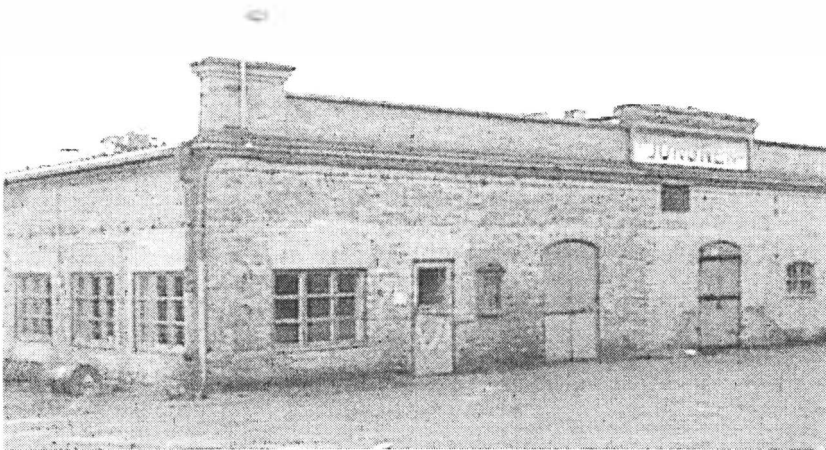


**REMEDIACTIONOFF A FORMER
NICKEL-CADMIUM
BATTERY-FACTORY AT
JUNGNERHOLMARN**

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Introduction

This is a short introduction to “Jungnerholmsprojektet”, starting with the foundation of the Jungner Company, the clean up after the battery produktion , regain valuable nature back to the community and ending with plans for future development of the area.

I hope you'll find it interesting, you are welcome to contact us if you have any questions, want to know more or visit the area.

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History

In the year of 1899 the inventor Waldemar Jungner got a patent for the nickel-cadmium battery. At that time he worked in Norrköping, a city in Sweden. Soon he needed to expand and looked for more suitable locations, and started a factory in Fliseryd.

In 1910 a management group, lead by Robert Ameln bought the company. Robert Ameln started a successful period when the company expanded in Fliseryd, Oskarshamn and further out in the world. The factory in Fliseryd had about 200-300 employees.

The Jungner Company had battery factories in 10 countries, for example Germany, Spain, Austria, Argentina and Brazil.

In 1974 the production in Fliseryd stopped and all production was moved to Oskarshamn.

In 1976 the company cleaned up the area and constructed two landfills from waste material within the area, before they left.

The surroundings

The battery factory in Fliseryd was located on islands surrounded by the Emå River. Emån is the largest watercourse in southeastern Sweden. It runs from an altitude of approximately 330 m and discharges its water into the Baltic Sea. Emån is 220 km long and its drainage basin, encompassing four counties and eleven municipalities, covers an area of approximately 4500 km². The mean average flow at the outlet into the Baltic Sea is 32 m³/s. Because there are not many reservoirs in the lower part of the catchment area the flows can vary from 2 m³/s to 270 m³/s.



Emån is of national interest for biological, cultural and recreational reasons. The river is characterized by multiple rivulets and very picturesque meanders. The great variety of habitats in the catchments area provides a solid basis for considerable biodiversity, in terrestrial as well as aquatic environments. The river accommodates more than 30 fish species.

The battery factory started on an island called "Kvillegårde" and in 1930 it expanded to the islands "Kvarnholmen" and "Bruksholmen". It was then located in a very beautiful part of Emån surrounded by water and connected by bridges.

Investigations

In 1992 the municipality of Mönsterås bought the estate in attention to find out and solve the environmental threat from the area. A period of investigation started, initiated by the municipality and the county which also participated in the work.

The main investigations are as follows:

- Heritage of cadmium and lead. Bo Bergbäck, Margareta Carlsson, 1995
- "Jungnerholmarna, Miljögeoteknisk undersökning ...", SGI, 1992
- "Undersökning av tungmetaller i mark ...", Högskolan i Kalmar
- "Platsspecifika riktvärden för Jungnerholmarna", Kemakta konsult 1997
- "Åtgärdsutredning", Golder Associates AB, 1997
- "Efterbehandling av Jungnerholmarna ..." Golder associates AB, 1997...
- ITM rapport 27, metallförorening och återhämtning i Emåns nedre lopp 1971-93.

These investigations showed a way to remediate the area.

In 1998 the municipality of Mönsterås applied at the Swedish ministry of environment for money to remediate the area.



The project started in the fall in 1998 with cleaning up inside the constructions and preparing for the next steps.

The project consist of three major parts:

1. Clean up and pull down the buildings.
2. Excavate and wash the soil, and then restore the area.
3. Construct, fill up and close a new class -1 landfill.

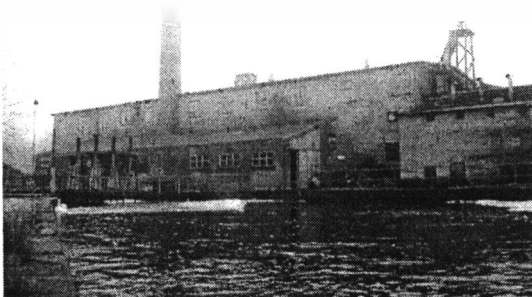
Contamination

The whole area, approximately 30 000 m², is contaminated with the heavy metals Cadmium, Lead and Nickel.

Ground

When the industry expanded, process waste and glaciofluvial sediments were used as filling material. The ground 0.3 – 4m consist of process waste, waste material, sand and gravel. Several excavations have been done, soil samples from these have showed increased amounts of Cadmium, Lead and Nickel. The typical values are (median) Cd 600, Pb 2000 and Ni 17 000 mg/kg TS in the ground.

Buildings



The constructions of the buildings are also contaminated, the contamination varies depending on the type of building and the type of process inside the building. Measurement made on walls and floors inside the heavy buildings made of bricks showed that the contamination decreased rapidly with the depth of the construction. The heavy metals had polluted the surface of these constructions.

Other buildings also made of bricks where lead had been recycled were contaminated right through the construction.

Aims of remediation

The project is initiated, motivated and financed because of concern of the environment of Emån and its surroundings. It is an ecological project and the aims of the project are:

1. Humans shall be able to stay in the area and the remaining buildings without any restrictions.
2. The discharge of Cadmium from the area cannot increase the amount of Cadmium in Emån more than 0,01 µg/l.
3. At least 90 % of the Cadmium in the soil in the area has to be removed.

To succeed with these aims we have guide values for contamination. For this project the level of Cadmium is increased from the normal guidelines of EPA. We work with two levels. The level 100 mg/kg TS is a level calculated from how much Cadmium Emån is able to take. The other level, 36 mg/kg TS, is calculated with respect to the human risk.

These levels are used to decide where to put the different material:

- Soil and waste construction material with less than 36 mg/kg TS Cd can be put on the surface after the remediation.
- Soil and waste material with values between 36 –100 mg/kg TS Cd can be recycled as filling material in the area if it is put more 0,5 under the ground.
- Soil and waste containing more than 100 mg/kg TS had to be deposited at the new landfill.

Table of amount and guidelines of heavy metals (mg/kg TS)

Metal	Median value Contaminated soil	Guide value According to Emå	Guide value According to Human	Guide value according to EPA in Sweden
Cadmium	600	100	36	0,4-12
Lead	17 000	86 000	225	80-300
Nickel	2 000	24 000	100	35-200

Buildings

Totally there were about 23 buildings in the area, four of these were bigger buildings of bricks. The biggest building was also the first production-building which had been enlarged several times. The building called the A-factory consisted of approximately ½ of constructing material. In the A-factory Cadmium had been processed and recycled and therefore the building was heavy contaminated with Cadmium.

Using a grinding machine attached to a small excavator called "Brokk" more than 5mm were taken off from the surface of walls and floors. The contaminated waste material from this process was sucked through pipes to big sacks which are to be put in the new landfill.

After 5 mm had been grinded off the surface the level of Cadmium Lead and Nickel was controlled. We could then decide whether the construction material was clean enough to be used as filling material or if it had to go to the new landfill. Some parts of the building, especially close to chimneys and ventilations, contained high levels of Cadmium right through the construction.



The B- and C-factories were taken down in a similar way.

Lighter buildings of wood were treated as contaminated material the whole buildings. They were pulled down turned into wooden chips and burned at SAKAB, as hazardous waste.

Lighter buildings of metal were cleaned at the site and then transported to ironworks and melted to new products.

Heavy brick buildings, on "bruksholmarna",

where lead had been recycled were contaminated deep down in the construction material and had to be pulled down as contaminated material and is to be transported to the new landfill.

The Cleaning and down pulling of buildings was finished before the summer of 1999. Materials are stored in the area for transport to the new landfill or to be used as filling material. Transportation and refilling the area will be finished next year, 2000.

Ground

The ground will be excavated as deep as where the amount of Cadmium is higher than 100mg/kg TS. Excavations done in investigations point to that it is the old filling material we have to dig up and treat. When reached the old natural surface, the surface before the battery company entered the area, measurements will be done to secure that the Cadmium level is below the guideline.

On the top of recycled material we will spread out pure soil.

Excavated ground will be passed through sieves to separate bigger material. Separated bigger material will be washed and recycled as filling material. Remaining smaller fractions will be transported to the new landfill. The Excavation volume is estimated to 30 000m³ and of this 10 000 m³ will be material which can be recycled back to the ground.

Old landfills made in 1976

Before the Jungner Company left the area they constructed two landfills. One, called lead landfill, already existed. It was filled up and then covered with clay.

Next to it a Cadmium-Nickel landfill was constructed. The bottom was constructed with a tight layer of clay and drainage system. The landfills were filled with waste material from the process, lying open on the ground. At last the landfills were covered with 0,5m of clay.

Both these landfills are going to be excavated and transported to the new class-1 landfill. The tight layer of clay on top of the landfill will be recycled as filling material.

Environmental control

Through the project, measurements of the influence on the surroundings will take place.

Measurements of temperature, river flow, rain flow are regularly measured.

The amount of heavy metals in Emån (water and biota), groundwater and dust are measured.

Future

The municipalities of Mönsterås together with local associations are planning the future use of the area. It will be a nature recreation area for fishing, canoeing and other adventures.

