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Bachelor thesis

Experimental Investigations on the Co-Pyrolysis of Polystyrene and Inorganic Substances in a Laboratory Reactor

Experimentelle Untersuchung zur Co-Pyrolyse von Polystyrol und anorganischen Stoffen an einem Laborreaktor

Background:

Building insulation is very often implemented in the form of external thermal insulation composite systems (ETICS). In addition to expanded polystyrene (EPS), which provides the thermal insulation properties, these also consist of inorganic layers such as mineral adhesives, mortars, and renders. For fire protection reasons, the EPS used is treated with flame retardants. Since brominated flame retardants must be destroyed rather than kept in circulation for health and environmental protection reasons, conventional mechanical recycling is not suitable.

Pyrolysis, a chemical recycling process in which sufficiently high temperatures are reached to decompose the flame retardants, offers a long-term solution in the sense of a circular economy. At the same time, under these pyrolytic conditions, polystyrene decomposes mainly into its monomer, styrene. This makes polystyrene particularly well suited to chemical recycling. The monomer can after purification be used directly, to produce new polystyrene.

While the pyrolytic decomposition of pure PS has already been well described, there is so far only limited knowledge about the influence that the inorganic material from ETICS has on pyrolysis. Even after pretreatment to enrich the EPS content, complete separation of the inorganic material is not possible. At the same time, it is possible that the presence of the inorganic material could even have a positive effect on the pyrolysis of polystyrene (PS).

In order to close this research gap, experiments are to be carried out on a laboratory reactor in the gram range. Selected inorganic components are to be brought into direct contact with the PS, on the one hand, and on the other hand, the inorganic material is also to be brought into contact with the primary pyrolysis products via a downstream fixed bed. This is intended to investigate the differing influence on the primary and secondary decomposition of PS.

The main products of PS pyrolysis are the monomer styrene as well as dimer and trimer. In addition, smaller amounts of further styrene fragments are also formed. All of these are found in the pyrolysis condensate. The aim is to determine the condensate yield and to characterize the condensates. Characterization will be carried out using the analytical equipment available at the institute.

The following tasks are planned as part of this work:

- Conducting pyrolysis experiments on a laboratory plant
- Evaluating the experiments with regard to product yields
- Comparing the experimental results with one another as well as with known results from the literature

Start of the work: immediately

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