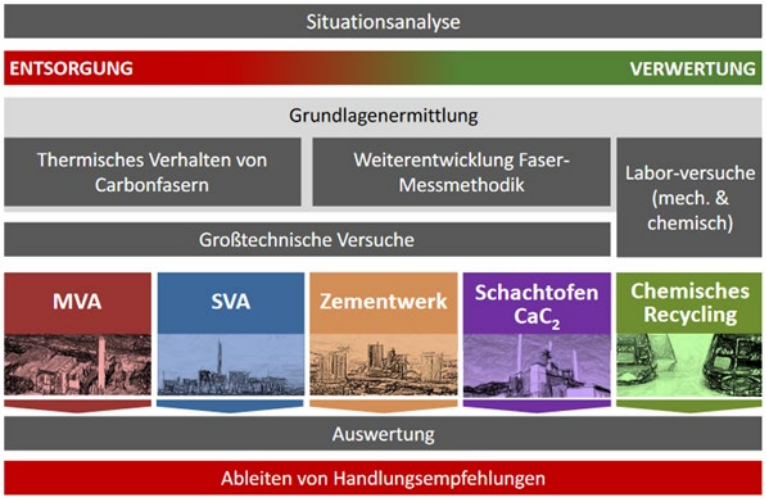
Possibilities and limits of the disposal of carbon fiber-reinforced plastic waste in thermal processes, under consideration possible risks in dealing with the process-specific residues

Funding code: ***FKZ 3716 34 318 0***
Duration: ***06/2016 – 06/2020 (finished)***
Project partners: ***RWTH Aachen, KIT-ITC, TU Dresden, TH Nürnberg, VDZ, Fa. MARTIN, Fa. Indaver, Fa. HeidelbergCement***

Contact: ***Werner Baumann***

Umwelt Bundesamt



As part of the project, various thermal processes were investigated with regard to their suitability for the energy or feedstock recycling of waste containing carbon fibers. The focus of the measurements at the large-scale plants was on determining the potential fiber load of the process-specific residues and products.

In addition, laboratory tests were carried out on thermal fiber degradation and mechanical and chemical fiber recovery.

Energy recovery was investigated in a municipal waste incineration plant, a hazardous waste incineration plant and a cement kiln plant. The investigations showed that municipal and hazardous waste incineration plants are not suitable for energy recovery from carbon fibers, as a large part of the carbon fibers were not sufficiently converted under the process conditions and were discharged to a considerable extent with the bottom ash or slag. Furthermore, in the municipal waste incineration plant in particular, carbon fibers were discharged from the combustion chamber with the exhaust gas flow. No fibers were discharged via the stack in any of the plants. Some of the fibers were present in geometries that correspond to the WHO definition of respirable fibers.

From this it can be concluded that both the targeted disposal of carbon fibers and their entry with other waste into municipal and hazardous waste incineration plants should be avoided.

The investigations in the cement kiln plant first of all required orienting experiments on the type of feeding of the carbon fiber-containing material flows. As part of the co-incineration process, the processed CF fraction was dosed with the substitute fuel (fluff) via the kiln burner. In the analyses of

the products, a moderate amount of carbon fibers was detected in the clinker in individual samples, but the amount did not differ significantly from the reference measurement (without CF co-incineration). As the addition of the waste containing carbon fibers could only take place in a very limited time interval within the scope of this project, the available results do not allow a conclusive evaluation of the recycling route cement kiln plant.

The large-scale investigations into the feedstock recycling of waste containing carbon fibers were carried out in an electron furnace for calcium carbide production, whereby special preparation of the waste containing carbon fibers was necessary for use in the carbide furnace. Extensive conversion of the carbon fiber-containing input materials was achieved in the carbide furnace. However, in order to be considered as a recycling option, the upstream processes for processing the carbon fibre-containing feedstock would have to be optimized. It should also be noted that some of the carbon fibers fed in are discharged with the furnace gas and these are separated, granulated and recycled externally together with the raw material dusts.

Publications of the project results are available at:

https://www.umweltbundesamt.de/sites/default/files/medien/479/publikationen/texte_131-2021_moeglichkeiten_und_grenzen_der_entsorgung_carbonfaserverstaerkter_kunststoffabfaelle_in_thermischen_prozessen.pdf