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# Arsenic Pollution over four north-east European countries influenced by anthropogenic activities

Howlader Rahidul Hassan

# Introduction

- Now-a-days, people exposed to different kinds of threats as the quality of our environmental is becoming worse over time. Soils are critical environments interfaced with air and water. Thus they are inevitably exposed to direct and indirect effects of anthropogenic activities.
- Mine tailing, ore processing and other human activities have continuously added to the pool of contaminants in the environment. Arsenic (As) is such a toxic element among those heavy metals which causes environmental pollution at higher concentration of it in soil, sediments, water and to some extent, in air.
- The present review summarizes the anthropogenic sources of As contamination of soil and water and outline the study areas, methodologies for measurements of concentration of As in soil and water and the status of As concentration & remediation ideas of As pollution in four north east European countries such as Finland, Sweden, Lithuania and Poland.

# Objective

Several investigations carried out in four North-East European countries such as Finland, Sweden, Lithuania & Poland and As pollutions have been discovered in the soil/sediments and waters of different parts of these countries.

The aim of the presentation is to outline anthropogenic sources of contamination and its influence over four aforesaid countries.

# Study areas

We divided the investigations areas into four north east countries of Europe such as

1. Finland : The Tampere region of southern Finland
2. Sweden : Adak mine site of Västerbotten district of northern Sweden.
3. Lithuania : Ražaitėliai and Šienlaukis of Raseiniai District.
4. Poland : Wiśniówka acid mine drainage (AMD) area, south-central Poland. Podwiśniówka and Wiśniówka Duża acid pit lakes.

# Type of samples & methods of measurements

| Country | Sample | Methods |
|---|---|---|
| Finland | Soil, bedrock wells, dug wells. | Portable X-ray fluorescence (XRF); Inductively coupled plasma atomic emission spectrometry (ICP-MS/AES). |
| Sweden | Groundwater samples, sediments around the Adak mine. | Varian Vista Pro Ax inductively coupled plasma-optical emission spectrometer (ICP-OES). |
| Lithuania | Wells water | Atomic absorption spectrometry |
| Poland | Water sources of Podwiśniówka and Wiśniówka Duża acid pit lakes | ICP-QMS; model ELAN DRC II, Perkin Elmer |

# Anthropogenic sources of contamination

1. **Finland -** Data on anthropogenic As sources were acquired in relation to chemicals (wood impregnates, pesticides), products (ammunition, fertilizers, fodder), and industrial activities such as mining and waste treatment sites. The most relevant arsenic sources in the Tampere region were determined to be wood preservative plants and old mine sites.

2. **Sweden -** weathering of mine tailings have resulted in high As concentrations in water and sediment samples around the Adak mine.

3. **Lithuania -** there is no evidence of Palaeozoic faults in the Raseiniai District area. Therefore, the natural origin of high arsenic concentration is doubtful. The increase of arsenic concentrations also can be related to the various industrial and agricultural pollutants: medicines, dyes, supplements, pesticides, insecticides, etc.

4. **Poland -** Tailing piles in the site of Wiśniówka mining area.

# Permissible limit of As in soil and drinking water

- Arsenic is found in the earth’s crust at an average level of 1.5 to 2 mg/kg. Most natural soils contain low levels of arsenic, but industrial wastes, mining activities and pesticide applications may increase concentrations.
- Permissible concentrations of As in soil ranges from 1 to 40 mg/kg.
- Arsenic levels in groundwater average about 1–2 µg/L, except in areas with volcanic rock and sulfide mineral deposits where arsenic levels can range up to 3400 µg/L.
- International guideline value for the As in drinking water is 10 µg/L .

# Status of As concentration in four aforesaid European countries

- **Finland** - The tailings area contains high concentrations of arsenic ranging from 1000 to 2200 mg/kg, resulting in runoff containing up to 250 mg/L of arsenic. Concentrations of arsenic in the contaminated soils at CCA (Chromated Copper Arsenate) plants which is used in wood treatment in the study area range from 3 up to12000 mg/kg.
- **Sweden** - Weathering of mine tailings have resulted in high As concentrations in water (up to 2900 μg/L) and sediment (up to 900 mg/kg) samples around the Adak mine.
- **Lithuania** - Median concentrations are 28.5 μg/L and 39 μg/L in groundwater of Ražaitėliai and Šienlaukis, respectively in Raseiniai district.
- **Poland** - As concentrations are 7.02–22.2 mg/L and 0.006–0.040 mg/L in Podwiśniówka acid pit lake and Wiśniówka Duża acid pit lake, respectively.

# Remediation

- **Finland -** In the Tampere region, the population centers are focused in the arsenic-rich areas and even in the vicinity of the old mine sites, posing a risk to human health. The expansion of residential areas to old mine sites or former wood impregnation sites, for example, may result in significant additional risks to human health. It is also necessary to ensure that in the future, the contamination at former mine sites will not extend to potential new residential areas. According to the risk assessment carried out within RAMAS, the main human health risks in the study region are from arsenic in drinking water, particularly that originating from drilled wells. These risks have been restricted, subsidized by government, for instance, by expanding the water supply network.

# Remediation (cont..)

- **Sweden -** Weathering of mine tailings result in AMD (acid mine drainage) and trace element contamination in Adak. Water, sediment, and soil samples indicate high concentrations of several toxic elements. From the viewpoint of environmental risks, old mine sites are particularly relevant owing to their large spatial scale. It is recommended to particularly restrict human activities in the tailings areas of mine sites in order to eliminate the distribution of arsenic to the environment via air and surface run off.

# Remediation ( cont..)

- **Poland -** The best option of AMD water remediation in the Wiśniówka mining area is a pollution source control. This can be achieved by isolation and revegetation of tailings piles to prevent oxidation, whereas in an emergency the action should include neutralization of strongly acidic pools and seeps with powdered high-grade limestone and subsequent sealing of metal(loid)-loaded ferric co-precipitates. In some cases small nearby wetlands, brushwood or other wasteland plots may be effectively used for remediation of acid waters.
- **Lithuania** – In case of Lithuania, the source of pollution is related to the various industrial and agricultural pollutants such as medicines, dyes, supplements, pesticides, insecticides that subsequently moves into the groundwater though the soil. In such areas, it is important to consider potential risks to groundwater quality. Household methods of water purification , rain water harvesting could be an effective way of remediation.

# Suggestions & recommendations

- Usage of pesticides and fertilizer for agricultural purpose should be carefully handled.
- Finding the alternative source of drinking water.
- Keeping As containing chemicals and waste safe from rain.
- Conducting household hazardous wastes collections and disposals.
- Managing the human activities near to mine sites to minimize the risk.

# Conclusions

- Arsenic poisoning is an alarming problem on a global scale. In this review based on the information of As contamination in soil and water in four north east countries of Europe, suggests that most of the sources of pollution are anthropogenic which work as a catalyst in the mobilization of arsenic, for example due to mining activities As concentration gone up to 2900 μg/L ( in water) and up to 900 mg/kg ( in sediment) in Sweden.
- The implementation of mitigation options can be facilitated by setting proper guidelines and to control implementation at appropriate intervals.
- The government and local authorities must pay special attention to limit the human activities that leads to As pollution in soil and water. The social awareness of the population is equally important in maintaining and choosing ways to get rid of As pollution.