DCE/GINR comments and recommendations for documentation of remediation of land-based spills of hydraulic oil

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Background

By phone 8 October 2024, the Environmental Agency for Mineral Resource Activities (EAMRA) has asked DCE/GINR to provide a scientific note related to documentation of environmental remediation of land-based spills of hydraulic oil.

Introduction

Usage of mobile machinery in the mining industry, e.g. front loaders and dump trucks, may cause spills of hydraulic oil to the terrestrial environment. The quantity of most spills constitutes less than 20 liters (Deuster and Schmitz, 2021), but some mobile machines can hold several hundred liters of hydraulic oil. Spills of hydraulic oil typically occur suddenly, when hoses or couplings break, but seeping spills over a longer period may also occur. The dispersal and resulting concentrations in the soil following these spills are therefore very variable.

Except for special-colored or very contaminated hydraulic oil, most hydraulic oils are almost colorless, transparent and odorless. Spills of hydraulic oil are therefore not easily detected by either visual observations or odors in the soil challenging the delineation and remediation of the spills. Due to its low volatility, hydraulic oil is typically not detectable by Photo-Ionization Detectors (PID).

In Denmark, remediation of spills of hydraulic oil by excavation of the contaminated soil volume is documented to the authorities by taking soil samples from the bottom and sides in the excavation after the contaminated soil has been dug up, documenting that non-polluted background level has been reached. These documentation soil samples are sent to accredited chemical analysis in specialized laboratories. If the documentation soil samples are clean of oil, the authorities approve the clean-up. If not, the operator must expand the excavation accordingly and take out new documentation samples until a clean background level is reached. In Greenland, there are no laboratory with this specialization, and the Danish solution is therefore not a practical operational solution in relation to documenting the remediation of hydraulic oil spills.

Mineral-based hydraulic oils are toxic in both soil and water environments and have a slow break down (Deuster and Schmitz, 2021 and Kamyab, 2024). Within the last 20-30 years, the use of bio-based hydraulic oils based on various vegetable oils have gradually become standard, especially in machines operating in environmentally sensitive areas (Kamyab, 2024) . Bio-based hydraulic oils are characterized by being significantly less toxic and they break down faster than mineral-based hydraulic oils in the soil and water environment (Deuster and Schmitz, 2021 and Kamyab, 2024). Until recently, bio-based hydraulic oils have shown limited suitability for use in Arctic regions as they become more viscous than mineral-based oil at low temperatures. But the latest technological development within the industry has resulted in the development of bio-based hydraulic oils with operational ranges that span very low temperatures (e.g. -40 °C for the BioFlo Synthetic AW 46 LT: https://www.bioblend.com/product/bioflo-synthetic-aw/ available on the market since 2023).

DCE/GINR comments and recommendations

With respect to the future practices of providing adequate documentation soil samples after excavation and remediation of spill of hydraulic oil in Greenland, DCE/GINR suggest that simple test-kits may be used (e.g. https://www.oil-in-soil.com/oil-in-soil and http://cheiron-resources.com/oilscreensoil.php). These test-kits are user-friendly and relatively inexpensive (less than € 20/DKK 150). They can easily and quickly detect contents of all types of oil in soil, and they are particularly useful in relation to the delineation of hydraulic oil spills as this type of oil is not detectable visually or by odor while excavating contaminated soil. The test kit works visually, which is also useful for photo-based documentation of the remediation.

DCE/GINR recommend that documentation for handling and mitigation of spills of hydraulic oils include the following elements in the incident report:

1. Recording of GPS coordinate(s) of spill site(s)

2. Commented photos of the spill site prior to remediation.

3. Photos and descriptions of the final open excavation after remediation, including where documentation samples have been taken. The documentation samples should be located where the spill is concentrated. If the spill site covers a limited area of less than 4 m^2 to a depth of less than 0.5 m, a single documentation sample is sufficient.

3. Photo(s) of documentation sample(s) in the transparent sample tube(s) without indication of oil content.

4. Photo of the filled-up/levelled excavation.

5. GPS coordinates and photos of handled contaminated soil ready for shipment and subsequent disposal.

6. If the surface of the spill area is frozen solid, photos are taken of the spill site and of the applied practicable remedial actions. GPS position is recorded so the spill site can be revisited to obtain documentation samples in the following summer, if required by the authorities.

DCE/GINR recommend that bio-based hydraulic oils by default be used at mining projects in Greenland, unless special compatibility issues are documented to the authorities by the operator. Bio-based hydraulic oil spills should be handled in no other way than mineral-based hydraulic oil spills.

Bibliography

1) Deuster, S. og Schmitz, K., 2021. Bio-Based Hydraulic Fluids and the Influence of Hydraulic Oil Viscosity on the Efficiency of Mobile Machinery. Sustainability, 13(14), 7570; https://doi.org/10.3390/su13147570 .

2) Kamyab, B. et al., 2024: Sustainable production of high-performance bio-based hydraulic fluids from vegetable oils: Recent advances, current challenges, and future perspectives. Biomass & Bioenergy, vol 183.