



HYDROTREATING OF BIO-OIL FROM THERMO-CATALYTIC REFORMING - A NOVEL ROUTE TO RENEWABLE FUELS AND CHEMICALS

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INTRODUCTION

Thermo-Catalytic Reforming (TCR[®]), developed at Fraunhofer UMSICHT, is a cutting edge conversion technology for the conversion of waste biomass to high quality products. The oil, in particular, has a remarkably high quality so that the TCR oils are applicable in refineries. After refining of TCR oils, the products can be used as sustainable fuel or chemicals.

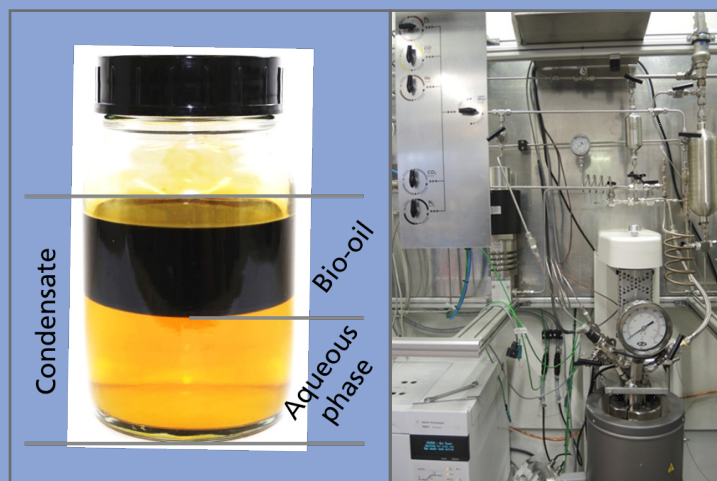
RESULTS

Bio-oil from waste biomass, like sewage sludge, was produced by TCR[®]. The crude TCR[®] bio-oil showed water content below 2%, high carbon content up to 84 wt%, and oxygen content below 5% resulting in a thermal stable and therefore distillable bio-oil. Due to its thermal stability the TCR[®] bio-oil can easily be used for further processing like removal of the sulphur, nitrogen, and oxygen. The catalytic hydrotreating forms a low viscous and transparent liquid. Promising catalysts like CoMo/Al₂O₃, NiMo/Al₂O₃, Ru/C, and ZSM-5 were tested at 380 °C and a pressure up to 170 bars for 20 h under hydrogen atmosphere.

The high yield of hydrotreated TCR[®] bio-oil (up to 84%) was fractionated to separate the biofuel into common fuel fractions, like gasoline and diesel. The renewable fuels were analysed and demonstrated that standards EN 228 and EN 590 can be met by hydrotreating of TCR[®] bio-oil. The combination of TCR[®], CHP, and hydrotreating is a promising approach to produce CO₂ neutral heat, power, and renewable fuels and chemicals.

CONCLUSION

- TCR[®] bio-oil revealed thermal stability as a unique property, high energy content, low acidity, low oxygen and water content.
- Successful production of TCR[®] based green fuel fully similar to fossil equivalents.
- Fossil fuel standards (EN 228 / EN 590) can be directly attained by hydrotreating and fractionation.
- CO₂ neutral heat, power, and renewable fuels and chemicals are being generated.



Liquid TCR[®] products separate clearly in bio-oil and water / Batch reactor for catalytic hydrotreating



Results produced by different catalysts for TCR-oil hydrotreatment (from the left side: ZSM-5, NiMo/Al₂O₃, CoMo/Al₂O₃, Ru/C)

	No Catalyst	ZSM-5	NiMo/Al ₂ O ₃	CoMo/Al ₂ O ₃	Ru/C
C [wt%]	81.9	82.0	85.8	86.4	85.4
H [wt%]	9.2	8.8	13.0	12.7	14.0
N [wt%]	6.6	6.6	1.3	0.8	0.6
O [wt%]	2.3	2.3	<0.1	<0.1	<0.1
S [wt%]	0.2	0.2	<0.1	<0.1	<0.1

Elemental composition of bio-oils hydrated by different catalysts