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THERMO-CATALYTIC REFORMING (TCR®) AND TCR®-BIOCHAR PROPERTIES

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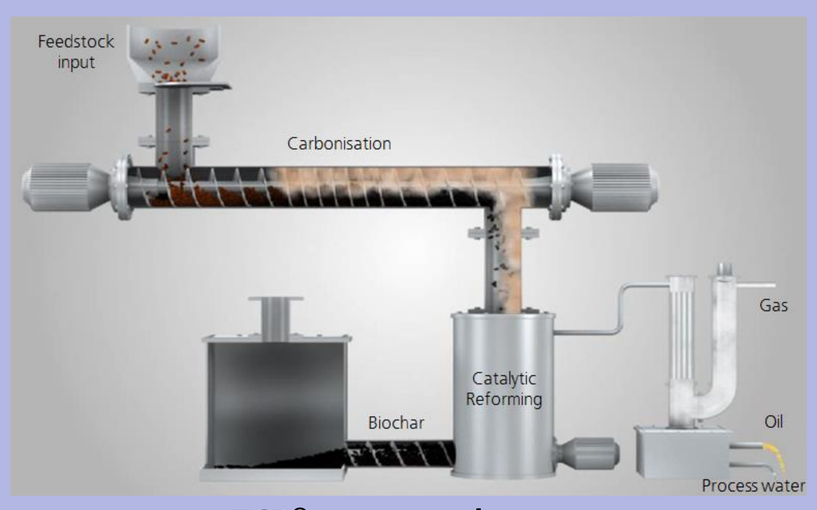
INTRODUCTION

The **Thermo-Catalytic Reforming process (TCR®)** is an endothermic two stage process developed by Fraunhofer UMSICHT, able to process biomass and biomass residues with high ash and moisture contents as well as with low ash melting points. The process is a combination of an intermediate pyrolysis reactor and a reforming stage.
Typically temperatures:
Carbonisation stage 350 - 500 °C.
Reforming stage 600 - 700 °C.
Residence time of the feedstock: minutes.
In the first stage pyrolysis vapors and biochar are produced. Through the patented process design, the biochar is an in situ produced catalyst with effects on the quality of the products in the catalytic reforming step.



TCR® process scheme

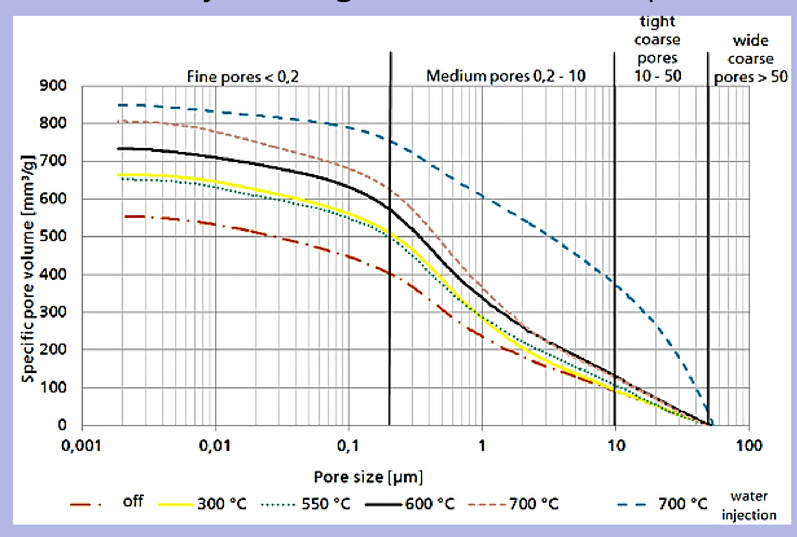
MATERIAL AND METHODS

The available lab scale (2 kg/h) and pilot scale (30 kg/h) TCR® units at Fraunhofer UMSICHT Sulzbach-Rosenberg are electrically heated. Further equipment for TCR® biochar modification (demineralisation or high temperature treatment) is available, too.

RESULTS

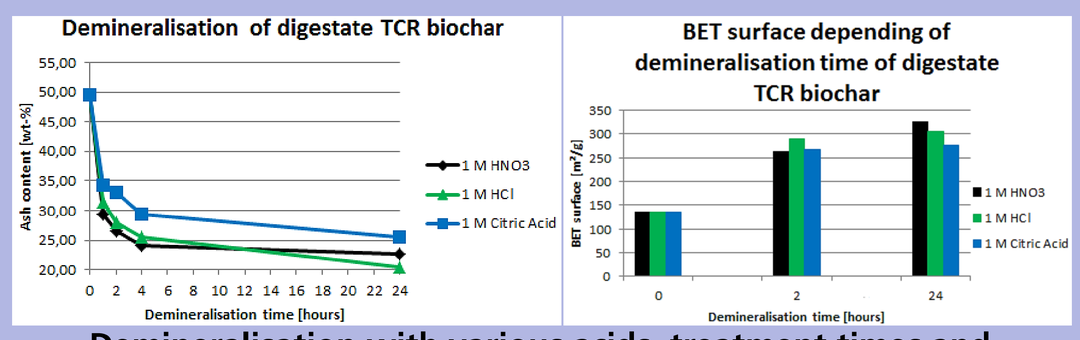
The TCR® products are a synthesis gas, biochar and an oil-water fraction which can be separated easily. The products have high quality. The synthesis gas is rich in hydrogen with a high lower heating value (LHV), the oil has a low viscosity and water content, a low total acid number and also a high LHV. The **TCR®-biochar** has very low O:C and H:C ratios (comparable with anthracite) by high C contents (depending on the feedstock and the contained ash content) without organic pollutants.

The TCR®-biochar yield as well as further TCR® biochar properties can be modified already through the TCR® process itself. By higher temperatures the biochar yield increases by getting higher ash contents. The pore size distribution can be changed through various reforming temperatures or by adding steam for example, too.



Pore size distribution of digestate TCR®-biochar by various reforming temperatures

For further usage as filter medium the reduction of the ash content with acid solutions afterwards can increase the BET surface, already. Further activation is possible, too.



Demineralisation with various acids, treatment times and resulting BET surface increase of digestate TCR®-biochar

CONCLUSION AND OUTLOOK

The TCR® is high flexible and can use a wide range of biogenic feedstock. All products show high quality.
The TCR®-biochar has a high stability. The H:C and O:C ratios are comparable with anthracite or hard coal. There is no organic left. The material use shows an ecological and economical added value compared to incineration usage for fossil coal substitution.
Depending on the feedstock the TCR®-biochar can be tailor made in the TCR® process itself or afterwards (e.g. ash reduction, change in pore size distribution or BET surface) for various applications.