Deutsches Biomasseforschungszentrum
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DBFZ

Energetic and material valorization of digestate via hydrothermal liquefaction

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INTRODUCTION

Digestate is a nutrient and carbon rich side stream of anaerobic fermentation, which is mainly used for its nutrient load via land application. This study highlights hydrothermal liquefaction (HTL) as an alternative technology for increased value creation.

MATERIALS & METHODS

- **Three digestates**: Digested sewage sludge (**DSS**), straw/manure digestate (**SMD**), and digested biogenic waste (**DBW**)
- **20 mL mini-batch setup** using KOH as catalyst.
- DoE: **spherical CCD**
- Temperature: **290–360 °C**
- Time: **6–34 min**
- Models to describe product yields were developed for each digestate accordingly.

RESULTS

- Product distribution differs for each digestate.
- Modeling reveals **time** as the most significant parameter towards biocrude yield.
- **Similar optimum processing conditions** are predicted for the different digestates, close to the maximum of the investigated interval.
- Carbohydrates and fats positively influence biocrude yield, while high shares of lignin are linked with low yield.
- **Synergy** of protein and carbohydrates is observed.
- Nutrients are found in the solid residue in significant amounts.

CONCLUSION

Conversion of digestate via HTL enables further energetic exploitation and nutrient recycling. Feedstock composition influences optimum processing conditions and product quality. Nutrient yield is high regardless of processing conditions. Biocrudes obtained have an excellent heating value, but contain high shares of nitrogen, necessitating upgrading.

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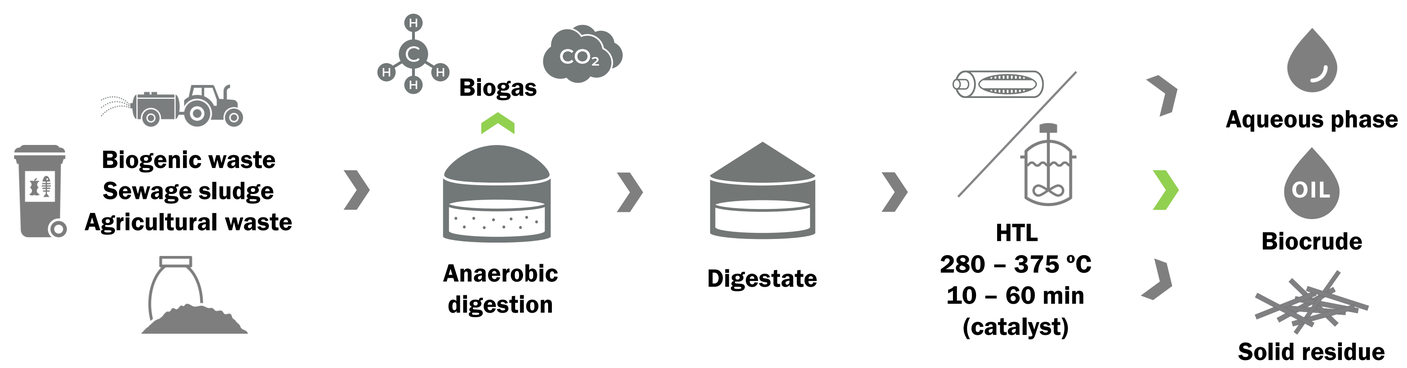

Figure 1: Proposed process scheme

Table 1: Feedstock analysis

		DSS	SMD	DBW
C	[$\%_{DM}$]	31.5	43.8	36.5
H	[$\%_{DM}$]	4.5	5.4	4.4
N	[$\%_{DM}$]	4.2	1.7	2.2
S	[$\%_{DM}$]	1.4	0.4	0.3
O	[$\%_{DM}$]	16.1	30.4	21.2
P	[g/kg_{DM}]	22.3	5.0	5.7
HHV	[MJ/kg]	13.8	18.2	14.9
Ash	[$\%_{DM}$]	38.7	16.0	35.5
Protein	[$\%_{DM}$]	18.8	12.4	16.2
Fats	[$\%_{DM}$]	7.1	4.1	3.7
Carbohydrates	[$\%_{DM}$]	35.4	67.4	44.6

Figure 2: HTL Mini Batch setup

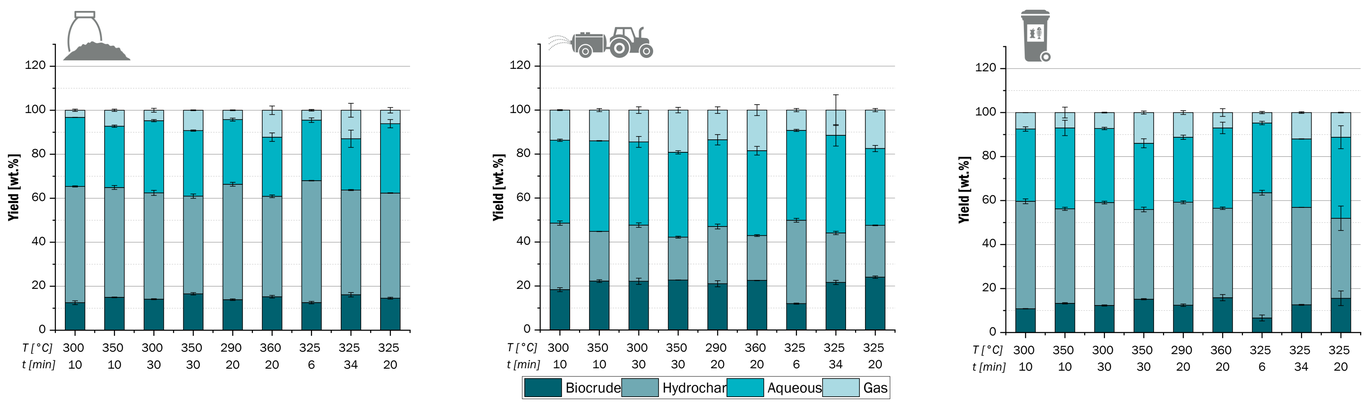

Figure 3: Product yields for DSS, SMD and DBW

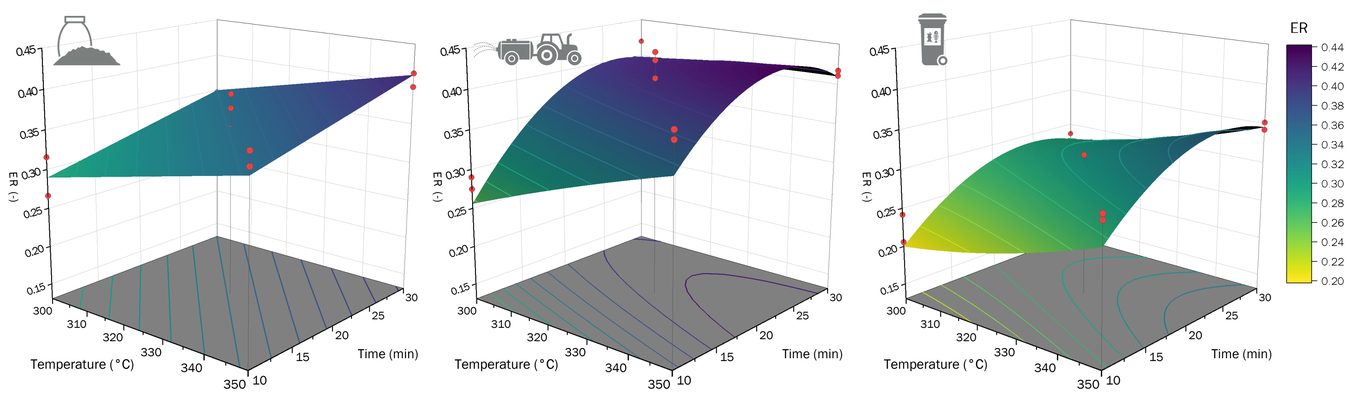

Figure 4: Energy recovery as a function of processing parameters for DSS, SMD and DBW

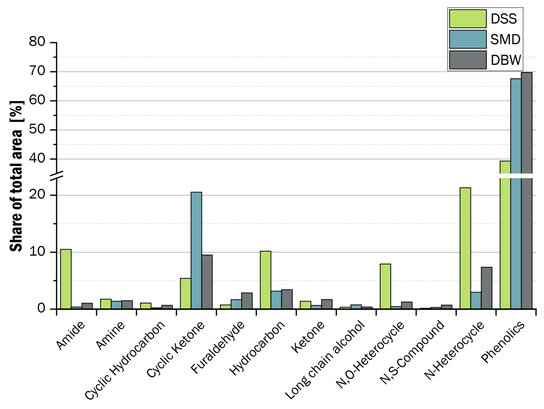

Figure 5: GC-MS of the biocrude

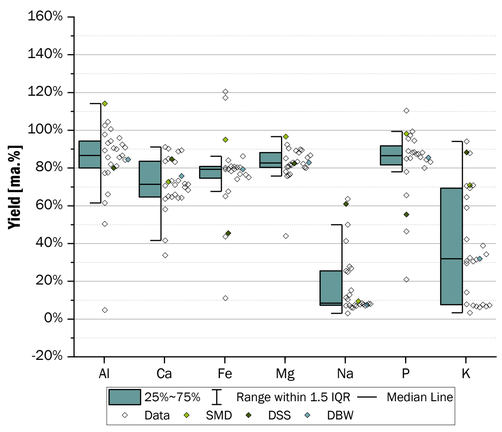

Figure 6: ICP-OES of the solid residue

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Financed by
Federal Ministry for Digital and Transport