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REVIEW ARTICLE

KUWAIT ENVIRONMENTAL REMEDIATION PROGRAM - OVERVIEW

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ABSTRACT

During the Gulf War in 1990-91, more than 700 oil wells in Kuwait were ignited, leading to the largest environmental and ecological disaster in Kuwait's history. The damaged oil wells spilled crude oil across the land surface and created 'Oil lakes' in low lying land. These oil lakes affected approximately 114 km2 of land in the northern and southern oil fields of Kuwait. The crude oil released has negative short-term and long-term impact on the physical characteristics of the soil, vegetation, and wildlife, threatening precious groundwater resources. These oil lakes are mostly dry in nature. Some features, however, still contain semi-liquid, and oil/sludgy material and are referred to as wet oil lakes. Today, over 29 years since the oil fires, these contaminated features (~26 million cubic meters of heavily oil contaminated soils) still exist in KOC oil field areas. The United Nations Compensation Commission (UNCC) awarded monetary funds to the State of Kuwait as per its Decision 258 guidelines to establish the follow-up program to monitor the technical and financial progress of the environmental remediation works of contaminated soil resulting from the Iraqi Aggression and 1991 Gulf War. In addition, in June 2006 the Government of Kuwait formed the Kuwait National Focal Point (KNFP) with authority to plan and supervise the implementation of projects and act as a liaison between UNCC and affected parties/stakeholders (e.g. KOC) for KERP program. In order to efficiently remediate the contaminated soil, the Total Remediation Strategy (TRS) was developed as more sustainable and environmentally friendly approach to replace the initial strategy, which required construction of a large number of landfills. The implementation of the TRS will ensure remediation through more sustainable environmental approaches, including a variety of treatment options, recovery/re-use and use of the Risk Based Approach (RBA) on the majority of these materials, thereby reducing the number of landfills. The TRS comprises alternative remedial solutions and relies on treating ranges of Total Petroleum Hydrocarbon (TPH) contamination levels with the most appropriate remediation techniques.

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INTRODUCTION

Soil Contamination: The different types of contamination features were identified from airborne deposition of crude oil, overland crude oil flow or earth moving activities used to mitigate crude oil migration, as described below.

Wet contamination areas: The distinguishing features of Oil Lakes with a surface area of over 7 km2 include a surface layer of weathered crude, oily liquid/ sludge, sometimes covered by a thin, hardened crust. Investigations revealed that the average depth of oil contamination in the wet contaminated areas is approximately 63 cm. Sludge material has been found to contain mean TPH concentrations in excess of 19%.

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The underlying contaminated soil is found to contain a mean TPH concentration of 3.4%.

Dry contamination areas: Dry contamination areas cover almost 100 km2 of the desert, with an average depth of approximately 25 cm. The surface tar material in areas of dry soil contamination was found to contain mean TPH concentrations of about 7.3%. Underlying contaminated soil found to contain a mean TPH concentration of 2.5%.

Oil-Contaminated Piles: Contaminated piles consolidate oil-contaminated soil and/or liquid oil into mounds. Oil-contaminated pile materials of 1.2 to 1.7 m in thickness are found to contain mean TPH concentrations of up to 12.0%. The underlying contaminated soil is contain a mean TPH concentration of up to 4.6%.

Total Remedial Solution (TRS): Total Remediation Solution (TRS) on Kuwait Environmental Remediation Program, which will indicates the immediate and future projects.

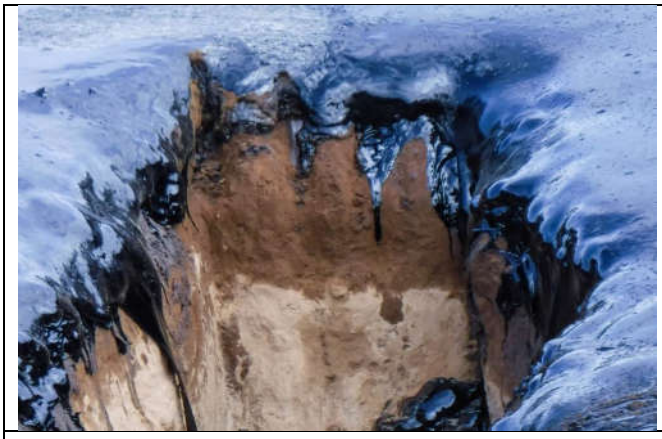

Fig.1: Wet Oil Lake

Fig. 2: Dry Oil Lake

Fig. 3: Oil Contaminated Piles

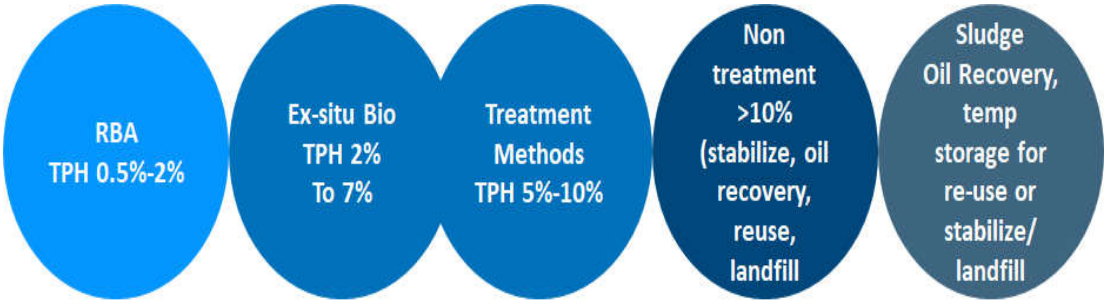

Fig. 4. Total Remedial Solution (TRS)

The TRS comprises of alternative remedial solutions and relies on treating certain ranges of Total Petroleum Hydrocarbon (TPH) contaminations with the most appropriate remediation techniques and to evaluate and promote remediation in areas were natural remediation exists after 29 years of the marginal oil spills. In this paper, predominately highlighted that the remedial solutions that make up the TRS comprises of the five key elements: and projected estimates: The TRS is focused to employ RBA coupled with multitude of treatment technologies inclusive bioremediation and beneficial re-use to efficiently treat as much as applicable and to reduce the number of landfills in the KERP program to untreatable or hard to treat materials.

Strategy of KERP Projects: The projects under the Kuwait Environmental Remediation Programme (KERP) are executed by different entities of the government of the State of Kuwait. KOC is one of the stakeholders that will plan and execute all soil remediation and restoration projects for contaminated land (i.e.26 million m3 of contaminated soil in entire KOC oil fields. Initially, KOC executed the following projects, which were completed in Dec 2018.

- NK Excavation &Transportation project (1.7 million m^3 of contaminated soil removed and total cleared area 5 million m^2)
- SEK Excavation &Transportation project (0.5 m^3 of contaminated soil removed and total cleared area 1.2 million m^2)
- NK Landfill project (capacity – 1.7 million m^3)
- SEK Landfill project (capacity – 0.5 million m^3)

In addition to above projects, KOC under implementation of Unexploded Ordinance (UXO) clearance project in both North Kuwait and South Kuwait oil fields. Further, the below mentioned upcoming projects to remediate the contaminated soil approximately 20 million m^3.

- North Kuwait Excavations Transportation Remediation (NKETR) project with volume of 4 million m^3.
- South Kuwait Excavations Transportation Remediation (SKETR Without I) project with volume 9 million m^3. South Kuwait Excavations Transportation Remediation (SKETR II) project with volume approx.5 to 7 million m^3.

Finally, Revegetation project would be implemented from remediated areas in NK & SEK oil fields in accordance with UNCC Claim. They advised that the need for the application of modern remediation/re-vegetation approaches to accelerate the recovery of native vegetation and restore the ecological functioning of the oil affected areas to pre-invasion levels. It was considered essential to reintroduce native plants and create favorable conditions for their establishment and growth as part revegetation project. KOC proposed a re-vegetation programme for 24km^2 of remediated area under the Kuwait Environmental Remediation Program (KERP). This project will be executed with phased manner for upcoming years.

Conclusion

As result of Gulf War, the highly contaminated oil lakes were formed covering a large area of Kuwait's desert oil presence and soil properties were negatively affected. Moreover, the contamination levels were extremely high that impacted the environment and ecological damage was observed affecting vegetation and wildlife as has been observed thought-out areas; As part of the integrated Kuwait Environmental Remediation Program, the contaminated soil needs to be remediated and restored as to its pre-war native conditions. This paper predominantly highlights that the overview of KERP program and present status remediation activities. Further, implementing the TRS will reduce the footprint required for multiple landfills thereby reducing long-term liability and limiting the loss of operational land that can potentially yield oil from underlying reserves.

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