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Extending the Hamburg Pyrolytic Technique to Destroy Toxic Wastes

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The basic idea is as simple as it is fascinating: solving our growing waste problem by recycling the waste materials into raw materials and reusing them. As far back as 1970, Professor Hansjörg Sinn also suggested recycling plastic waste by reclaiming its basic materials by means of a pyrolysis process.

A fractionation column is charged with pyrolyzed plastic waste in order to precipitate various volatile components. (Photo: Peter Allert)

Pyrolysis is the thermal decomposition of organic materials at temperatures of 400 to 900 degrees Celsius while hermetically sealed, with the result that no actual combustion occurs. When plastic waste is treated in this manner, decomposition products are formed, namely gaseous or liquid hydrocarbon compounds such as methane, ethylene, propylene, benzene or toluene, which can be reclaimed to a very large extent. Hansjörg Sinn was one of the first scientists to show in laboratory trials and finally demonstrate the technical feasibility of this method in its further development with Walter Kaminsky in a pilot plant, also tailored to the pyrolysis of unshredded car tires. In 1978, when a pilot plant for this purpose was successfully commissioned, the 'Hamburg pyrolysis process' was born. Similar efforts to recycle household waste, on the other hand, had to be regarded as a worldwide failure at the end of the 1970s. The subsequent work by Professor Kamin showed that the more complex the composition of the waste is, the more difficult reclaiming reusable hydrocarbons becomes. In the presence of chloro-organic compounds the proportion of unusable materials increases and toxic residual products occur which in turn are difficult to dispose of.

The objective of the project subsidized by the Körber Prize was therefore to attempt to add a further step to the Hamburg pyrolysis process and thereby also come to grips with toxic residual waste. In the further course of research work the pyrolysis process has since proven competitive for only a few applications. A large-scale demonstration plant for the pyrolysis of unshredded car tires which had been taken over in 1986 by Asea Brown Boveri was closed in May 1990. The operating company established technical problems in the chlorine discharge and was not prepared "to finance the necessary subsequent developments against the background of the distinct lack of cost-effectiveness as compared to incineration". The problem of the chlorine discharge was subsequently solved quickly by adding ammonia.

In contrast, following the mediation of Dr. Vasilij Dragalov in 1990, the oil shale combine Kohtla-Järve in Estonia showed interest in collaboration. The largest oil shale pyrolysis plants in the world are to be found here and are looking for an environmentally friendly way of disposing of their oil sludge waste.

This oil sludge contains condensed aromatic compounds, substituted phenols and other tar products and until now has simply been tipped into landfills without any further processing. The first laboratory tests using the Hamburg pyrolysis process showed that 30 percent oil and gas respectively can still be reclaimed from the oil sludge and that the fully cured residue can then be stored in a safe way. In December 1993, a support program of the European Community was signed which provided this project with ECU 200,000. Now that the chemical industry is also planning to conduct plastic pyrolysis on a larger scale and the BMFT (Federal Ministry of Research and Technology) is now also supporting pyrolysis, the existing pilot plant in Hamburg can be brought up to the state of the art. Professor Sinn and Professor Kaminsky want to show that the technical problems that used to occur, particularly with the addition of the oxidizing stage, can be solved. The economic analysis of pyrolysis assigned to Professor Alfons Buekens has not yet been completed.

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