

Revitalisation of the Agua de Mina Waste Dam for Aquaculture, Livestock Raising and Wildlife Habitat

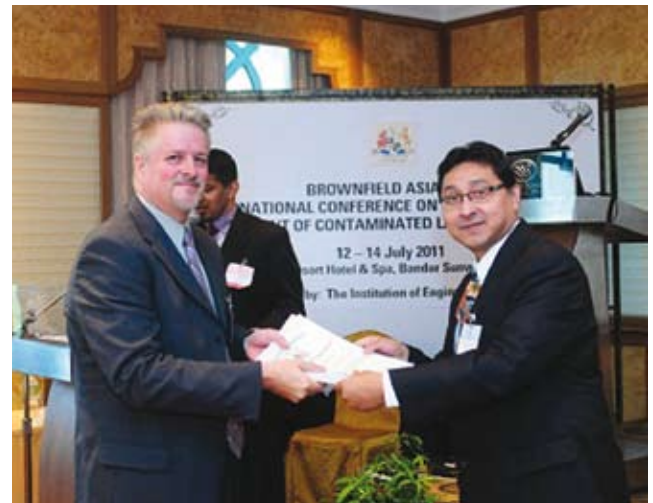


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THE the later part of the 20th Century, in southern Veracruz State, Mexico, a large sulphur extraction industry was formed. The latter used the Frasch process to inject hot water into wells in salt domes, liquefy the mineral and then pump it to the surface where it was treated with sulphuric acid to “mineralise” the petroleum and sediments that were also extracted in the process, resulting in more refined sulphur for commercialisation purposes. This generated acid water and waste hydrocarbons. The bentonite clay and oil base drilling fluids employed for the extraction wells were not reused (as is common today in petroleum drilling). The acid water and waste hydrocarbons (from the salt domes), as well as the spent drilling fluids and cuttings, were deposited into a 320Ha holding dam that had been constructed in a low-lying area that previously consisted of shallow lakes, marshes, swamps and floodable pastures.

Following the bankruptcy of the mining unit and closure, the Mexican government assigned the cleanup task to the nationalised oil company Petroleos Mexicanos (Pemex), which began neutralising the water in the dam with MgO. Subsequently, the site and surrounding areas were characterised for total petroleum hydrocarbons and PAHs (in water, sediment and fish), plus pH and salinity (EC), and metals (Cr, Pb). The water, sediment and soil were also tested for ecotoxicity using *V. fischerii* and *D. magna*. Fish, meat and water consumption data were obtained via questionnaires from the surrounding communities. In addition, dose-response data for pasture grass growth was determined experimentally from contaminated sediments. Finally, feasibility studies were performed for different treatment techniques in soil and saturated sediments.

The results of these studies encompassing, (1) characterisation, (2) human and cattle health-based risk assessment, (3) ecological risk assessment, (4) dose-response in pasture, and (5) feasibility studies, were used to develop a risk based remediation plan. Approximately 180Ha were contaminated with a hydrocarbon crust (~8cm to 15cm thick) of low mobility and low toxicity (when compared to background levels). Also, 24Ha of hydrocarbon contaminated sediments were also identified with hydrocarbon concentrations of between 5% and 7% on average. The treatment of these two areas was estimated to produce a total of about 500,000m³ of waste hydrocarbons and contaminated sediments, in roughly equal proportions.



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The cleanup criteria were produced based on leachate potential, ecotoxicity and biodiversity. The proposed remediation of the contaminated hydrocarbon crust consisted of chemical stabilisation and re-use for road base. For the remediation of contaminated sediments, a novel process was tested at both lab scale (20kg) and industrial scale (150m³), which converts the bentonitic hydrocarbon contaminated mud into a non-toxic, soil like material with biological indicators (microbial respiration, root density) similar to other tropical soils under cultivation, pasture and gallery forests. The use of a risk based approach in this project reduced the amount of material that required treatment by roughly 70% and overall treatment costs by 80%, converting an industrial waste dam into a revitalised area suitable for fisheries, livestock raising or conservation with a potential cost savings of approximately USD160 million dollars. ■