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Chemical herder effectiveness as oil spill response tool in ice-infested water

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Abstract

The effectiveness of the chemical herding of crude oil, an enhancement for oil spill response methods, was studied in ice-infested waters to evaluate the applicability to oil spills in Arctic waters. The average slick thickness, surface coverage distribution of the slicks, as well as the burning efficiency of a North Sea crude oil were studied after herding to determine the herder effectiveness as a function of the ice coverage, amount of herder, wind speed and use of free floating or fixed ice. Experiments were performed in a small scale laboratory setup, featuring a 1.0x1.0x0.5 m³ water basin (1 m² surface area), and in an outdoor test basin of 4.0x4.0x0.05 m³ (16 m² surface area) in Sisimiut, Greenland. The chemical herder, which is a surfactant that spreads out to form a monolayer, was distributed equally (150 µL/m² oil) among the edges of the water surface after the crude oil had spread out, to compact and thicken the oil slick. Objects on the water surface were shown to have a negative effect on this process, distributing up to 25% of the total oil among additional small oil slicks as compared to the formation of a single oil slick on open water. The average slick thickness of the herded oil reached up to approximately 6 mm and the oil slicks could easily be ignited. However, the formation of additional slicks reduced the burning efficiency by at least 8%, as some of the smaller slicks did not participate in the burning. Burning times were also increased significantly as separate slicks needed to be ignited one at a time. The results showed that while the herding process is effective because it thickens the oil slick to an ignitable thickness, its effectiveness was reduced with increasing ice concentrations on the water surface. Current herding and *in-situ* burning logistics would need to adapt to the formation and burning of multiple oil slicks in ice-infested waters common in the Arctic environment in order to achieve maximum efficiency.