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Biofuel from "humified" biomass

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In France, 26% of the emissions of greenhouse effect gas originate from transportation which depends for 87% on fossil fuels. Nevertheless biofuels can contribute to the fight against climate change while reducing energetic dependence. Indeed biomass potentially represents in France 30 Mtoe a year that is to say 15% national consumption. But 80% of these resources are made of lignocellulosic materials which are hardly exploitable. First-generation biofuels are made from sugar, starch, vegetable oil, or animal fats. Due to their competition with human food chain, first-generation biofuels could lead to food shortages and price rises. At the contrary second-generation biofuel production can use a variety of non food crops while using the lignocellulosic part of biomass [1]. Gasification, fermentation and direct pyrolysis are the most used processes. However weak yields and high hydrogen need are limiting factors.

In France, the National Program for Research on Biofuels (PNRB) aims to increase mobilizable biomass resource and to develop lignocellulosic biomass conversion. In this context, the LIGNOCARB project studies the liquefaction of biodegraded biomass in order to lower hydrogen consumption. Our aim was to develop and optimize the biodegradation of the biomass.

Once the reactor was achieved, the influence of different parameters (starting material, aeration, moisture content) on the biotransformation process was studied. The monitored parameters were temperature, pH and carbon /nitrogen ratio. Chemical (IHSS protocol) and biochemical (van Soest) fractionations were used to follow the maturity ("humic acid"/"fulvic acid" ratio) and the biological stability (soluble, hemicelluloses, celluloses, lignin) of the organic matter (OM). In example, the increase in lignin can be related to the stabilization since the OM becomes refractory to biodegradation whereas the increase in the AH/AF ratio traduces "humification". However, contrarily to the composting process, we do not look forward to obtain a mature OM for which the carbon loss would be too important.

The global analysis of the biomass OM during biodegradation using infrared spectroscopy (DRIFTS) confirms "humification". Indeed the relative intensity of bands associated to aromatics increase relatively to those associated to aliphatics[2] [3]. The molecular study of lipids and humic fractions was realised using mass spectrometry (GC/MS), pyrolysis (Py-GC/MS) and thermodesorption (Headspace-GC/MS). The decrease in lipids indicates a high biodegradation. Amongst volatile organic compounds (COVs), the isoprenoid C18 ketone which is probably produced from biodegradation of phytol is observed in all our samples.

The organic matter obtained after biodegradation is stable (resistant to biodegradation) and humified but still rich in carbon. The characterisation of bacterial biomarkers will help us to specify and thus to optimize biotransformation mechanisms.

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