# VALORISATION OF MUNICIPAL AND TANNERY SLUDGE VIA HYDROTHERMAL LIQUEFACTION: EFFECT OF THE SUBSTRATE CHEMICAL COMPOSITION ON YIELD AND QUALITY OF BIO-CRUDE

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Hydrothermal liquefaction (HTL) process is a thermochemical route to obtain a liquid energy vector (bio-crude) from high-water-content biomasses. In fact, in hydrothermal conditions (250–400°C and 40–200 bar), water acts as catalyst, reactant and thermal flywheel, and thus the biomass organic components can be directly converted without a drying step, which is instead fundamental in competing technologies such as pyrolysis, gasification and combustion. At the end of the HTL process, apart from the target bio-crude, a gas phase, a solid residue, and an aqueous phase are also produced [1].
Municipal and industrial sludges appear to be particularly interesting raw materials for HTL, due to their high moisture content (usually in the range of 80–90%$_{vol}$) and their constituents that include mainly proteins, lipids and carbohydrates. However, sludges are a very heterogeneous biomass, and their composition can change according to both source and seasonality, influencing the yield and quality of bio-crude formed through the complex reactive network that takes part in the HTL process. There are different literature works that study the interaction of macro-components using model compounds; moreover, the synergistic/antagonist effect of different organic fractions is evaluated through predictive models [2].
In this work, two sludges of different nature, namely a municipal and tannery sludge (Table 1), were subjected to HTL tests, in a 500 mL batch autoclave, to study the yield and quality (including *Higher Heating Value*, *HHV*) of the bio-crude produced at different temperatures and isothermal reaction times [3]. Subsequently, the yield of bio-crude using mixtures of the two sludges was evaluated to verify possible synergistic or antagonistic effects of lipid, protein, and carbohydrate fractions during the HTL process.

*Table 1 – Main properties of parent sludges (% by weight, dry basis)*

| | C [%] | H [%] | N [%] | S [%] | Carbohydrates [%] | Lipids [%] | Proteins [%] | HHV [MJ/kg] |
|---|---|---|---|---|---|---|---|---|
| Municipal sludge | 34.6 | 4.9 | 5.9 | 0.8 | 59.0 ± 0.03 | 2.4 ± 0.1 | 25.0 ± 0.1 | 13.5 |
| Tannery sludge | 33.5 | 5.3 | 2.5 | 4.1 | 21.0 ± 0.02 | 5.3 ± 0.2 | 29.4 ± 0.9 | 14.9 |

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