EXPERIMENTAL STUDY OF OXIDATION OF BIO-OIL SURROGATES IN JET-STIRRED REACTOR

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INTRODUCTION

The energy transition is nowadays one of the most important political and social topic. The utilization of bio-oil as fuels or additive in fuels is one of the answer proposed to us. However the utilization of bio-oil is compromised by its great diversity of composition. The composition of a bio-oil is indeed mainly dependant of the biomass of origin. Due to this diversity, it is complex to characterize a bio-oil directly, that is why the use of surrogate can be interesting. To determine the bio-oils surrogates and to study their oxidation can be a huge step towards the utilization of bio-oil as bio-fuel.

BIO-OIL COMPOSITION

The composition of a bio-oil is mainly dependant of the origin of the used biomass. Some bio-oils can contain until hundreds compounds and the characterization of bio-oil is often not complete. There is always a unknown part in the bio-oil that can be more or less important. However it is possible to classify every identified and quantified compounds of a bio-oil in chemical families: non-aromatic, heterocyclic and aromatic compounds. With this classification, differences between bio-oils with the same biomass of origin can be seen. Within this classification it is also possible to create subfamilies to describe more precisely the composition

Figure 1. Composition of three bio-oils coming from pinewood produced by pyrolysis

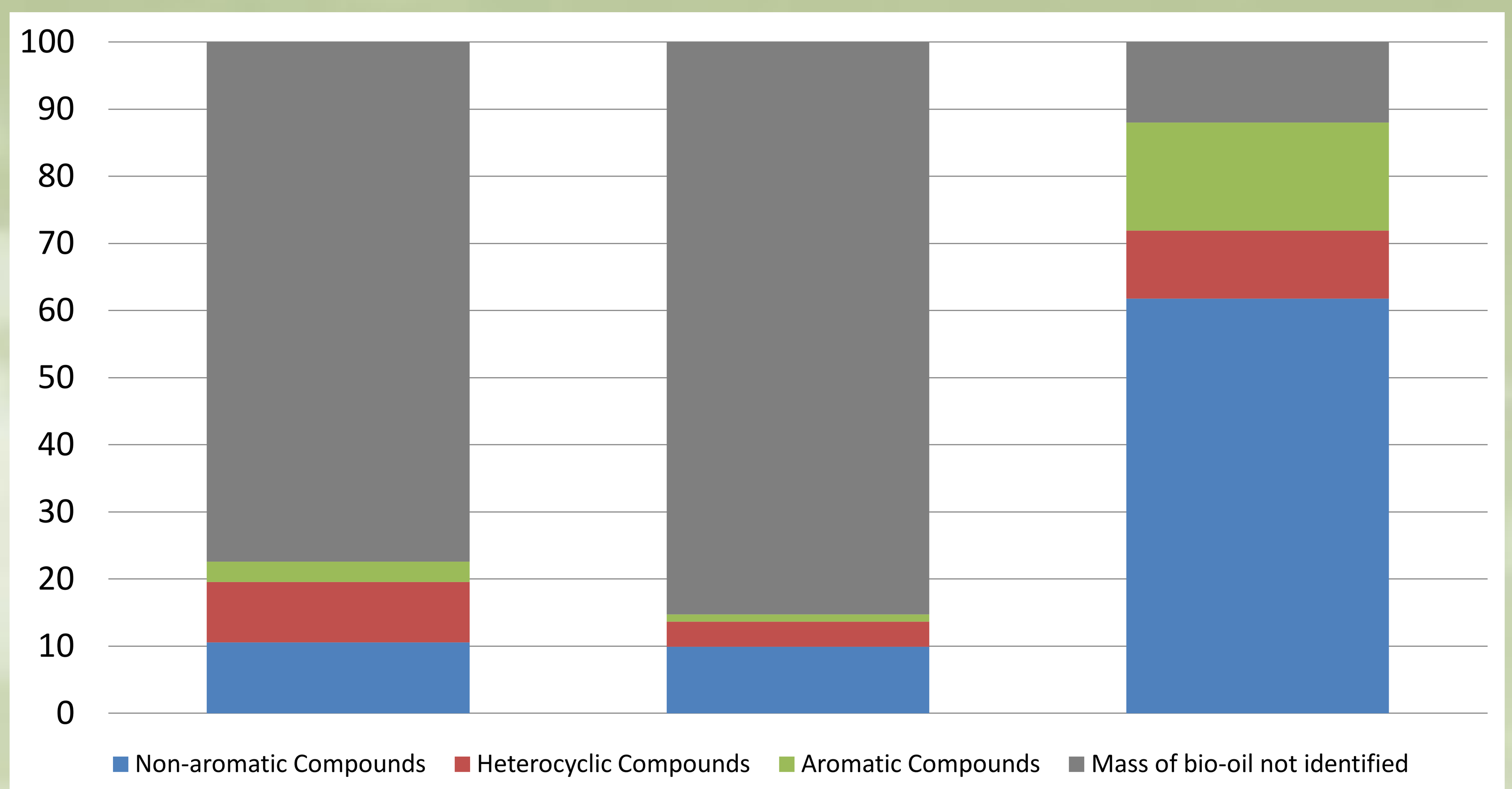
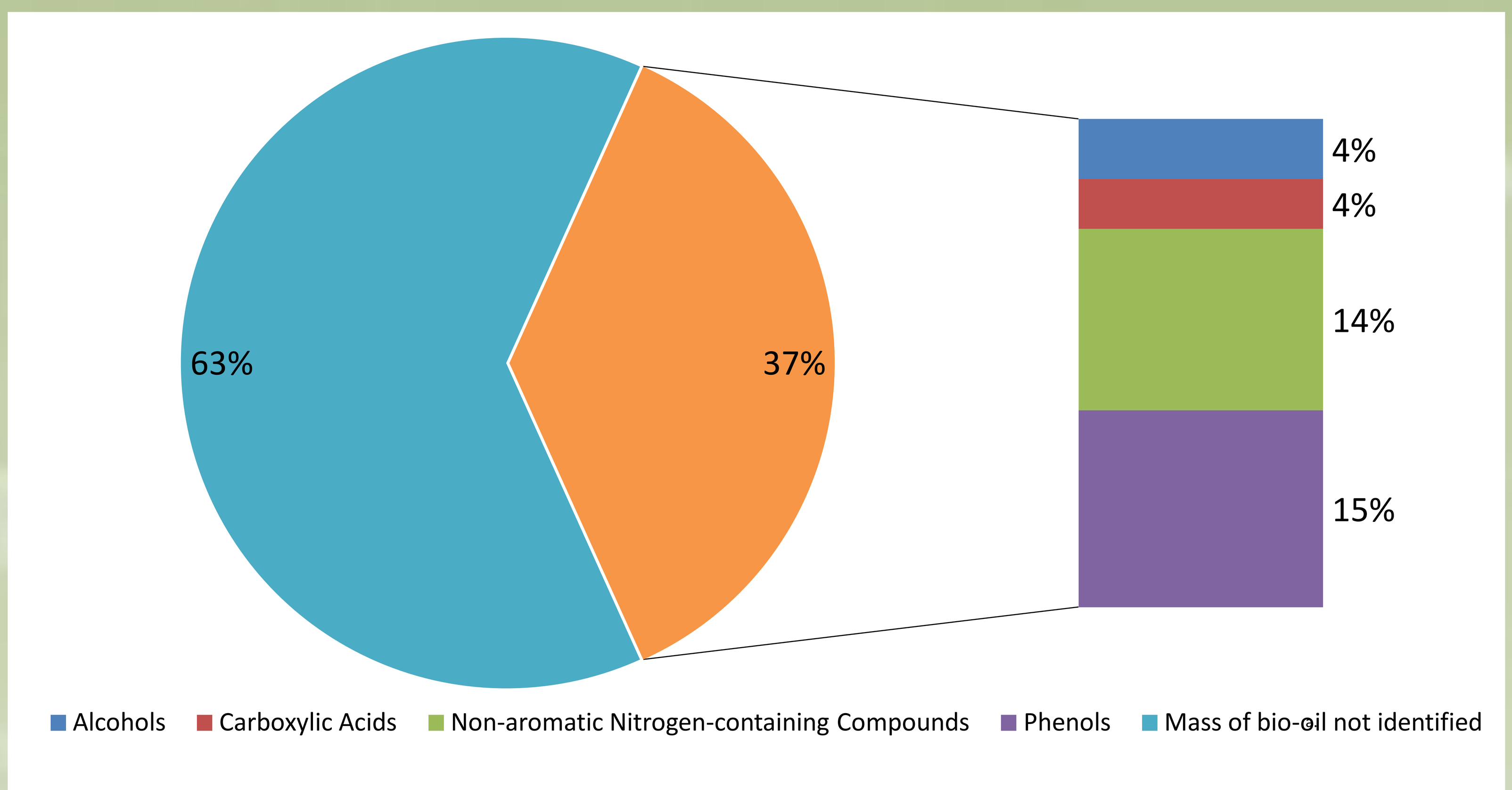


Figure 2. Composition of bio-oil coming from poultry litter produced by pyrolysis

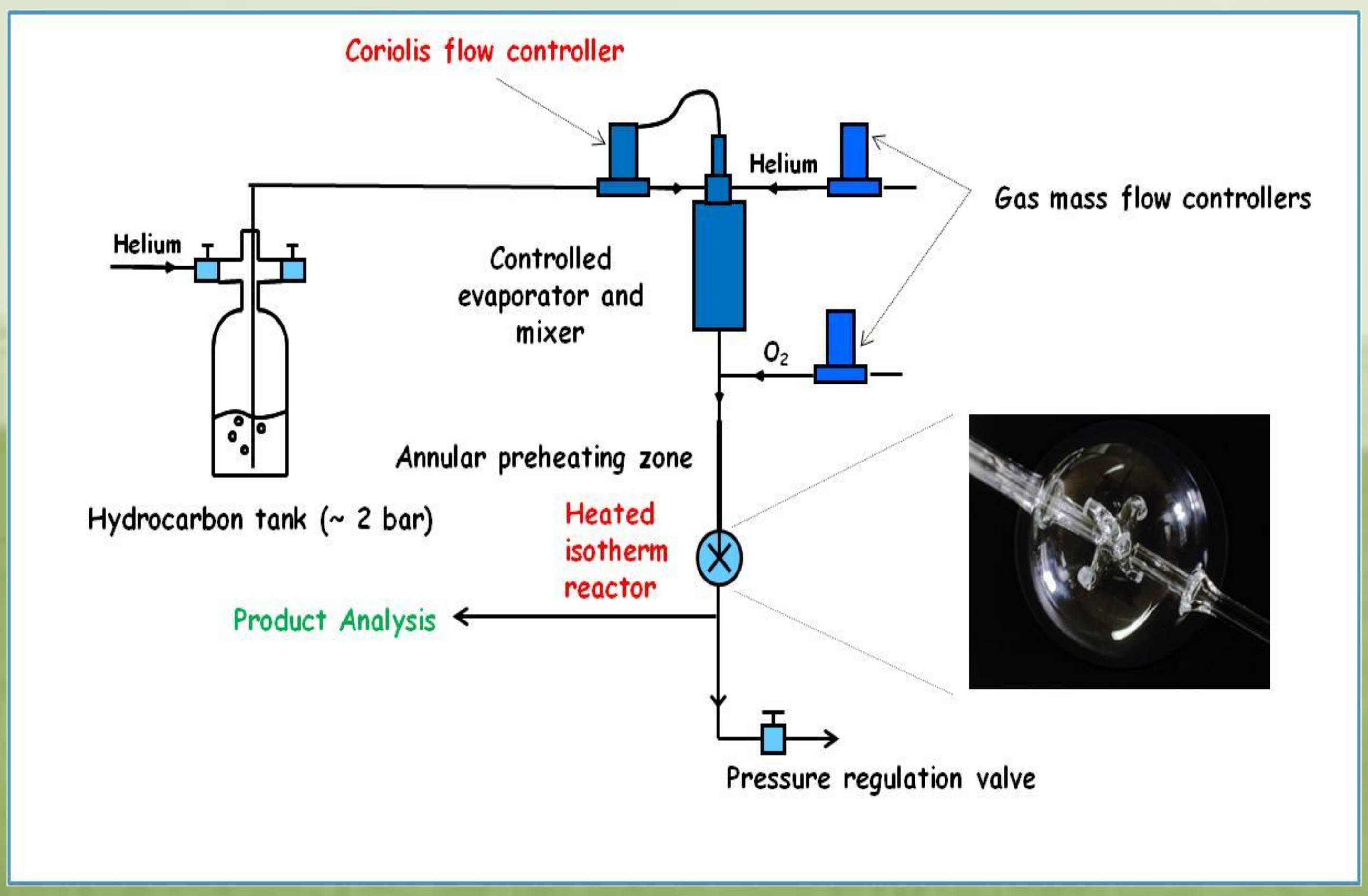


With these information, a surrogate for the bio-oils have been defined. The chemical subfamilies that will be studied are: alcohols, aldehydes, acids, furan derivatives and phenol derivatives. A big part of the work will also be on the nitrogen containing compounds as they are typical of bio-oils.

OPERATING CONDITIONS

Experiments are carried out in a jet-stirred reactor at a constant pressure of 800 Torr and at a constant residence time of 2s. Oxidation are studied for lean, stoechiometric and rich conditions (equivalence ratio in fuel = 0.5-1-2) and for a large range of temperature (500-1100 K). The fuel is diluted in helium in order to obtain a initial mole fraction equals to x=0.005.

Figure 3. Experimental set-up



The fuel and its products concentration are measured by online gas chromatography.

RESULTS

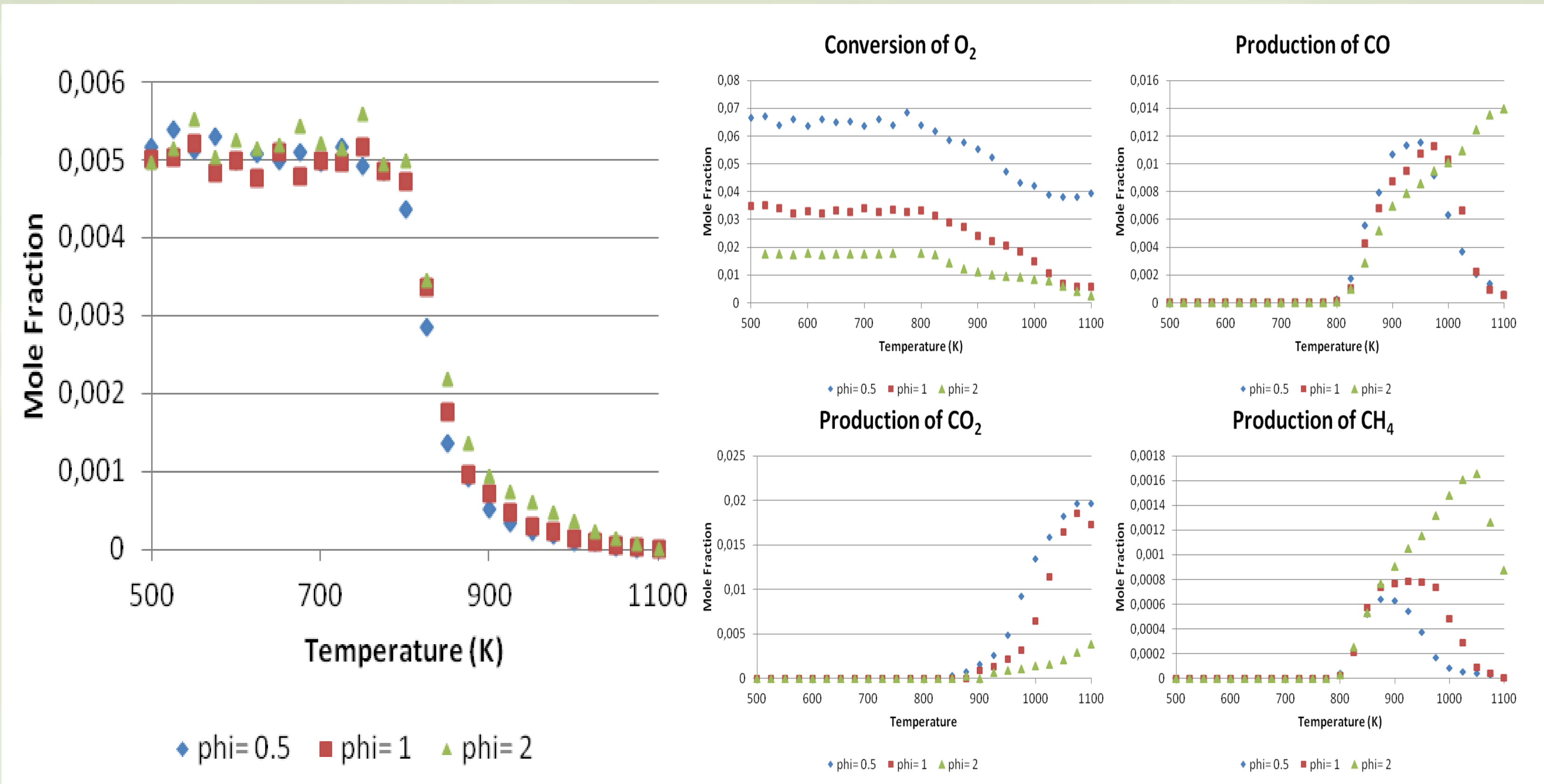


Figure 4. Results obtained for the oxidation of butanal for three equivalence ratios

CONCLUSION AND PERSPECTIVES

A surrogate for bio-oil have been proposed to study their oxidation. The study of n-butanol, n-pentanol and butanal have already been performed. Many products have been identified like CO, CO_2, CH_4 and other one like formaldehyde or aldehyde…

Next studies will be on pentanal and acids. With the results for the oxidation of these products, modeling will be made to improve the existing kinetics models.

ACKNOWLEDGMENT

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