How does olive oil affect the production of bioenergy feedstocks from olive mill waste?

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The Mediterranean region is currently responsible for a large proportion of the olive oil production worldwide. Spain, Italy, Turkey and Greece are the main producer countries and supplied almost the 80% of the total olive oil produced during the 2013-2014 campaign. The main process used to produce olive oil is a two-phase centrifugation method, which is a relatively new process that solves many issues with the three-phase method. The two-phase method reduced the amount of process water, the energy requirements and the volume of waste generated and improved the quality of the olive oil produced. However, this technology generates a new waste known locally as 'alperujo' or two-phase olive mill waste (TPOMW), which is a high polluting by-product that, in addition, has a very high moisture content (>65%). Likewise, the TPOMW still contains some olive oil and the amounts vary depending on the TPOMW origin mill. Current technologies are insufficient in treating this waste and a specific management regarding minimization, valorization and mitigation of their environmental impact is needed (Roig *et al*, 2006).

This work focuses on the development of a possible treatment method: the hydrothermal carbonization (HTC) of TPOMW to produce bioenergy feedstocks. Hydrothermal carbonization is a wet thermochemical treatment technique that takes place in a sealed reactor, where several complex reactions occur to produce a carbon-enriched solid more suitable for energy generation (HTC-char) and a liquid wastewater (Libra *et al*, 2011). As the moist waste is heated, the water is evaporated producing autogenous pressure that holds the rest of the water in the liquid phase and, consequently, prevents large amounts of energy being wasted evaporating water. Other pyrolysis processes require a dry feed; HTC reduces the energetic requirements to treat the TPOMW as the water must not be eliminated before this technology.

In this work the influence of the olive oil in the physical and chemical properties of the HTC-char was evaluated. Fresh TPOMW was dried at 105ºC during 24 h and then the remaining olive oil was totally extracted by accelerate solvent extraction (ASE) with hexane. Afterwards, mixtures of dry and extracted TPOMW (DE-TPOMW) and olive oil (OO) were prepared with different DE-TPOMW/OO ratios. Experiments of HTC were conducted in a high pressure lab-scale reactor with an internal volume of 1 L at a temperature of 225ºC and residence time of 2 hours. Figure 1 shows the diagram flow of the experimental procedure. Finally, several analysis techniques were used to characterize both the HTC-char and the liquid wastewater.

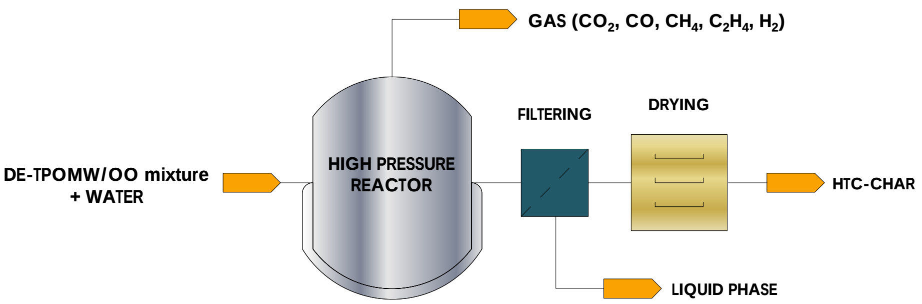

Figure 1. Diagram flow of the experimental procedure.

It was found that the olive oil mainly remains in the HTC-char and, consequently, contributes to enhance the global heating value of the solid by a 12%. Other characteristics, like the solid yield (%) and the hydrophobic properties, were also improved as the olive oil content in the previous mixtures increased. Thus, on the one hand, the solid yield rose from 50 to over 58% and, on the other, the dewatering of the HTC-chars by mechanical filtration was easier with increasing OO. As a result, the moisture content of the HTC-chars after filtration considerably decreased.

Therefore, it could be concluded that HTC is deemed to be an effective treatment of TPOMW and that HTC will be more beneficial to produce bioenergy feedstocks as the amount of olive oil retained in the TPOMW increases.

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