Effects Associated with Processing Ballast and Waste Oil at Port Reitz, Mombasa-Kenya

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Abstract
This study was carried out in response to a complaint regarding environmental pollution, arising from the processing of ballast water and waste oil on the premises of the landlord on Plot No. LR 1192/VI/MN, Port Reitz, Mombasa. The plot is designated commercial for purposes of land use purposes, and its tenant had been undertaking a ballast water/oil sludge scheming process to obtain fuel oil, which he sold to industrialists. This had resulted in damage to the environment as the facility incorporated no safeguard to address oil spills and no drainage system to contain waste discharges from the process. The study was undertaken to establish the level of environmental damage, propose rehabilitation costs, and offer recommendations for remedial measures. The study was realised through desk study, field visits, digging and sampling of soils for analysis. The results showed that between 60-70% of the soil in the premise was contaminated with oil, penetrating at least one meter deep. Effect from the oil contamination manifested in the failure of the soils to support growth of new vegetation, while existing tree plants were withered. The impact from this was the loss of aesthetic beauty of the property, reducing its amenity value. Percolation of oil underground in porous rock formation has potential to contaminate groundwater, threating the quality status of this resource for domestic purposes. The process activities were also of health concern since no safeguards had been provided to protect the workers from direct contact the oil. Hydrocarbon oils when exposed to hot climatic conditions like those prevalent in Mombasa, which provide high solar radiation have the potential to breakdown, emitting some toxic and potentially carcinogenic substances. The facility therefore exposed the workers to the dangers of contracting cancer through inhalation of the emissions with potential long term health consequences. Finally, the massive physical environmental damage on the premises means rehabilitation costs could be high. Estimates indicated that as much as US$100,000 would be required to restore the premises to a condition that would allow natural regeneration. The findings also indicate that the activity being undertaken, is not the best land-use for the area. It is consequently recommended that if the activity must continue, then it must be conducted according to established guidelines. Otherwise, it is ideal that it is ceased, and rehabilitation works, commenced. It is also observed that important potential effects were not included in this research. Ballast water is known to introduce invasive species. Efforts therefore need to be undertaken to determine the presence such species in the neighbourhood before they attain pest proportions.
Keywords: Ballast water, MARPOL, oil sludge; air, soil and groundwater contamination, environmental damage, health effects, toxic substances carcinogenic products.

1 Introduction

Water has been used as ballast to stabilize vessels at sea. The ballast compensates for weight loss due to fuel and water consumption, reduces stress in the hull, thereby providing stability and improving propulsion and manoeuvrability of ships to maintain safe operating conditions throughout a voyage. However, despite its usefulness, ballast water is a source of serious ecological, economic and health problems due to the multitude of various marine species it could contain. Such among others, which may be unknown, include bacteria, microbes, small invertebrates, eggs, cysts and larvae of various species. These species, transferred from one region to another may survive and establish a reproductive population in the host environment, becoming invasive, out-competing native species and multiplying into pest populations. This problem is brought about by the large traffic of seaborne vessels, trading cargo among countries, a business –that is yet to reach its apex, and with it, needless to say –the spread of the problem.

The effect of water is recognized as one of the greatest threats to ecology and economic well-being of the planet. Its impacts on biodiversity affects the natural riches of the world, undermining the livelihood of many coastal communities. Direct and indirect health effects of ballast water are becoming increasingly serious and the damage it causes to the environment is often irreversible. To counter the threat arising therefrom, IMO Member States adopted the International Convention for the Control and Management of Ships' Ballast Water and Sediment (IMO, 2004). The aim of this Convention is to prevent the spread of harmful aquatic organisms from one region to another by establishing standards and procedures for the management and control of ships, ballast water and sediments. As such, the Convention required all ships to implement a Ballast Water and Sediment

Management Plan, and guidelines to this effect were also developed. Parties to the Convention were given freedom to add any additional measures they deemed fit.

At the port of Mombasa ballast water, oil sludge, sewage, solid waste and other waste material from ships have been handled by several small scale operators primarily because of the lack of a centralized reception facility. Lacking modern facilities, the local operators have often used crude and rather messy methods in carrying out their operations. Such activities have been cause of adverse environmental impacts on the immediate neighbourhood, and may affect a wider area, including effects on groundwater. In the year 2003, a ballast water and oil sludge handling facility was commissioned. This arrangement promptly allowed a monopoly to receive and handle such waste material, locking out the small scale practitioners from the apparently lucrative business, making the latter to lodge a protest through the courts, culminating in their reinstatement. Competing for less material to handle, the commissioned ballast water handling company closed down.

Taking advantage of the situation small scale local operators, have as a result, increasingly engaged themselves in handling of ship waste, including ballast water. One such small trader involved in the processing ballast water and oil sludge was located along the Port Reitz road in Changamwe, Mombasa, who at the time of the study had been operating for about three years. The process this operator undertook involved receiving and transporting sludge and contaminated ballast water from the port, and using it as raw materials for harvesting fuel oil, which he sold out. Therefore, this study was commissioned to establish the impact the ship-waste had on the physical and socio-economic environment of the area. This study did not involve itself with what threat invasive species could have on the environment, rather, focus was place on the issues damage done to his property. Consequently, the issues of main concern studied herein included ascertaining the designated land use of the area, establishing if the activities being carried out were compatible with that designated land use. It was also to establish if there was adherence to good environmental practice. The study was also expected to identify the impacts resulting from the fuel oil recovery activities and, if effective mitigation plans were in place to counter any impacts. If damage was confirmed, the cost for rehabilitation were to be determined.

2.0 Handling and Processing of Ballast Water and Oil Sludge

The business site is located on a 0.75 acre plot (Plot LR No.1192/VI/MN) along the Port Reitz Road in the Mombasa North mainland of the Mombasa County. The plot is bordered in the north by a Transporting, in the south by a Contractors, in the east is another Transporters Ltd; while in the west are residential homes. The premises were initially used for residential purposes by the land lord, with a parking yard for general cargo by the landowner for close to 18 years. In the year 2001 or thereabouts, the premises were taken over and occupied by the current tenant on lease from the proprietor with an indication that they intended to use it as a depot for goods trucks. However, the new tenant ventured into the business of handling and processing ballast water and oil sludge from ships berthing at the Mombasa harbour to extract fuel oil instead. The ballast water and/or oil sludge from ship bunkers was received by road tankers and ferried to the facility at Port Reitz. The oily mixture was allowed to settle in the tanker to separate into a lower aqueous layer and upper oil layer. The lower aqueous layer was discharged into an open drain leading into an earthen holding pond. The oil layer which remained in the tanker was then pumped into a storage tank in the premises. The facility had the capacity to handle about 100 tons of waste oil monthly. The separated oil, composed mainly of heavy fuel oil, was then sold to manufacturing industries for use as fuel to fire boilers.

2.1 The Ballast Water/ Waste Oil Processing Infrastructure

The processing infrastructure comprised of a system of two earthen ponds, a shallow pond measuring 5 meters X 3 meters X 2meters depth and second adjoining pond of size 4 meters X 3 meters X 2.5 meters depth. These were used to contain the residual oil water remaining from the separation process that remained in the tanker after the intended product had been drained into storage tanks. The oily water was allowed to settle further in the shallow pond and periodically the surface was skimmed for oil. The retrieved oil stored in 200 litres' steel drums before transfer into larger storage tanks. The wastewater with oil residues that could not be recovered was then allowed to flow into the second deeper pond for storage. Occasionally, the wastewater was sold to other manufacturing industries to use in their processes such as utilization in the brick making process. The system of ponds for holding and processing the wastewater is shown in Figures 1 & 2. To support these operations, the operator had 4 tankers of 25 tons capacity each, 2 Canter Lorries of 3 tons capacity each, 1 lorry fitted with a pump, and storage tanks for the product with a capacity 100 tons. There was a strong odour pervading the facility and premises. This was primarily due to the poor handling and processing methods, which resulted in leakages and wastage. The leakages and spillages occurred during the pumping operations and, from the storage tanks. Also, the manual skimming of oil from the earthen separation ponds, and transfer to the storage drums cause further spillages, contaminating the soils with the fuel oil.


Fig. 1: The shallow wastewater receiving and holding pond. Note the dark fuel oil skimmed from the pond


Fig. 2: The second deeper wastewater storage pond

2.2 Legislative Authority

The setting up of a facility to handle and process ballast water and oil sludge is governed by various legislative authorities under the laws of Kenya. As a signatory to the MARPOL Convention, the Kenya Port Authority has provisions for the handling of ballast water and waste oil. But this is as far as the operations go when conducted within the port. Outside the port, the Physical Planning Act, 1996 guides the planning of infrastructure in the development process. According to this Act, to set up any facility, the infrastructural plans must be approved by the Ministry of Lands and endorsed by the respective Local Authority under the Local Government Act and By-Laws. The proponent is also required to obtain a letter of authority to store petroleum oil products underground. Such a letter was granted under the Ministry of Energy, but its issuance had been delegated to the Provincial Administration, by then represented by local District Commissioners. It was also a requirement under the Municipal Council bylaws that the installed oil facility is inspected annually by the Municipal Fire and Ambulance Services Department for compliance. Subsequent fire precaution inspections were also to be carried out similarly and a Certificate of Inspection issued.

The operator was required to register with the Directorate of Occupational Health and Safety Services under the Factories and Other Places of Work Act, Cap 514, of the Laws of Kenya, so that his facility could be subjected to regular inspections. The regular inspections were to be carried out to safeguard conditions of the working environment, and to ensure workers' safety and health. Thus, the operator was expected to comply with the respective legislative authority and/or regulations before setting up of the type of business he was venturing in. In summary, he had to meet both legislative and regulatory requirements before operating.

3 Study area and Methodology

3.1 Biophysical Environment

Prevailing climatic conditions play a significant role in the concentrations and distribution of airborne contaminants that could potentially pose health hazard to people, animals and plants. In the case of petroleum hydrocarbons, high temperatures and air movement or winds enhance loss of light hydrocarbon fractions into the atmosphere by evaporation and dispersion, whereas solar radiation, in particular ultra-violet light, may induce degradation of the contaminants by photo-oxidation. Climatic conditions in the Kenya coast in general are largely influenced by the NE Monsoons, blowing from November to March, which are characterised by warm temperatures (mean range 23 – 32 °C) and moderately low humidity conditions (mean relative humidity range 59 – 67 %), and a relatively lower cloud cover (average solar radiation 20.5 – 22.7 MJ m^{-2}); and the SE Monsoons, which blow from May to September, bringing relatively low temperatures (mean range 21 – 29 °C).

Rainfall is diurnal with the long rains occurring in the inter-monsoonal period, starting towards the end of March and peaking in May. Over 60 % of the rainfall occurs during the long rains. High cloud cover (relatively low radiation ranging from 17.1 – 20.5 MJ m^{-2}) and relatively higher humidity conditions (mean relative humidity range 61 – 86 %) are experienced during this season; and low temperatures, prevail in June/July due to the cool winds blowing from the south. There is a diurnal variation in the relative humidity, particularly in Mombasa where humidity attains about the 60 – 70 % range during the afternoon, rising to 92 – 94 % during the night and early morning (UNEP, 1998). Short rains occur in the next transition period between October and November. The Mombasa District on average receives a mean rainfall of 1027 mm yr^{-1}. Fig. 3 presents the rainfall distribution, temperature and humidity variations in the Mombasa.

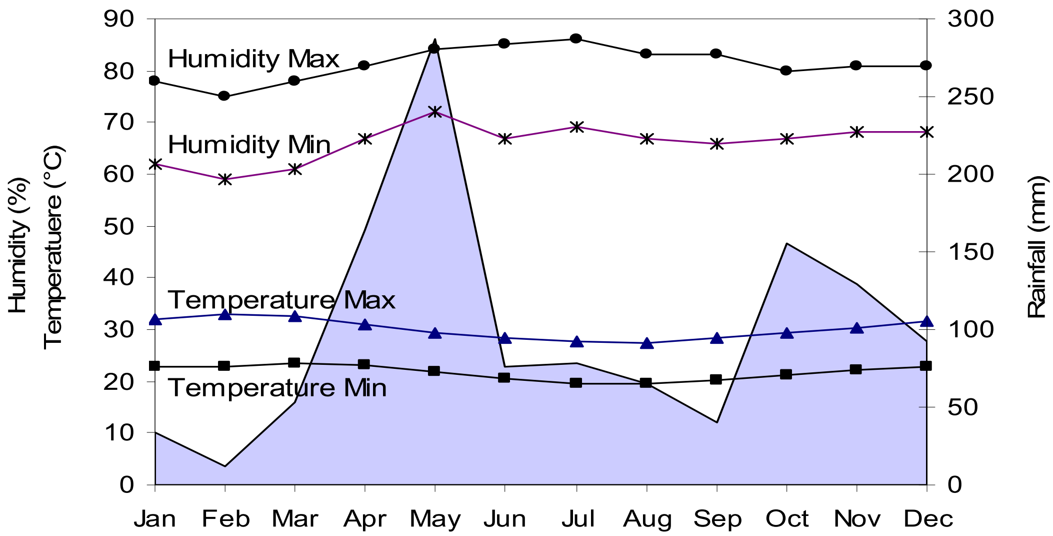

Fig. 3: Temperature, relative humidity and rainfall averages for Mombasa for 1989 – 1999.
(Source: Kenya Meteorological Department, Moi International Airport, Mombasa)

The daily variations in wind speed and direction along the coastal area is greatly influenced by the heating of the land surface and sea-land breeze. Thus, the wind strength drops at night and during early to mid-morning when the wind direction is mainly long-shore depending on the season. However, by mid-afternoon the sea-land breeze strengthens, blowing on a north-westerly direction. Mean wind speeds ranging between 6.7 and 10.6 knots at 0900 hrs and 1500 hrs, respectively, have been recorded (Table 1). GOK (1975) reported low wind speed blowing with variable direction at night. The relatively stronger SE Monsoon are less influenced by the sea-land breeze, as indicated by the wind direction from May to June, which is predominantly south to south-westerly in contrast to December to February with a strong westerly to north-westerly component (Table 1) (UNEP, 1998; GOK, 1975).

Table 1: Average solar radiation and wind direction and speed for Mombasa, 1998 – 1999
(Source: Kenya Meteorological Department, Moi International Airport, Mombasa)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Radiation	(MJ m^{-2})	21.9	22.6	22.7	20.6	17.7	17.9	17.1	19.3	22	22.7	22	20.5
Winds	Direction	202	208	141	204	199	212	215	201	188	166	121	205
0900 hrs.	Speed (knots)	6	6	5	7	8	9	8	8	7	6	4	6
Winds	Direction	91	105	114	165	182	181	178	168	155	152	135	107
1500 hrs.	Speed (knots)	11	12	11	10	10	11	11	10	10	11	10	10

On geology, Soils and Vegetation the area falls on the dominant Magarini Pleistocene sands, the Mtomkuu cretaceous shales geological formations with subordinate sandstone and limestone, including the Baratumu Miocene (Fig. 4). Soils developed on the unconsolidated Magarini sands are composed of sandy to loamy soils. These are well drained, very deep sandy clay loam to sandy clay, with a topsoil of fine sand to sandy loam. (GOK, 1988).

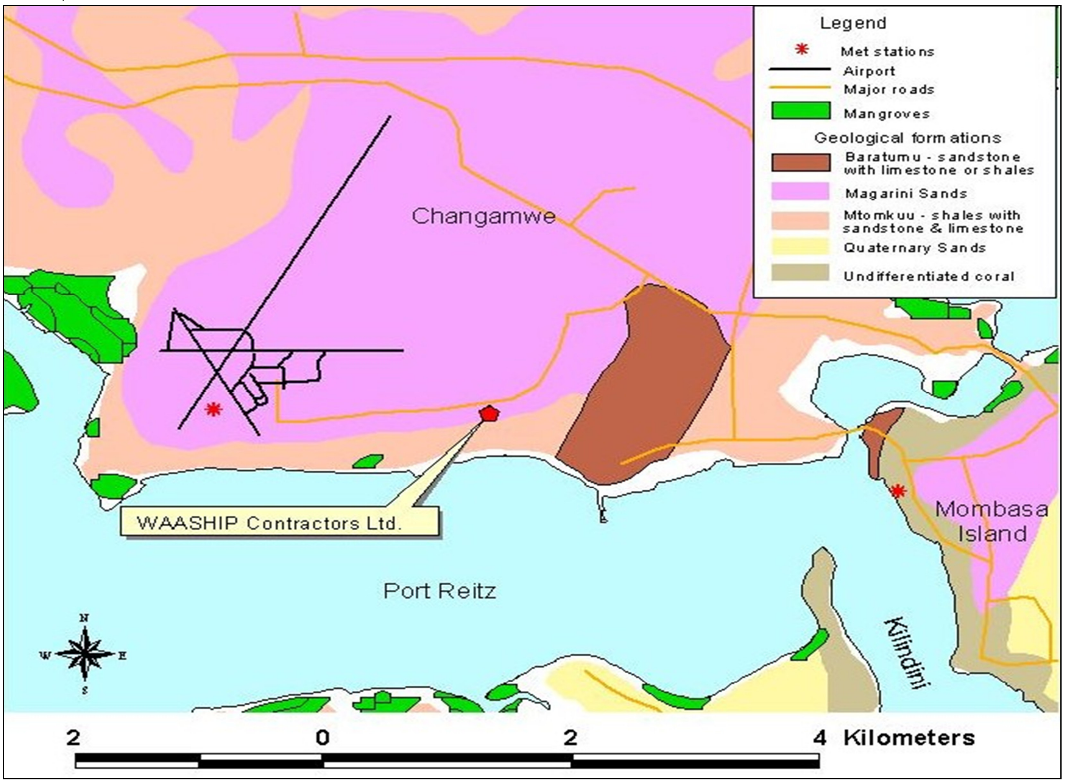

Fig. 4: Map showing the location of the study area and geological formations

The Magarini residual sandy deposits form a recharge area to the unconfined water aquifer because of their inherent high permeability. While the overlying soil layer forms the first line of defence against infiltration, the high permeability and hydrologic conductance makes the aquifer vulnerable to contamination. When contaminants or pollutants are released on or below the surface, such as from soak pits and pit latrines, they quite rapidly enter the groundwater system, depending on the soil characteristics. The facility under study is located within the Magarini sands geological formation, ecologically designated as the coconut and cassava agro-ecological region. Perennial vegetation in this zone include coconut and mango trees, which invariably happened to be in very bad condition. Vegetation offers the first line defence against groundwater pollution, its absence readily exposes groundwater to petroleum hydrocarbons contamination.

3.2 Methodology

The method employed to accomplish the objectives of the study involved a desk study, field visits, digging the soils to determine the depth of percolation of the oil, laboratory analysis –which results are not reported here as they were to be carried out by an independent private company for legal purposes, measurement of the area and volume of soil affected and calculating estimated rehabilitation costs.

4 Results

4.1 Effects on Soil and Vegetation

The most visible impact of the ballast water and oil sludge handling and processing activities at the facility is the extensive contamination of the soil with heavy fuel oil, resulting from leaks and spills during processing/storage operations. In the absence of proper waste oil handling facility on the site, oily waste had spread within the compound. In the middle of the plot, a 25 ton capacity storage tank had leaked, resulting in a thick layer of black oil (Fig. 5). It was estimated that between 60 and 70 % of the area within the plot not occupied by the office building was covered with oil, contaminating the soil and vegetation. The magnitude and persistence of the oil on the ground was demonstrated by the pools of oily water. Though large patches of areas had been covered with fresh soil to hide evidence oil spillage, its presence was still evident. The immediate impact of oil pollution on the soil surface was the loss of aesthetic beauty of site with the unpleasant looking patches of oil, reducing the amenity value of the property. Chronic oil pollution effects on the soil were manifested by the lack of vegetation including, impact to perennial plants and trees. Grass was non-existent, and mango and several coconut trees had defoliated and withered.

Fig. 5: One of the oil storage tanks at the premises. Note the pool of leaked-out oil with water below the storage tank (arrowed), and the results of attempts at rehabilitating oiled sections by spreading stones and murram.

Some of the critically affected trees are clearly evident in Fig. 6. Most of the open areas of the plot were virtually barren and it was just a matter of time before all the remaining vegetation became completely destroyed. The observed impact of oil pollution to vegetation at the site was a clear indication of acute toxicity effects. The toxic components of fuel oil include Polycyclic Aromatic Hydrocarbons (PAHs), some of which are known environmental carcinogens, an issue not investigated in this study.

Fig.6: Impact of chronic oil pollution of the soil - withered mango and coconut trees (arrowed). Note the oil contaminated foreground and mound of fresh soil for covering the oil pools in the background.

4.2 Effects on Air

The waste oil spread throughout the premise is also thought to have impact on air quality as the generally prevailing high ambient temperatures encouraged a certain degree of volatility of particularly for the relatively low molecular weight components of petroleum hydrocarbons. Low molecular PAHs such as naphthalene, phenanthrene and anthracene are known to undergo photo-oxidation as one of their degradation pathways, yielding contaminants, an occurrence of high probability for an area of high solar radiation as that experienced in Mombasa, resulting in products that are often more toxic to animals, and potentially also carcinogenic. The air quality at the premises was further compromised by the unmistakable, unpleasant strong odour of petroleum products. Despite this, people working under these environmental conditions, including young children who resided within the compound, took no precautions to minimize the inhalation of hydrocarbon fumes and foul air, with the long-term effects being a matter of grave concern, taking cognisance of the health hazard could potentially be caused.

4.3 Potential Effects on Groundwater

The vulnerability of the water supply aquifer to pollution due to anthropogenic waste in Mombasa has been demonstrated by high concentration levels of nitrates and faecal microbial organisms in groundwater attributed to the on-site disposal methods of sewage Munga et al., (2004). Similar findings have been documented for water from the few boreholes located in the study area. As such, frequent oil spills and the use of earthen ponds for processing the oily ballast water posed both real and potential threat to groundwater quality as the unconfined water supply aquifer underlying the unconsolidated Magarini sands (found in the area) is vulnerable to pollution since contaminants deposited on the surface or sub-surface have the potential to reach groundwater aquifers due to the high permeability and hydraulic conductance of the aquifer media.

Taking into consideration the general shortage of water in Mombasa, and increasing dependence on groundwater for domestic use, the threat of pollution of water resources by petroleum hydrocarbons due to the poorly managed activities at site cannot be ignored. It is recognised that in the event that groundwater get contaminated with petroleum hydrocarbons, the effect tends to persistent for long periods of time under conditions of low oxygen and microbial activity –conditions that do not help in oil biodegradation. In addition the costs of cleaning-up contaminated groundwater resources could be prohibitive.

4.4 Occupational Safety and Health Concerns

The premise was operating without a certificate of registration by the Director of Occupational Health and Safety Services. As such, no inspection had been undertaken by the Directorate. As a result, the premises are un-kept as the house- keeping activity is unsatisfactory. Spilled oil covers large parts of the premises, and absence of a drainage system, effluent arising from within the premises posed occupational health risk to persons employed therein, to its residents and the neighbourhood. The waste also oils contain varied amounts of toxic aromatic hydrocarbons –a common cause of dermatitis; while additives contained therein, also posed health risks to the exposed persons. Microbial contamination of oil is also associated with certain health hazards. Biotransformation of some of the hydrocarbon components change the composition of the oil, making it more toxic, with effects to animals, birds and humans. Contaminated oil is also thought to aggravate existing skin conditions, certain individuals suffer. With no appropriate personal protective gear provided, and no trained First Aider to assist in case emergency situations arose, or caution against any impacts, the first aid box provided, serves no purpose even if adequately stocked.

Similarly, there were no contingent plan for combating fires in the event of outbreaks. Such contingency would have included modalities for reporting fire outbreaks and evacuation from the premises. Thus, though the operator had provided fire extinguishers fire within the premises, these had been neglected, as they had not been regularly inspected to ascertain functionality. Compounding the situation, was that none of the workers had been trained on the correct use of the fire extinguishers, and no fire drills had ever been carried out to prepare the workers in the event a fire break-out occurred. Finally, pits containing stagnant pools of oil were not secured through fencing and therefore posed the significant danger to children who played within the compound, making them vulnerable to drowning in the event of a fall into the ponds.

4.5 Adherence to Regulatory Requirements

The operator made no effort to comply with the regulatory requirements governing his operations. There was no certificate of approval of the infrastructure used in the process activities, neither was there authorisation to handle and store fuel oil. The operator did not hold a certificate of inspection by the Municipal Fire and Ambulance Services Department as required by the Municipal Council bylaws. Also having not been registered with the Directorate of Occupational Health and Safety Services, the premises lacked reports that could have indicated regular inspections, corrective measures, suggested on safety and health by the statutory organ.

4.6 Contingencies for Combating Oil Spills

There were no contingent measures to combat accidental oil spills. This was aptly evident from the lack of band-walls around the oily-water holding pits. Attempts to rehabilitate the worst affected areas by filling the pools and potholes with stones and spreading fresh soil or murram (see Fig. 5), had been undertaken, however the initiative had not been effective, for, except for hiding the unsightly areas, the effort tended to have aggravated the situation in some important aspects by creating conditions that favour long-term persistence of the contaminant in the soil, rather than promoting natural degradation when exposed to the air environment. This resulted in the preservation of the oil under the soils, with the consequences that the soil could not support plant growth. Similarly, this aggravated the potential for groundwater contamination through aquifer recharge during the rainy period.

4.7 The Cost Estimates for Rehabilitating the Premise

Presented in Table 2 are the estimates of the cost of rehabilitation of the contaminated compound. In computing the estimates it was considered that for the coconut and mango trees to be affected, the oil should have penetrated to a depth of at least 1 m. Thus, the estimates were made with the assumption that a layer of soil 1 m thick will be excavated from the site and transported about 25 km to the municipal dumpsite located at Mwakirunge for disposal, and fresh uncontaminated soil, obtained from Utange about 20 km away, would have to be transported to the premise to replace that which had been excavated. Labour costs associated with the excavation and loading the soils to and away from the premise, including spreading of the fresh soil were considered.

Table 2: Cost of rehabilitation of the Premises

Data		
Total area of plot	(m^2)	3,035
Less: area occupied by buildings	(m^2)	500
Less: total area of ponds	(m^2)	22.7
Plot area (open)	(m^2)	2,512.3
Volume of soil to be excavated (at 1 m depth)	(m^3)	2,512.3
Total Volume of soil to be purchased	(m^3)	2.560.9
Volume of ponds (19.44 + 29.16 m^3)	(m^3)	48.6
Cost of excavation	(KES /m^3)	260
Cost of transport	(KES/m^3 km)	60
Purchase cost of soil	(KES/m^3)	200
Cost of spreading soil	(KES/m^3)	36
Cost of cutting dead trees	(KES/tree)	2,000

Activity	**Estimated Cost (KES)**
Excavation of contaminated soil (average depth = I m)	653,198
Transportation of oiled soil to Mwakirunge dumpsite (25 km)	3,768,450
Cost of purchasing fresh soil	512,200
Transportation of fresh soil from Utange (20 km)	3,073,200
Labour costs (spreading fresh soil)	92,196
Labour costs (cutting dead trees)	12,000
Purchase, planting & tending of seedlings and grass cover	40,000
Total (Approx. US$ 100,000)	**8,151,244**

5 Conclusions and Recommendations

5.1 Conclusions

The operator is a small business man handling ship waste – mainly ballast water and waste oil to extract oil for sell as fuel oil to industrialists. His operations at the site have been a cause of adverse environmental impacts on the immediate surrounding and/or neighbourhood, and may affect a wider area including groundwater. This is because the operations are carried out in a crude manner with no proper environmental management systems to address negative impacts. Wastewater containing considerable quantities of waste oil is discharged into earthen ponds within the compound, which is rather improper. The operator handles and processes ballast water and oil/sludge without legal authority. Operating in such a manner, in an area with the climatic conditions capable of vaporizing the waste oil makes the undertaking a potential threat to the health of people, plants and animals in the vicinity. The activity has greatly impacted the soils and vegetation and has potential to pose a threat of groundwater contamination with petroleum hydrocarbons. Though the facility has provided some jobs to local people, no care has been taken regarding their safety and welfare. As such, the short term benefits they derive from their employment may be more than outweighed by future potential ill health. The likely presence of airborne Poly Aromatic Hydrocarbons exposes the workers to potential environmental carcinogens. Despite being in operation for more than three years, the activity is not yet registered with the Director of Occupational Safety and Health Services for purposes of safeguarding the workers. There being no drainage to take care of oil spills, including waste water; the unsecured open ponds containing discharged oil waste are a potential threat to children when playing. Finally, there is potential risk that invasive species could have contaminated this environment.

5.2 Recommendations

It is recommended that the operator obtains the necessary legislative authority governing this type of activity. Proper drainage systems, as required by the Public Health Act, 1972 should be provided while the oil storage tanks should be secured with a band wall to hold and retaining oil in the event spillage occurs, as dictated by the Energy Act, 2006; conditions that promote natural degradation of oil sludge and contaminated soil and/or even using microbial organisms should be put in place. The workers should be provided with appropriate personal protective gear to minimize contact with the oils should be avoided by using impervious gloves and aprons for those handling the oil; awareness must be created among the workers on the importance of using the personal protective gears provided in advancing personal hygiene practices; the compound should be levelled and kept free from the oil spillages that can create slippery surfaces, result in falls and potential injuries; in the interest of the health of the persons employed at the facility that they undergo medical examinations to determine their health status, even if the business was to be terminated, which really are requirements under EMCA and the Factories and Other places of Work Act. Alternatively, since observation made during the study did not seem to show any efforts put towards establishing appropriate facilities for the undertaking, as demanded by the Physical Planning Act, 1996, the activity could be completely ceased and rehabilitation works undertaken. Finally, this study left out the dimension of invasive species, (whose impacts are highlighted by the by the Ballast Water and Sediment Management Convention) which could have entered the land environment from the oil scheming processes, and as such, further investigations are recommended to establish the presence or otherwise of such species before they grow into pest proportions.

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