

Production of activated carbon from TCR char

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The utilization of char for adsorptive purposes is known since the 18th century. At that time the char was made of wood or bones and used for decoloration of fluids. In the 20th century the production of activated carbon in an industrial scale was started. The today's raw materials for activated carbon production are hard coal, peat, wood or coconut shells. All these materials entail costs especially the latter. Thus, the utilization of carbon rich residues (biomass) is an interesting economic opportunity because it is available for no costs or even can create income.

The char is produced by thermo-catalytic reforming (TCR®). This process is a combination of an intermediate pyrolysis and subsequently a reforming step. During the pyrolysis step the material is decomposed in a vapor and a solid carbon enriched phase. In the second step the vapor and the solid phase get in an intensive contact and the quality of both materials is improved via the reforming process. Subsequently, the condensables are precipitated from the vapor phase and a permanent gas as well as oil is obtained. Both are suitable for heat and power production which is a clear advantage of the TCR® process.

The obtained biochar from the TCR® process has special properties. This material has a very low hydrogen and oxygen content. Its stability is comparable to hard coal or anthracite. Therefore it consists almost only of carbon and ash. The latter depends from input material. Furthermore the surface structure and area can be influenced during the reforming step. Depending from temperature and residence time the number of micro pores and the surface area can be increased.

Preliminary investigations with methylene blue solution have shown that a TCR® char made of digestate from anaerobic digestion has adsorptive properties. The decoloration of the solution was achieved. A further influencing factor of the adsorption performance is the particle size.

Based on the results of the preliminary tests a systematically investigation was started. For this a muffle furnace with a maximum temperature up to 1300 °C is used. Furthermore the gaseous atmosphere can be controlled. So it is possible to carry out the trials with the absence of oxygen by purging with nitrogen, carbon oxide and/ or steam for example. With the addition of steam the number of mesopores is increased. These pores are responsible for the adsorption performance in liquid phases. The trials for the TCR® chars made from beech wood (reference) and digestate are currently carried out. Additionally the reduction of the ash content of the char by using hydrochloric and acetic acid is investigated, too. These leaching tests are carried out in a lab scale test rig at an operating temperature of 60 °C and a residence time up to 4 hours. The main objective is to adapt the TCR® process with regard to an optimized activated carbon production from biogenic residues to obtain an economic sustainable concept.