Production of iron with low CO_2 emissions. Electrowinning from molten salts.

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With a long time perspective in mind the objective of these experiments were to investigate alternative steelmaking processes where the total carbon dioxide emission can be reduced substantially[1]. Electrolysis experiments were conducted in iron oxide-fluoride/chloride mixtures in laboratory scale where solid iron was deposited on a steel cathode. Another objective of these tests was to find materials that could serve as oxygen-evolving anodes in the molten salt mixtures.

Electrolysis experiments were run for 4 to 6 hours at constant currents up to 10 A. The experimental set-up is shown in Figure 1. A rotating steel cylinder served as the cathode. Electrolysis was interrupted for short periods when the cathode was taken out for cleaning and removal of the deposit. The deposit was easily scraped off while it was still red hot as shown in Figure 2.

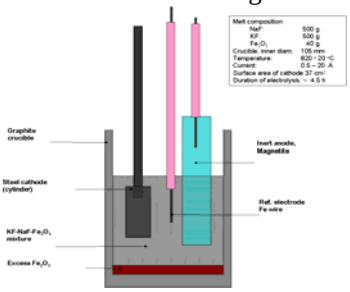

Figure 1. The experimental cell

Figure 2. Scraping off the cathode deposit

The deposited iron was very dendritic, causing substantial electrolyte entrainment. By a method of water treatment and magnetic separation the iron could be cleaned and separated as a fine powder. The structure varied with the experimental conditions, especially current density and the cathode's rate of rotation.

The work on finding an "inert" oxygen-evolving anode was concentrated on materials were iron oxide was the main component. Most electrolysis experiments were carried out with magnetite and magnetite-iron cermets as anodes, as any wear of these would cause no contamination in the electrolyte and the deposited iron. Negligible wear was observed in these 4 – 6 hours experiments.

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[1] EU 6th Framework Programme, ULCOS (Ultra Low CO2 Steelmaking), http://www.fz-juelich.de/ptj/datapool/page/2345/ULCOS.pdf