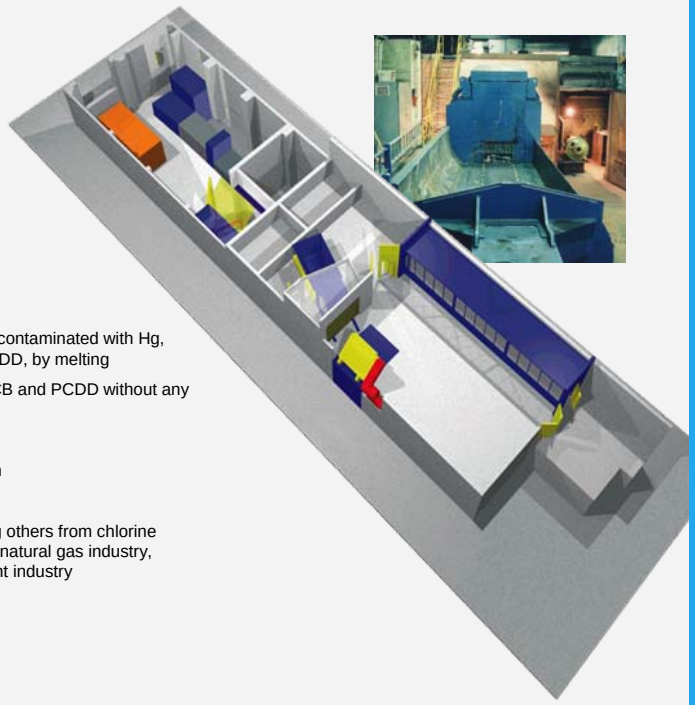
GERTA

Industrial-Scale Melting for the Recycling of Toxic Waste



Scope of Services

- Decontamination of metals contaminated with Hg, NORM, asbestos, PCB, PCDD, by melting
- Destruction of asbestos, PCB and PCDD without any residues
- Cutting and sorting
- Extraction of secondary iron
- Recycling of slag
- Processing of scrap, among others from chlorine electrolysis, mineral oil and natural gas industry, phosphoric acid and pigment industry

Technical Data

- Melting plant licensed according to German BImSchG
- Licensed annual capacity 2,000 Mg
- 8 Mg net frequency induction furnace
- Guillotine shear with 650 t of shear rate and a pre-press-pressure of 300 t; length of the pre-press chamber is 6 m
- Encapsulated burning chamber for thermal cutting of large components
- Exhaust systems for gathering emissions with a capacity of 35,000 m³/h
- Sulphur doted activated carbon filter for flue gas cleaning

Acceptance Limits

- Hg < 1 wt.-%
- NORM after individual check
- PCB < 50 mg/kg
- PCDD/F < 10,000 ng/kg
- Asbestos < 0.1 wt. - %

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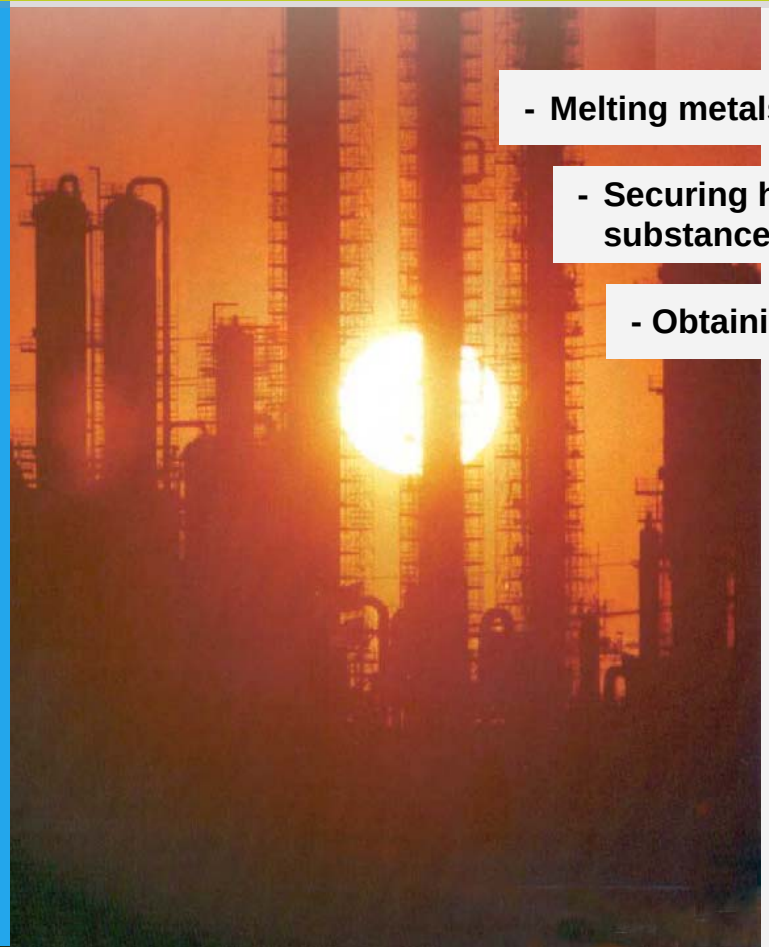
Recycling by Melting

Recycling of chemically and NORM contaminated metals



- **Melting metals**
- **Securing hazardous substances**
- **Obtaining resources**

Recycling by melting

Recycling of chemically and NORM contaminated metals

In a resourceful economical recycling management, industrial waste should receive preferential treatment. In the mineral oil and natural gas industry, in the chemical and tungsten industry, many components are contaminated with substances that do not allow an unrestricted recycling.

Due to decommissioning and refitting of European chloralkali plants, working with the amalgam process, large quantities of mercury contaminated metal will be generated. During natural gas production large quantities of pipings and components get contaminated with mercury. This material can also be contaminated with radio nuclides of natural origin (NORM), and the recycling of such waste sets a high standard on applied technologies and staff experience. NORM contaminated scrap is also accumulated in the fertilizer production and in the tungsten industry (welding electrodes and electric filaments). High legal requirements, the acceptance criteria of the iron industry and the new radiation protection guidelines cause an increasing demand for suitable innovative recycling paths. In the terms of a resourceful economical recycling management this contaminated scrap should be made available to the iron industry as secondary raw material. A suitable technology to separate harmful substances from reusable metal, has been developed at Siempelkamp Nukleartechnik and has been successfully applied over a period of years. The main core of this plant is a fully enclosed furnace with a filter system to retain all harmful substances.

The “Spin-off”

In the beginning of the eighties a melting process was developed to recycle radioactively contaminated metals from nuclear facilities. In this melting plant, named CARLA (Centrale Anlage zum Recyklieren Leichtradioaktiver Abfälle - central plant to recycle low radioactive waste) up to now approx. 17,000 Mg of scrap has been successfully treated and reused in the production of components for the nuclear industry, such as containers for the transport and storage of radioactive waste. It is not commonly known, that in non-nuclear industries the raw materials can contain natural radioactive elements, and the waste disposal is a growing problem. For example, when decommissioning mineral oil and natural gas extraction plants, the scale in the pipelines is contaminated with radium and thorium including all decay products. Depending upon origin and particularly fornatural gas extraction plants, a mercury contamination has also to be taken into consideration. As mercury completely evaporates at high melting temperatures, the furnace has to be equipped with an effective exhaust and combined air filter system. GERTA, a large scale plant for recycling of toxical waste, is licensed according to federal law on air pollution - BImSchG. The annual melting rate for mercury and NORM contaminated steel and iron scrap is at present limited to 2,000 Mg. A delivered load scrap can in average contain up to 1 wt.-% of mercury. For scrap contaminated with radioactive materials of natural origin, for example from the mineral oil and natural gas industry, fertilizer production or tungsten industry, the final disposal or use of waste resulting from the melting process is decisive for the acceptance limits. For this purpose, a study was made for the maximal allowed quantities of radionuclides out of the uranium and thorium decay chain in the annual waste, and in accordance to the radiation protection ordinance to ensure that the radiation exposure to the public is below 1 mSv/y. The furnace is the main component of the plant, with an adjoining workshop for mechanical and thermal cutting, and storage bunkers (fig.1). For the cutting of tubes out of the mineral oil and natural gas industry, a guillotine shear with cutting power of up to 650 t is used. Large components are thermally cut with plasma equipment in a closed area, with a controlled extracted airspeed of up to max.19,000 m³/h, and the staff wear full protective clothing. The cut scrap can be separately stored in three bunkers according to type of material and kind of contamination. Filling of the furnace is done with the help of a mobile charging system, after loading the carriage with 5 Mg of scrap, it rolls through a lock and connects onto the furnace hood by means of a leak-proof adapter (fig. 2), this avoids gas leakage into the working areas. The hall has roof extractors for ventilations, and all air extracted from the working areas, thermal cutting areas, and the furnace hood are purified in a multi-stage filter system consisting of cyclone, air cooler, air filter, and an activated carbon fixed bed adsorber (fig. 3). The offgas stays two sec. in the sulphur doted activated carbon of the fixed bed adsorber which retains mercury in the form of $HgSO_4$ or Hg_2SO_4. If reproduced in the exhaust gas, dioxins and furans can also be bound safely into the activated carbon. Pollution of extraneous elements in air are limited according to the valid safety regulations.

Limits:

- Dust < 20 mg/m³
- Mercury and compounds < 0.2 mg/m³

This filter system guarantees compliance to the strict limits of 50 µg/m³ for Hg emission according to 17. BImSchV. The total concentration of mercury in the extracted air is under continuous control, an automatic system working on the cold steam atom adsorption method is used. Approximately 500 Mg of scrap contaminated with mercury and radioactive nuclides of natural origin had to be melted in order to give evidence for official licensing. After the melting process, all metal was free of contamination and could be released for unrestricted use, the contamination was transferred into the resulting waste consisting of slag, furnace lining, and filter dust. For the waste there is a licensed disposal path, that is in accordance to the present radiation protection ordinance. Slag contaminated with radioactive nuclides from the radium and thorium decay chain, can after processing be used in depository con-can be deposited in an underground depository. Since 1998 this unique plant exists in Germany and provides the possibility to recycle contaminated scrap, that previously could only be disposed of. In 2002 a tungsten / thorium melting campaign proved that other combinations of material and contamination widen the GERTA service range. The melts help to demonstrate and rapidly examine the behavior of other contaminated materials, for instance PCB and asbestos.

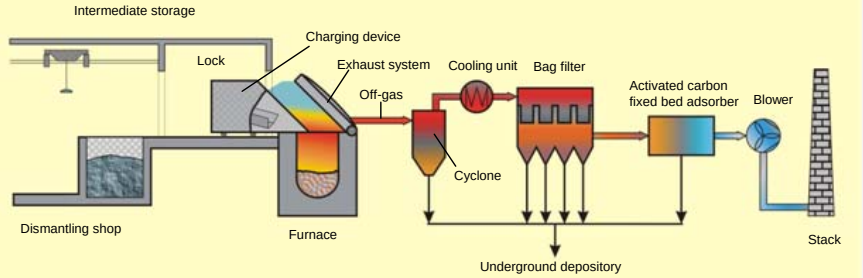


Fig. 1: Layout of GERTA plant

Fig. 2: Charging system adapted to the furnace suction hood

Fig. 3: Filter system with activated carbon fixed bed adsorber

Fig. 5: Chlorine electrolysis with Hg contamination

Fig. 4: Furnace casting

Fig. 6: Components from the natural gas industry