

Sewage Sludge: A successful Approach based on Thermo-Catalytic Reforming

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INTRODUCTION

The Thermo-Catalytic Reforming (TCR[®]) process, developed at Fraunhofer UMSICHT, produces TCR[®] bio-oil, hydrogen rich gas, and volatile free char from waste biomass. Due to the remarkable thermal stability of the bio-oil, it is directly suitable for catalytic hydrotreating. This poster shows an approach for integrating the side products (hydrogen and TCR[®]-char) into the upgrading process.

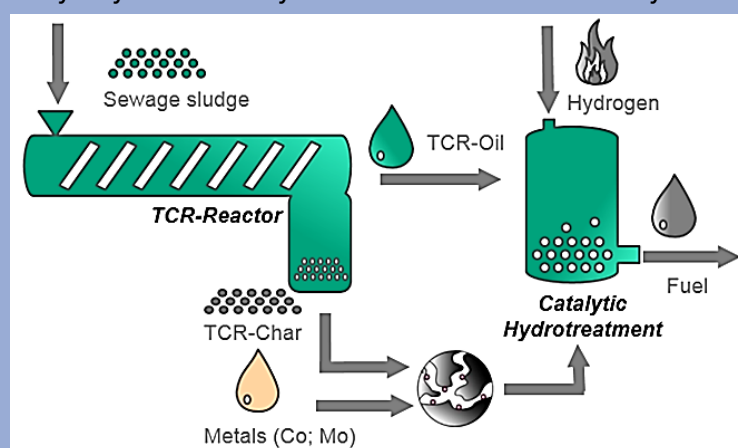
RESULTS

Sewage sludge was converted by TCR[®] at reforming temperatures of 973 K to generate bio-oil, gases and char. 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 thermally stable bio-oil. Due to its thermal stability, hydrotreating can be directly applied to the TCR[®] bio-oil, to remove undesired sulphur, nitrogen, and oxygen compounds due to hydrogen. Therefore, the hydrogen extracted from TCR[®]-gas is able to cover the required quantity for upgrading the oil. Usually, CoMo/Al₂O₃ is used as a hydrotreating catalyst. In this case, TCR[®]-char and activated carbon (AC) are impregnated with the active compounds (Cobalt & Molybdenum). After analysis, they are applied for upgrading at up to 170 bar for 5 h under hydrogen atmosphere. The surface of the TCR[®]-char is less structured and smaller than the AC-surface (see figure), but during hydrotreating both catalysts show similar results. The carbon and hydrogen contents increase, while oxygen, sulphur, and nitrogen yields are decreasing, forming a low viscous liquid.

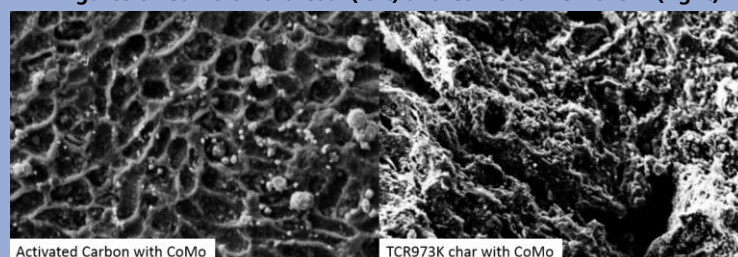
CONCLUSION

- TCR[®] bio-oil revealed thermal stability, high energy content, low oxygen, and water content.
- The hydrogen produced by TCR[®] covers the hydrogen requirement for upgrading the generated TCR[®]-oil.
- A TCR[®]-char based catalyst is produced and shows similar activities like the catalyst made from activated carbon.

The process consists out of Thermo-Catalytic Reforming (TCR[®]) and catalytic hydrotreatment by the utilization of TCR[®]-char as catalyst



REM figures of CoMo on charcoal (left) and CoMo on TCR[®]973 K (right)



Composition of hydrotreated TCR[®]-oil from sewage sludge by CoMo/TCR973K and CoMo/AC in comparison to crude TCR[®]-oil

