Industrial Solutions
Process Technologies

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engineering. tomorrow. together.

Industrial Solutions

Polymer recycling using supercritical water (SCW)

thyssenkrupp

Recycling of polymer feedstock by supercritical water technology

In times of rising importance for sustainable material utilization, the demand for recycling processes has increased. This is especially true for the value chain of polymer products, since these are produced in large quantities.

Supercritical water for ‚cracking' of long chain polymers

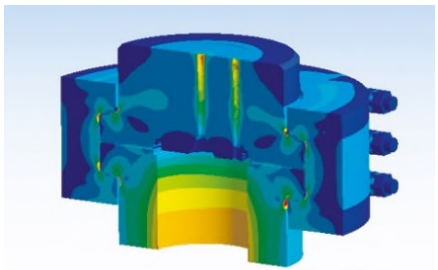
One example for recycling of these products is to disassemble long chain molecules of polymers to shorter chain hydrocarbons, which can be used as educts for new products. This can be achieved by using water at supercritical conditions.

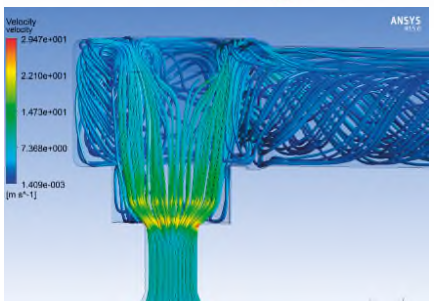
In general, this process is comparable to the classical steam cracking process which has been implemented for a long time in industrial scale, especially in the oil and gas industry. Even though process conditions are a bit more harsh for the supercritical water treatment, this process can be considered a proven technology.

Usually, the feed material (generally a molten polymer or a fluidized mixture containing small solid particles) is brought into contact with water at high pressure and temperature to achieve supercritical water conditions. Under these extreme conditions, the polymer chains are fragmented and smaller chain molecules are formed. After depressurization and cooling of the product, the water is removed and the product mixture can be further separated and used for new products.

Engineering for SCW processes

Uhde HPT is able to assist clients with engineering activities, especially with regard to the high pressure part of the process. This does not only include selection of material and design of corresponding components but Uhde HPT is also able to assist with engineering of adjacent process sections such as pressurization, pre-treatment and separation. Thus, a complete solution for a plant can be developed together with our clients.





Picture top: Stress analysis for high pressure compounds using finite element analysis

Picture bottom: Modeling of flow characteristics using CFD analysis

Equipment for high pressure processes with extreme requirements

Uhde HPT is able to assist clients in many steps of establishing a supercritical water polymer recycling plant. This also includes the supply of equipment for these harsh process conditions with regard to high pressure and temperature.

Long term high pressure expertise

Uhde HPT can look back on more than a century of activities in the field of high pressure processes. The requirements for these processes are usually connected to extreme conditions with pressures ranging from several hundred to several thousand bar. In some processes, like the LDPE process, these high pressures are also combined with requirements for high temperature. Since this process is well established since the second half of the 20th century, the knowhow for equipment for this process can also be transferred to processes with supercritical water.

High pressure equipment for SCW processes

Uhde HPT is a supplier of high pressure equipment designed to meet specific process requirements. This does not only concern high pressure piping and gasket system but also other important process equipment for high pressures and temperatures like the reactor, which can be designed as autoclave or pipe reactor and can incorporate associated equipment like heating jackets or stirrers.

Furthermore, a very important item for such plants are the corresponding high pressure valves (e.g. letdown valves for maintaining the process pressure) which are also in the scope of supply of Uhde HPT.

For all supplied items, Uhde HPT does also provide assistance for the adequate design of these components.

Picture top: High pressure autoclave reactor with stirrer and different inlets

Picture bottom: Industrial scale valve for high pressure applications