Poster E16

Supercritical Gasification and Partial Oxidation of Beet Residues in a Continuous Reactor

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This work deals with the gasification of a waste (beet residue) in supercritical water. A system already designed for oxidation processes has been used, without oxygen or with limited oxygen to obtain partial oxidation of biomass. Some data are necessary for the continuous process developing and for a future use in an energetic evaluation. The reactor is operated in continuous mode at a maximum pressure of 30 MPa. Experiments are conducted with good mass balances.

For supercritical gasification, the reduction of total organic carbon in the liquid effluent output presents a little variation, between 59 and 69%. The gas compositions are 30 to 60% for molar fractions of CO_2 and hydrogen, and about 3 to 15% for the molar fractions of methane. The mole fractions of CO and of the other hydrocarbons are at traces levels. Global and partial balances on carbon are respectively in the range of 86 to 99% and 55 to 90%. Maximum yields obtained are 70% for carbon conversion yields, 45% for carbon gasification yields and 491 $g.kg^{-1}$ of dry beet residues. Gas mixture LHV is 5 $MJ.kg^{-1}$. Only the initial concentration and the ratio between water and waste have a slight influence.

To increase the reaction temperature, supercritical water partial oxidation has been conducted. The highest carbon gasification yield is obtained for the highest equivalent molar ratio, indicating a great interest of partial oxidation. In the case of partial oxidation study, results show partial and total material balances on carbon ranging from 80 to 100% and 75 to 113%. Global yields obtained are 81% for carbon conversion, 69% for carbon gasification and 816 $g.kg^{-1}$ of dry beet residues for global yield of gasification. Gas mixture LHV is equivalent to that obtained in the gasification case. Moreover, the results indicate that the process accepts biomass flow variations without influencing the global efficiency.

This study helps to highlight the feasibility of the biomass treatment process in a continuous reactor (POSCEA2) originally designed and sized to achieve a hydrothermal oxidation of organic compounds.