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TWO STEP PROCESS FOR THE GENERATION OF EN-STANDARD FUEL AND CHEMICALS FROM WASTE BIOMASS

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INTRODUCTION

The Thermo-Catalytic Reforming (TCR®), developed at Fraunhofer UMSICHT, is the basis technology for the generation of chemicals and fuels from waste biomass. Due to the remarkably thermal stability of the bio-oil produced by TCR® it is directly suitable for catalytic hydrotreating to form desired products from waste biomass.

RESULTS

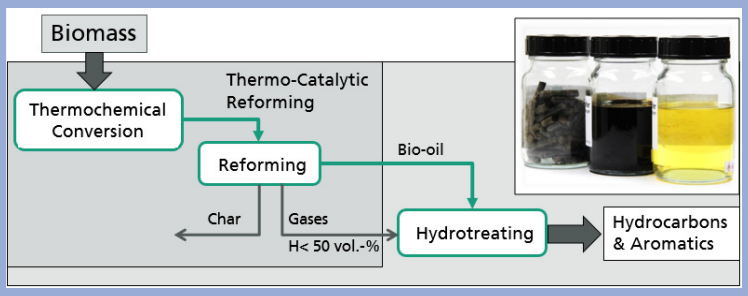
Bio-oil from sewage sludge was produced by TCR®. The crude TCR® bio-oil showed a water content below 3 wt.%, high carbon content (78 wt.%), and low oxygen content (7 wt. %) resulting in a thermal stable bio-oil. Due to its thermal stability the TCR® bio-oil is directly applicable for hydrotreatment to remove undesired sulphur, nitrogen, and oxygen. Promising catalysts like $CoMo/Al_2O_3$, $NiMo/Al_2O_3$, and Ru/C were tested at 380 °C and up to 170 bar for 20 h under hydrogen atmosphere. Successful hydrotreating formed a low viscous and bright liquid. A GC/FID analysis showed that product yields and compositions of the products depend strongly on the catalyst. Due to the high activity the yield of Ru/C catalysed hydrogenation is very low (54 %), NiMo and CoMo on alumina deliver yields up to 84 %. The utilization of Ru/C produced more hydrocarbons (36 %) and less aromatics (26 %; BTXE = 8.5 %) as $CoMo/Al_2O_3$ (31 % hydrocarbons; 27 % aromatics; BTXE aromatics = 11 %).

The product was fractionated into common fuels meeting the EN standards EN 228 (gasoline) and EN 590 (diesel). The combination of TCR® and hydrotreating is a promising approach to produce CO_2 neutral renewable fuels and chemicals.

CONCLUSION

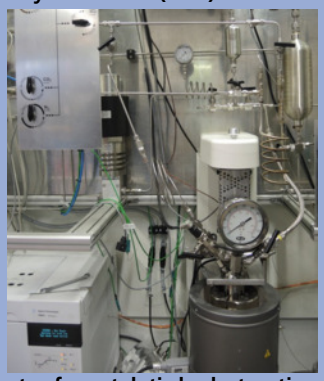
- TCR® bio-oil revealed thermal stability, high energy content, low oxygen and water content.
- The product yield and composition depend on the catalyst. $CoMo/Al_2O_3$ generates high amounts of BTXE aromatics, moderate hydrocarbon contents and maximum product yields.
- Successful production of TCR® based green fuel fully similar to fossil equivalents (EN 228/ EN 590).

The process for renewable products consists out of Thermo-Catalytic Reforming (TCR®) and catalytic hydrotreatment



Comparison between of TCR® crude oil and hydrotreated (HDT) TCR®-oil

Properties	Crude TCR®-oil	HDT TCR®-oil
C / wt.%	77.6	86.2
H / wt.%	8.0	13.8
N / wt.%	4.6	< 0.1
O / wt.%	7.0	< 0.1
S / wt.%	0.6	0.0015
H_2O / wt.%	2.2	0.0016
LHV / (MJ/kg)	34.0	42.8



Batch reactor for catalytic hydrotreating

Fractionation of hydrotreated TCR®-oil from sewage sludge into gasoline (EN 228) and diesel (EN 590) in a ratio of 40:40