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Title: "Fate, Behaviour and Impact Assessment of New Generation of Biodiesels and Biofeedstocks in Case of an Accidental Spill"

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Topic: **Shipping Risks – marine fuels**

Abstract

Following an accidental spill of biodiesel in inland waters (France, 2016), Cedre and TotalEnergies decided to initiate a project to understand the fate and behaviour of biodiesels and biofeedstocks in case of accidental release in fresh or marine waters. Two biodiesels (B10 and Hydrogenated Vegetable Oil-HVO) and two biofeedstocks (Tallow Oil- TO, Used Cooking Oil-UCO) were selected. The influence of natural weathering processes were assessed at laboratory and pilot scale in Cedre's flume tank. The different parameters measured were density, viscosity, emulsification, oil adhesion, natural dispersion and biodegradability. In addition, the ecotoxicity of the four products were compared through normalised tests on marine bacteria (*Vibrio fischeri*) and marine algae (*Phaeodactylum tricornutum*).

Due to their high pour point, the two biofeedstocks TO and UCO (transported at 60°C) rapidly solidify after release in water. Due to agitation, the slick breaks up into 2-3 cm diameter pieces for UCO and up to 5 cm diameter balls for TO (figure 1). As a consequence, recovery techniques must be adapted to the specific characteristics of this pollutant. Given the rapid "freezing" of TO and UCO, the use of recovery devices such as nets, trawls or dip nets will be preferred. Deployment of confinement booms will be advised in order to facilitate the recovery operations. Although no evidence of natural dispersion was found during the trials, the presence of small pieces of TO up to 1 meter deep was observed during the trials. In the case of an environment with strong currents, a punctual immersion of this product could complicate the containment operations. Regarding the ecotoxicity tests, the two biofeedstocks did not present any toxicity towards the 2 marine species tested. As regard to the biodegradability, the two products appeared highly biodegradable. These rates are in agreement with the IMO recommendations for the implementation of bioremediation worksites.

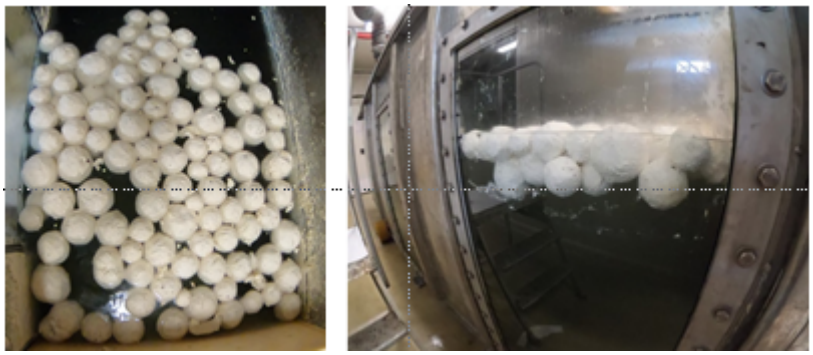

Figure 1. View of TO balls (5 - 10 cm) of TO after one week of weathering.

Regarding the biofuels B10 and HVO, they tend to disperse progressively but systematically after 2-3 days of weathering. This dispersion implies the integration of a water quality monitoring in the contingency plans. This behavior - which is contrary to the behavior of conventional oil such as crude oils - remains nevertheless dependent on surface agitation. Experiments at lab scale were conducted in order to explain this phenomenon on weathered samples of biofuels. Additionally to level of agitation, these tests allow us to highlight the influence of evaporation and photo-oxidation on the natural dispersion behavior.

Under low hydrodynamic conditions, the biofuel slick remains at the water surface and present a low emulsification rate. Therefore, if a surface slick is detected, mechanical recovery, for example using a weir skimmer, and oleophilic devices using discs or drums, appeared the most appropriate for this type of product. The success of these options depends on the possibility of confining the pollutant using an anti-pollution barrier in order to increase the thickness of the slicks.

Concerning the biodegradability, the tests undertaken in the laboratory allow us to conclude that the biodegradation of B10 did not exceed 40% and that HVO was highly biodegradable (more than 90%).

As regard to the ecotoxicity measurements, HVO did not present any toxicity towards the 2 aquatic species tested (*Vibrio fischeri* and *Phaeodactylum tricornutum*). As regard to the B10, this product is to be considered as toxic towards the marine bacteria and moderately toxic towards the alga.

All of the data and conclusions from this study will now be integrated in contingency plans in order to improve the response in case of spill.