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NICKEL CADMIUM BATTERIES, THEIR PRODUCTION AND TREATMENT AT THE END-OF-LIFE AND SWEDISH ENVIRONMENT POLICY OF THE 20TH CENTURY

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ABSTRACT

The Saft factory for industrial nickel-cadmium batteries at Oskarshamn, Sweden, was started in 1907. During its almost 100 years the view of the environmental aspects of production and products has changed dramatically. The various environmental trends are reflected in the development of the factory.

Start-up of Production at the Beginning of the 20th Century

In 1907 the Swedish inventor Waldemar Jungner started an accumulator factory at Fliseryd, situated at the river Emån 25 km south-west of Oskarshamn, Sweden. The first accumulators based upon the Jungner patent dated September 1899 were based on the nickel-iron chemistry. However, already after a few years, the iron of the negative electrode was replaced by cadmium. Nobody considered the environmental aspects. About 40-50 years would pass until for example cadmium would be regarded hazardous to humans and another 20 years before Sweden got its first Environmental Protection Act in 1969.

The river Emån made electric power as well as process water available – and offered the possibility to get rid of industrial wastewater according to ancient custom. We may assume that nobody saw the environmental risks connected to the selected location close to a river, today considered a river of national interest with extensive vegetation and several interesting species of fish.

The first batteries were actually intended for the electric vehicles that had golden days at that time. However, the drive behind the electric vehicles was not at all to avoid air pollution in the large urban areas but a fear that a first oil crisis was near in time.

The Jungner company did organised collection and recycling of used nickel-cadmium batteries already in the 1910's. However, the intention was not at all to save the environment but to secure the availability of cadmium at acceptable prices.

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The electrode production and the cell assembly were moved into the harbour area of Oskarshamn in 1915, while the chemical processes – production of active materials based upon nickel hydroxide and cadmium oxide - and the recycling of nickel cadmium as well as lead acid batteries stayed at Fliseryd until 1975.

The Trend of the 1970's - Pollution Control via Reduction of Emission

The intention of the first Swedish Environmental Protection Act in 1969 was first of all to control the establishment of new industrial activities, to avoid industry with an assumed environmental impact in sensitive areas, and to protect the surroundings of industrial plants from pollution. During the 1970's, Society made large efforts to reduce the emissions of existing as well as new plants.

With respect to the battery factory at Fliseryd and Oskarshamn, the new signals conduced to a decision to move also the chemical plants from Fliseryd to Oskarshamn. However, in addition, management decided to implement the vision of a Closed Loop factory (Figure 1): The production scrap containing nickel and cadmium, the sludge from the industrial wastewater treatment plant and the dust from the air filters were to be treated internally in one "dry" and one "wet" unit. Furthermore, the development of a third step of material recovery was initiated in 1976 – an up-to-date recycling plant for used industrial NiCd's.

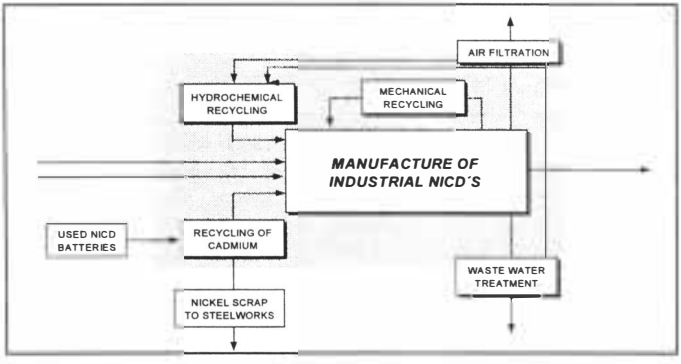

Figure 1: The Closed Loop of Saft at Oskarshamn

The growing interest in pollution control promoted the development of more effective filter equipment. The emissions of the Oskarshamn factory could be drastically reduced in 1983-1984 when new equipment was available at the market (Figure 2).

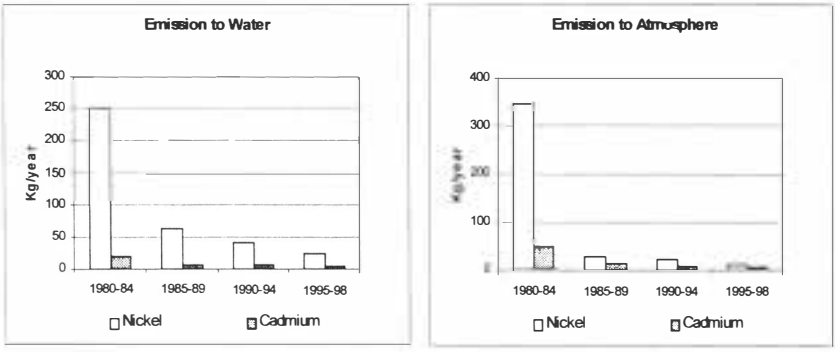

Figure 2: Emission of metals to water and atmosphere

The 1980's - Pollution Control via Products

Towards the end of the 1970's, the public attention was moved from the production and from the industrial plants as sources of pollution to the chemicals used in production and to the products. The impact of low dose exposure was increasingly considered.

The first "battery metal" concerned was mercury, followed by cadmium and lead. Sweden got a first "cadmium ban" in 1982. Restrictions were directed against cadmium in more or less all products except batteries. A first law on Chemical Products came into force in 1985.

A programme for collection of used industrial NiCd's existed already since the 70's. In the middle of the 1980's the Swedish government asked industry and trade organisations to collect all consumer batteries – primary as well as rechargeable - due to the content of mercury and cadmium. The figure 0.025 per cent became known all over the world as the maximum content of mercury + cadmium of alkaline batteries allowed at the Swedish market. Battery industry made large efforts to reduce the mercury and cadmium content in primary batteries. The collection of consumer batteries was after a while concentrated upon the portable NiCd's.

The market for portable rechargeable accumulators increased sharply from about 1988 and forward. The environmental pressure at mercury, cadmium and lead in combination with increasing technical requirements encouraged to extensive research and development efforts. New types of rechargeable batteries based upon nickel metal hydride or rechargeable lithium batteries showed up at the consumer market while no substitute accumulators have become commercially available for the transportation and standby applications.

The Oskarshamn factory, already receiving almost 100 per cent of used industrial NiCd's from Sweden and other countries where its market shares were high, reacted by modifying the

existing recycling plant to permit more efficient treatment of portable nickel-cadmium batteries (Figure 3).

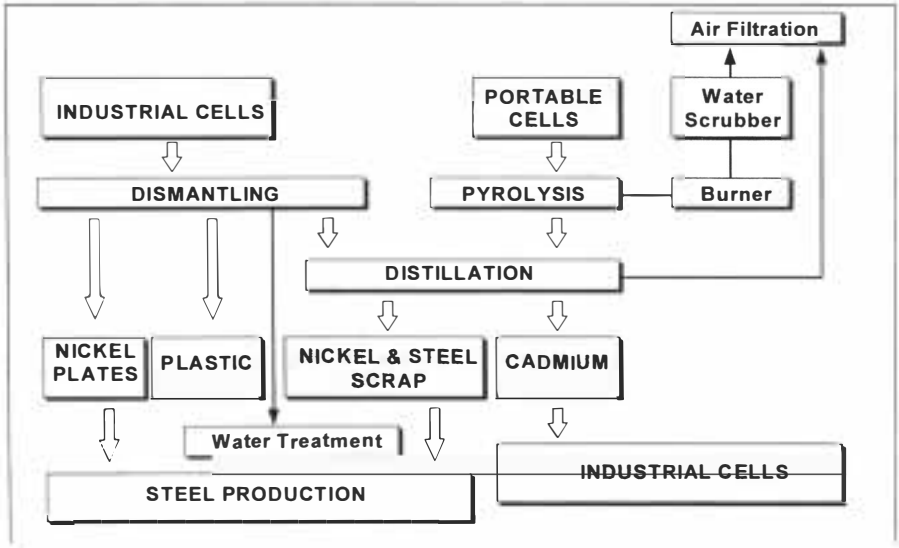

Figure 3: The Recycling Process at Saft, Oskarshamn

New trends have started to have an impact on the industry. The attention is moving from actual emission figures to the use of Best Available Technique. It is no longer sufficient to have a clean plant and to organise the collection and recycling of used products. The full life cycle of a product is evaluated – the consumption of raw materials, energy and water at manufacturing is evaluated. The plants are to be certified according to for instance the ISO 14001 or registered according to the EMAS procedure.

According to a regulation in force since January 1998 all used batteries in Sweden are collected for proper treatment or recycling. The collected nickel cadmium batteries are treated at Oskarshamn. Similar legislation is considered for EU.

Saft AB at Oskarshamn takes actions to adapt the activity to the environmental concepts of the future: An alkaline process replaced the trichloro-ethylene as the degreasing agent of the nickel-plating unit. A new process for coating the perforated steel strips for the electrodes with PVA for dust protection eliminated the emission of i-propyl-alcohol.

Saft AB at Oskarshamn received its ISO 14001 certificate during spring 1999. The objectives of continuous improvements at the Saft plant is the reduction of the water consumption, reduction of the emission of cadmium to the water recipient – the Baltic Sea – and reduction of the emission of organic compounds.