1.2 Summary

The Hamburg pyrolysis process makes it possible to recycle different polymers in a fluid bed. Depending on the process variables monomers, aliphatic or aromatic oils can be produced. Due to the lack of oxygen the forming of toxic substances is reduced.

In the near future the legal regulations for disposing waste products, containing organic material will change. Therefore, I started an investigation in the usability of plasticised pvc-products in the Hamburg-Pyrolysis-Process. It should be figured out whether this chemical recycling process will be useful alternative for plasicised pvc-products. Other members of the working group examined the use of a mixture of PE and PVC, which were pyrolysed by adding different neutralization agents or ammonia to reduce the chlorine content of the pyrolysis oil, in the fluidized bed reactor.

At first the products were chosen on the basis of their market share and analysed with respect to their formulations (see table 1). The filler content of the selected products (tube [Schlauch], floor covering [Bodenbelag], cable [Kabel]) increase from 0 up to 30%.

In order to predict the products of the fluid bed model mixtures were analysed via pyro-gc-ms and with another laboratory-plant. So some of the difficulties were already known.

To carry out the experiments a small pilot plant was build which suits for the input material and can also be used in different process variations. Special focus was set on the input system to feed the vary elastic PVC-material. Also a heated cyclone was included to recover the fillers and the sooth.

In table 2 you can have a look at the results of the new plant (LWS1) with some commercial plasticised products. In the tables(1 and 2) the products were sorted by an increasing amount of filler. The table view shows, that a huge amount of pyrolysis products consist of tar, sooth, Carbon oxides and $CaCl_2$. The chlorine content of the produced fractions (gas, oil, residues) was analysed to figure out how the total chlorine is distributed over the fractions of the plant. From the experiments follows that fillers react to a high extent with hydrochloric acid produced during the pyrolysis. The total content of gaschromatografical chlororganic compounds with a maximum of 0.4%, relating to the organic part, is lower than the obtained values of almost 2% at the pyrolysis of polychloropren. A higher amount of fillers in the raw materials leads to a lower amount of chlororganic compounds. The distribution of inorganic chlorides relates to the destribution of calcium within the fillers and water. The organic polymer backbone is almost totally dehydrohalogenised. Nevertheless, it was not possible to recover the plasticisers as a by-product. The pyrolysing of pure phthalic plasticisers leads to phthalic acid anhydride as a main product. Its output is reduced with rising temperatures. High amounts of carbon dioxid and carbon monoxid is found in the gas fraction depending on a filler contents and the decomposition products of the platicisers (see table 2). The products which were found in the output of this process are hardly suitable for an input of plasicised PVC into the recycling process .

In a technical process aimed at the recovery of energy and hydrochloric acid high amounts of fillers reduce the output (HCl, energy). Table 1 and 2 illustrate that fillers react to a high extent with hydrochloric acid produced during the pyrolysis. The input of high imp act plasticised PVC failures because of the negative energy- and raw-material balance of the process. The low chlorine content of detected chlororganic substances by gaschromatography is, however, a positive result of this investigation.

If you compare the results of the pyrolysis of the LWS1 with the results on pyrolysis-gc-ms, you can get information whether or not it is possible to predict results on the LWS1 on the basis of results from the pyrolysis-gc-ms.

In order to predict the products of the fluid bed pyrolysis, model-mixtures were analyzed via pyrolysis-gc-ms. In particular, the reactions of different flame retardants and mixtures of flame retardants and common plastics (i.e. PE, PS, PP) were analyzed. The results of the pyrolysis-gc-ms can not completely be used as a prediction for the fluid bed pyrolysis. From the obtained values and results of this investigation, it can be concluded that the use of flame retardants in the input material leads to a number of disliked products, as well as to a reduction of the output of raw materials which are usually obtained in the Hamburg Pyrolysis Process.