to poor concrete quality. The dump site has no lower layer protection and some 10 000m3 of slag are deposited here. The alluvium layer beneath wastes reaches the thickness of 6 to over 13m. Under this layer, there is hard peridotite bedrock at increasing depth away from the banks of the river.

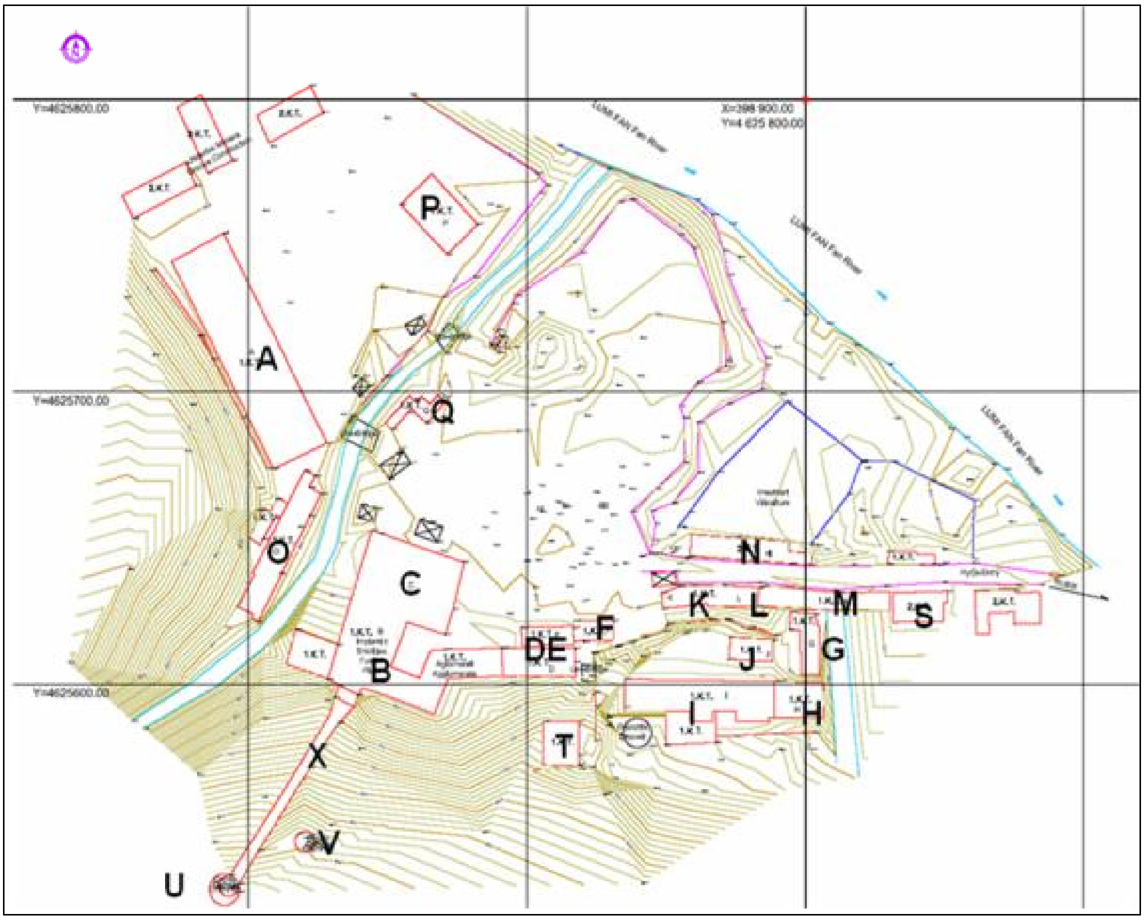
Copper Slag

In both areas, the alluvium strata form a significant aquifer on account of the large grain size and correspondingly high hydraulic conductivity. Combined with the fact that local groundwaters flow into the river predominantly through the alluvium where present, or through the slag, this suggests that any groundwater contamination would travel rapidly downstream within the aquifer, or directly into the river. In the process area, groundwater is collected by an in-built drainage system and discharged by pipe work directly into the river. In the confined disposal facility area, groundwater depths vary from 3m to 0.5m. The alluvium forms an intermediate storage medium for surface water drainage into the river, in the same way as the slag across the process area. The construction of the confined disposal facility need not influence flow through the alluvium, provided surface water inflow from the valley side is not impeded.

Since the area of the plant has been unkept for about 10 years, also the cohesion of slopes is endangered by erosion by vegetation.



Processing area
Documentation for "Tender for the envrionemntal clean-up and siposal of hazardous waste in selected "hot spots" in Albania. 2007. EU



Buildings in the site

Documentation for "Tender for the envrionemntal clean-up and siposal of hazardous waste in selected "HOT SPOTS" in Albania. 2007. EU

CONTAMINATION

During the productive years of the plant, byproducts from the processing of copper ore were discharged into the river (which turned green due to copper sulphate). Also sulfuric acid mist and dioxides were released into the atmosphere. What had been a major source of air pollution and groundwater contamination is today a quiet facility. According to management, however, the impacts of the plant's earlier **SO2** emissions and **acidic wastewater** discharges are still reflected in the environment surrounding the former copper plant.

In total, some 13 000m2 of the processing area of the plant were found to be contaminated with copper compounds with leachability above EC Decision 1003/33/EC acceptance criteria for materials deposited in a landfill for hazardous waste. At least 100.000 m^3 of hazardous waste material/slag are deposited in the processing area.

UNEP soil sampling in September 2000 found that disposed slag contains significant amount of **copper** (1,696mg/kg), **chromium** (492 mg/kg) and **lead** (99 mg/kg). Heavy metals have been washed out from the slag to groundwater by acid rainwater occurring when sulphuric dioxide is emitted by ore factories. Because of this fact, the water in the area of the plant contains significant amount of **copper** (22,4 mg/l), **chromium** (0,04 mg/l) and **cadmium** (0,012 mg/l)

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Soil sample of mine slag (UNEP sampling, 22th September 2000)

Heavy metals	As	Sb	Cr	Cu	Pb	Cd
mg/kg	<10	<10	492	1,696	99	<10

Water sample of acidic extract from slag – water with sulphuric acid pH=3 (UNEP sampling, 22th September 2000)						
Heavy metals	As	Sb	Cr	Cu	Pb	Cd
mg/kg	<0,02	<0,02	0,04	22,46	<0,02	0,012

Given the lack of drainage system together with geological and hydrological characteristics of the plant area, contaminated groundwater can travel rapidly downstream within the aquifer, or directly into the river. However, there is no evidence of contamination of river water arising from the process area.

Although test haven't been done yet, given the fact, that copper ore melting and metal-related industries with high temperature processes are considered to be significant sources of dioxin pollution, the area of the factory may be also contaminated by dioxins.

HEALTH AND ENVIRONMENT HAZARD

Elements and compounds that were found or are assumed to be present in the soil and water in the processing area of Rubik copper plant in significant amounts (Cu, Pb, Cr, Cd, dioxins) can pose certain dangers to the environment and human health. Let's focus on them.

Copper

Copper is a metal chemical element with the symbol Cu. It naturally occurs in rock, soil, water, sediment and air. Most usual are compounds such as sulfides, carbonates, and the oxide. It is an essential element for human heath, but high intake of copper can be dangerous to human body be it through alimentary tract, skin or other ways.

Drinking water containing with high level of copper can cause problems such as nausea, diarrhoea, epigastric pain and discomfort or stomach cramps with their seriousness depending on the level of copper in the water and the length of exposure. Children under one year of age and people with liver damage or Wilson's disease are more sensitive to copper. The maximum level for copper in drinking water set by the Environmental Protection Agency (EPA) is 1.3 mg/l.
Chronic exposure to copper dust can irritate the nose, mouth, and eyes and cause headaches, dizziness, nausea, and diarrhoea.

Also copper is considered to be the most potent catalyst for dioxin formation providing surface upon which dioxins can form.

Lead

Lead is a heavy metal chemical element with the symbol Pb usually occurring in ore with zinc, silver and copper. It has characteristics of a cumulative poison which means that it stays in the body for a very long time and can build up from many years of exposure to low levels. Exposure to lead can be toxic to humans and wildlife.

Lead and its compounds can be absorbed to human body through ingestion or inhalation. High intake of lead can cause abdominal cramps, learning disabilities, attention deficit disorder, constipation, anemia, tiredness, nerve damage, vomiting, convulsions, anorexia, or brain damage. Even with mildly elevated blood lead levels can be connected with toxic effects to the brain, blood cells, kidneys or to the central nervous system and may lead to long-term neurobehavioral and cognitive deficits. Children are more sensitive to lead exposure than adults because lead is more easily absorbed into growing bodies (they can absorb up to half of the amount of lead ingested), and organisms of small children are more sensitive to the damaging effects of lead. Children poisoned by lead can suffer from learning disabilities, delays in mental development, mental retardation, speech handicaps etc. High blood lead levels can cause convulsions, coma and death. Lead poisoning has several symptoms such as headache, abdominal pain, vomiting, irritability, anemia or weight loss.

Wildlife and waterfowl are also frequently poisoned through the ingestion of lead and lead shot.

Cadmium

Cadmium is a heavy metal chemical element with the symbol Cd and its occurrence and production are mainly connected with zinc and copper mining, refining and smelting. Cadmium and its compounds are toxic and can be absorbed to human body through ingestion and inhalation. It is a cumulative poison which means that it stays in the body for a very long time and can build up from many years of exposure to low levels.

Chronic exposure to cadmium dust or fume in the air can irreversibly damage the lungs leading to shortness of breath and emphysema. Exposure to high levels of cadmium can cause lungs damage or death. The Enviroment Protection Agency set a limit of 0,005mg cadmium per 1 litre water. High levels of cadmium in food or drinking water can irritate the stomach, cause vomiting and diarrhoea. Due to its cumulative character, cadmium mainly accumulates in the kidneys and liver and can lead to serious kidney failure, nephrotoxicity, renal stone formation, bone disease and persistent proteinuria at high exposures. Acute cadmium exposure may cause liver injury, convulsions, muscle cramps, shock, renal failure or sensory disturbances. Long term exposure to cadmium can lead to high blood pressure, liver disease, iron-poor blood, lung, intestinal nerve or brain damage or fragile bones. It also causes abnormalities in calcium, phosporus and vitamin D metabolism. Cadmium metal and some of its compounds are listed as carcinogens by The International Agency for Research on Cancer.

Chromium

Chromium is a naturally occurring metal chemical element with the sign Cr. It can be found in rocks, animals, soil, volcanic dust and gases in different forms, most commonly as trivalent chromium (Cr III) and hexavalent chromium (Cr VI). It can be absorbed to human body by ingestion, inhalation or dermal absorption.

Trivalent compounds (Cr III) are important components of healthy human and animal diet and they do not cause any serious damage to organism. However, hexavalent compounds are highly toxic carcinogens causing death if ingested in large doses. Inhalation of high levels of hexavalent chromium compounds can cause runny nose, nosebleeds, ulcers and holes in the nasal septum. Ingesting large amounts of these compounds can cause stomach upsets and ulcers, convulsions, kidney and liver damage or death. Dermal absorption with some of these compounds can cause skin ulcers.

Dioxins

Since, as it was said, copper is the most potent catalyst for dioxin formation and since copper ore melting is one of the sources of dioxin pollution, we can assume that Rubik area (especially copper slag) may be contaminated with dioxins as well. This case is also known from Germany, where high concentration of PCDD/F where found in “Kieselrot” - slag residue from the Marsberg copper ore smelting process. The same slag was used to a considerable extent in the 1950´and 1960´as a covering material for sportgrounds and playgroudns, and also in road and path construction.This might also be the case of Rubik copper plant and its surrounding. (needs to be confirmed)

Dioxins (Polychlorinated dibenzodioxins, PCDDs) can be described as chemicals that are highly toxic and highly persistent in the environment. Due to their ability of bioaccumulation, dioxins climb up the food chain and are absorbed by human body mainly through diet. Even low exposure to dioxins can be dangerous. The problems connected with dioxin exposure contain cancer, birth defects, inability to maintain pregnancy, decreased fertility, reduced sperm counts, endometriosis, diabetes, learning disabilities, immune system suppression, lung and skin problems etc. It has been proven that dioxins have similar effects on non-human animals as well

WHAT NEEDS TO BE DONE?

Risks resulting from some sixty years of activity of the copper plant require an action to be taken to prevent environmental and health damage.

Albanian NGOs proposed four steps that need to be taken with high priority in order to prevent the environment and health of the people of Rubik from being endangered by hazardous waste disposed in the area of the former copper plant:

- As a short-term means of preventing groundwater contamination, the residue has to be covered with lime or limestone.
- Potential risks to human health in the area have to be clarified. Private well water quality downstream of the factory has to be investigated.
- Monitoring wells between the factory and the river have to be established. River waters and private well water have to be monitored.
- Contamination potential has to be eliminated altogether. The residue has to be moved back into the mine.

Decontamination of the processing area of the plant has to include these steps:

- Abandoned buildings have to be demolished
- The area of the plant has to be cleaned-up, covered with top soil, cultivated and prevented from being flooded.
- Hazardous material must be prevented from emitting to the environment.
- All contaminated masses and materials have to be deposited in a disposal facility constructed as a landfill for hazardous waste according to EU directives.

It has been decided that the waste will be deposited in the existing dumpsite on the eastern side of the river. However, this site is not in condition that would provide safe disposal. First, the existing landfill has to be cleaned. Base, drainage and capping layers need to be constructed in accordance with the EU directive for landfills as well as an open concrete channel for the diversion of rainwater. Also the dam protecting the dumpsite from floods has to be repaired and extended according to EU standards. There is a water supply pipe still in use crossing the confined disposal facility area. To prevent contamination of the water and to allow future repairs, it needs to be reinstalled to lead along the railway bank. All area has to be protected against erosion by vegetation. Disposed masses with high leachability (about 10% of the total amount of contaminated masses and material) have to be stabilised by various treatment methods. After the construction of the landfill is finished and after the waste is disposed there, the security of the area will need to be monitored on a regular basis.

RESOURCES ON POPs

Websites:

A) Governments / IGOs / Institutions

1. Stockholm Convention website - http://www.pops.int/
2. The United Nations in Albania - http://www.un.org.al/
3. UNEP Chemicals website – http://www.unep.org/ http://www.unep.org/themes/chemicals/
4. UNDP – POPs - http://www.undp.org/gef/05/portfolio/chemicals.html#pops
5. International POPs Elimination Project – IPEP Website- www.ipen.org
6. UNDP / GEF – http://www.undp.org/gef/05/
7. GEF - Small Grants Programme - http://sgp.undp.org/
8. World Health Organisation - http://www.who.int/en/
9. Basel Convention website - http://www.basel.int/
10. EU (European Union) website – POPs - http://www.europa.eu.int/comm/environment/dioxin/index.htm
11. State of the Environment in Albania 1997-1998 - http://enrin.grida.no/htmls/albania/soe1998/eng/index.htm
12. European Environment and Health Committee - http://www.euro.who.int/eehc/implementation/20051108_1
13. World Bank POPs website - http://lnweb18.worldbank.org/ESSD/envext.nsf/50ParentDoc/PersistentOrganicPollutants?Opendocument
14. Meteorological Synthesizing Centre-East - http://www.msceast.org/about.html
15. U.S. Environmental Protection Agency - http://www.epa.gov/
16. Danish Environmental Protection Agency - http://www.mst.dk/homepage/
17. Food and Agriculture Organization of the United Nations - http://www.fao.org/
18. Protocol on Pollutant Release and Transfer Registers - http://www.unece.org/env/pp/prtr.htm
19. EUNECE (United Nations Economic Commission for Europe - http://www.unece.org/
20. European Environmental Agency - http://www.eea.eu.int/
21. OECD (Organisation for Economic Co-operation and Development) - http://www.oecd.org/
22. UNIDO – POPs - http://www.unido.org/doc/46478

B) NGOs / NGOs Networks

22. IPEN (International POPs Elimination Network) website - http://ipen.ecn.cz/
23. IPEP (International POPs Elimination Project) website - http://www.oztoxics.org/ipepweb/
24. Greenpeace website - http://www.greenpeace.org/international_en/
25. WWF website - http://www.panda.org/ http://www.panda.org/about_wwf/what_we_do/toxics/index.cfm
26. GAIA (Global Anti- Incinerator Alliance, Global Alliance for Incinerator Alternatives) - http://www.no-burn.org/
27. PAN (Pesticide Action Network International) website - http://www.pan-international.org/

Databases / Magazines:

a) toxicological databases – international
1. ATSDR (Agency for Toxic Substances and Disease Registry) - http://www.atsdr.cdc.gov/
2. INCHEM (Chemical Safety Information from Intergovernmental Organisations) - http://www.inchem.org/
3. Haz-Map Occupational Exposure to Hazardous Agents - http://hazmap.nlm.nih.gov/index.html

b) Magazines
Environmental Health Perspectives - http://ehp.niehs.nih.gov/