# High Temperature Solar Thermal Recycling of Aluminum Scrap in a Directly Heated Rotary Kiln: Mini-Plant Experiments, Dynamic Simulation, and Cost Estimation

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The main objective of the high temperature treatment of hazardous wastes is to transfer that material to an environmentally benign form either for safe disposal or for recycling purposes. In the first case toxic organics must be destroyed and leachable inorganics must be fixed. In the second case the waste material has to be separated from accompanying substances frequently being toxic in order to achieve a secondary crude sufficient in quality for recycling.

The thermal treatment of low calorific inorganic wastes like metal scrap, filter residues, waste acids and metal hydroxide sludges, or dusts resulting from processing of metals has a high energy demand. At present this energy demand is mainly met by the combustion of fossil fuels with the disadvantage to generate big exhaust gas streams which must be purified. Solar thermal waste treatment enables the substitution of fossil fuels which has the advantages to reduce the off gas streams and $CO_2$-production as well as to destroy organic wastes photolytically.

Solar processes offer the chance to save fossil fuels especially when solar energy is directly used in production processes. In summary, low calorific value of the waste material, high cost of conventional treatment, and scope of application are the decisive selection criteria for solar detoxification and recycling techniques.

In this paper we present our investigations on aluminium recycling in a directly solar heated rotary kiln which were carried out in the solar furnace in Cologne. First successful melting experiments in a directly solar heated rotary kiln in mini-plant scale make us optimistic regarding the feasibility of this process. In comparison to fossil fired plants alternating solar insolation may cause additional problems in the operational behaviour of solar-heated rotary kilns. In order to investigate these problems and to develop a tool for the design of solar-heated rotary kilns, a transient simulation model is set up and tested. A new object-oriented simulation language called SMILE is used for the implementation of the model.

Improvements in plant design and a smaller exhaust gas treating in comparison to conventional aluminium recycling may result in a economically competitive process for aluminium recycling in the future. The presentation summarizes the work on solar thermal waste treatment in a rotary kiln. Also a design study for a pilot plant and a cost estimation will be presented.