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Reaction path analysis of microalgae biomass conversion to biofuel through microkinetic modelling

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Environmental problems have forced the society to explore possible new renewable sources and technologies for fuel production. Microaglae are considered as a potential third generation biodiesel source and have been explored greatly. The biofuel algal production has developed considerably after 2010, however major cost and quality challenges still need to be addressed.

Among the three main approaches used, the lipid extraction and further transesterification, pyrolysis, and the hydrothermal liquefaction, the first is currently the most common fuel production pathway. The latter is also gaining a lot of attention, mostly due to the high algal water content. This research studies the one-pot *Chlorella sorokiniana* microalgae liquefaction and catalytic hydrotreatment in a three-phase slurry reactor over NiMo/γ-Al_2O_3 catalyst.

The kinetic studies may reduce the cost prohibitive processes, since are crucial to better understand optimal operating conditions. In order to obtain a decent kinetic model, reaction mechanism was first needed to be determined based on experimentally obtained products and intermediates. Several microkinetic models for intermediates, such as fatty acids [1], triglycerides and fatty acid methyl esters [2,3], have already been developed. To the best of author's knowledge, this is the first kinetic model established for microalgae conversion into diesel-like hydrocarbons. The model considers the mass transfer phenomena involved in the liquefaction process, the mass transfer of hydrogen from gas to liquid phase, adsorption, desorption and surface reaction kinetics. Activation energies together with reaction kinetic constants were obtained numerically and provided insight into the catalytic mechanism. The lowest rate constant was calculated for the microalgae conversion to triglycerides, indicating slow liquefaction.

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