Thermal properties and burning efficiency of crude oils and refined fuel oil

Thermal properties and burning efficiencies of fresh and weathered crude oils and a refined fuel oil were studied in order to improve the available input data for field ignition systems for the in-situ burning of crude oil on water. The time to ignition, surface temperature upon ignition, heat release rate, burning rate and burning efficiency of two fresh crude oils (DUC, a light crude and Grane, a heavy crude), one fresh refined fuel oil (IFO 180) and weathered DUC (30-40 wt% evaporated and 40 wt% evaporated with 40 vol% water) were tested. Experiments were conducted in a newly designed water-cooled holder for a cone calorimeter under incident heat fluxes of 0, 5, 10, 20, 30, 40 and 50 kW/m². The results clearly showed that the weathered oils were the hardest to ignite, with increased ignition times and critical heat fluxes of 5-10 kW/m². Evaporation and emulsification were shown to be the determining factors increasing the critical heat flux compared to the physical properties of the oils. Boilover was observed for both emulsified DUC and fresh Grane and dominated the energy released by these oils. These results provided further evidence that the boilover phenomenon is correlated to the superheating of relatively volatile components such as water (DUC emulsion) or light hydrocarbons (Grane). Boilovers can thus occur due to inherent properties of the burning oil and should therefore be taken into account in the safety planning of in-situ burning operations. Maximum burning efficiencies of 85-90% were obtained for heat fluxes of 40-50 kW/m² for the crude oils and 80% at 30 kW/m² for IFO 180. The heat feedback in large scale fires, however, was estimated to be about 17 kW/m², for which the burning efficiencies were < 80%. These results indicate that the increased heat feedback to the fuel surface is not the only factor that increases the burning efficiency for large scale fires compared to laboratory experiments. Additional factors such as feeding of surrounding oil into the fire by buoyancy induced wind flows into the hot smoke plume are probably also contributing to these increased burning efficiencies.

General information
State: Published
Organisations: Department of Civil Engineering, Section for Building Design
Publication date: 2017

Host publication information
Title of host publication: International Oil Spill Conference Proceedings
Volume: 2017
Source: PublicationPreSubmission
Source-ID: 137073708
Research output: Research - peer-review > Article in proceedings – Annual report year: 2017