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Water Pollution Disasters Caused by the Leakage of Hydrocarbons During Shipping Operations

"Systematic Review for Hydrocarbons Transportation Operations Across The Sea From The Ports Of The Arabian Gulf"

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Abstract

The leakage of hydrocarbons during the shipping operations is markedly prevalent in Arab Gulf Countries waterways since these countries are considered oil generating countries and most of its ports are designed for oil transport. The negative impacts of oil leakage could be alleviated through applying sophisticated risk management techniques. Besides, identifying the effects of such leakage on water resources, environment and human being is very important for sustaining the precautionary and aftermath measures.

The current study aims at describing the strategies for managing the disasters of water pollution in hydrocarbons during shipping operations, identifying the extent to which hydrocarbon leakage during shipping operations affects water resources, and identifying the risks of water pollution caused by hydrocarbon leakage during shipping operations on human life.

Following the systematic review approach, the researcher reviewed some studies and articles related to water pollution disasters caused by leakage of Hydrocarbons and the management measures of this dilemma. The results of the study showed that Hydrocarbon leakage has a negative impact on the water resources, human being and environment. Besides, the results revealed that ensuring proper management for oil and Hydrocarbons leakages mitigate the negative effects. Based on the results of study, the researcher recommended recruiting professional cadres who are fully aware of the leakage hazards and know how to deal with its consequences. Besides, the shipping companies are recommended to follow strict and practical standards related to the safety of shipping Hydrocarbons materials.

Keywords: Oil leakage, Shipping, Gulf Area, Water Pollution, Hydrocarbons.

Chapter I

Research Background

1.1 Introduction

Water occupies a large space in the atmosphere, and it is considered the single largest material in it. Water represents 70.8% of the Earth's surface, which is why some scientists is calling the earth the water bubble. Water contributes to about 60% to 70% of the living organisms, including humans, additionally, it contributes to 90% of the formation of other microorganisms. Having that said, water pollution leads to serious damage to the living organisms (2014, Tang, et al.).

Water pollution is defined as the accumulation of one or more substances in the water of different bodies of water such as oceans, rivers or seas, causing destruction and problems of livestock and humans. The 1969 UN report defined ocean pollution as: "introduction of materials or energy into the marine environment such as estuaries, directly or indirectly; through human activities, leading to adverse effects, such as damage to living resources, risks to human health, as well as the disruption of marine activities such as fishing, resulting in reduced quality of the water and reduce Amenities (Sweileh, et. Al, 2015).

In its narrow concept, development has led to an increase in production and consumption, which has contributed to the greatest damage to the environment. A problem has been raised in highlighting the environmental dimension in establishing projects that guarantee the greatest number of basic requirements for significant numbers of people (Alexander, 2013).

The environment in general and the marine environment in particular have been subjected to a number of pressures which have resulted in many of their potentials in avoiding these damages, in order to ensure balance in many of their natural environment, the most important of which is the improper disposal of solid and liquid waste, Hydrocarbons, resulting in the imbalance between natural elements, and threatened the lives of many sea creatures, and have a significant impact on the life of organisms in general under the exhaustion of pollution applied at all levels,

and adequate supply of all economic goods as opposed to the increase in consumption patterns and infinite needs, where man is directed to the establishment of large naval fleets and ports designed to ensure optimal exploitation of water wealth and the occurrence of water pollution (Rozell, & Reaven, 2012).

One of the main causes of pollution of the aquatic environment is the pollution of sewage with industrial detergents, some types of bacteria, and harmful microbes. When sewage flows to lakes and rivers, it also leads to pollution, and industrial waste, which includes the residues of food factories, chemical and artificial fibers, chemicals, and toxic salts such as salts of mercury, arsenic, and salts of heavy metals such as lead and cadmium, nuclear reactors that cause heat pollution in the water, radioactive contamination can occur for later generations of humans and other organisms, and pesticides that spray on crops. Some of these pesticides may seep into sewage. Canal and canal water are contaminated by spraying of spraying equipment, killing fish and other organisms. As well as the deaths of animals and livestock that may be contaminated with pesticide-contaminated water. Examples of pesticide spillage into watercourses are the tragedy that occurred in Iraq between 1971 and 1972 when a type of insecticide containing mercury was used, which has led to the entry of 6,000 people to hospitals; 500 of them have died. One of the major causes of water pollution is the hydrocarbon leakage in the sea or ocean waters as a result of the frequent drowning of tankers, the cleaning and washing of tankers and the dumping of laundry waste in the seas and oceans. Leaving behind a health hazard that causes the death of marine organisms, and the damage or death of the chain that feeds on these organisms. The incident of California's beaches in the United States of America in the late 1960s is one of the most famous incidents of the leakage of petroleum and its derivatives into the oceans, Oil spill during exploration, resulting in a large 800-mile-long oil spill on the Pacific Ocean, leading to the deaths of countless sea birds, fish, dolphins, and marine organisms (Alexander, 2013).

The Arab Gulf Countries oversees many major ports responsible for maritime transport operations, especially the transport of hydrocarbons as an oil-rich country which in turn may cause some water-pollution disasters. This requires the attention of officials in this area through the adoption of strict decisions in this regard (Bergqvist, 2013).

1.2 Research Problem

The leakage of hydrocarbons during the shipping operations is markedly prevalent in Arab Gulf Countries waterways since these countries are considered oil generating countries and most of its ports are designed for oil transport (Bergqvist, 2013), which motivated the researcher to review the studiers and articles that studied the water pollution disasters caused by leakage of Hydrocarbons and the management measures of this phenomena.

Based on the above, the study problem can be framed in the following main question:

"How effective is the management of the water pollution disasters caused by the leakage of hydrocarbons during shipping operations?"

To answer this question, the researcher will seek answers to the following sub-questions:

1. What are the strategies for managing the hydrocarbon water pollution disasters during shipping operations?
2. How much does the hydrocarbon leakage during shipping operations affect water?
3. To what extent do the shipping operations apply water reservation laws?
4. What are the risks of water pollution caused by the leakage of hydrocarbons during shipping operations on human life?

1.3 Research Objectives

The main objective of the study is to manage the water pollution disasters caused by the leakage of hydrocarbons during shipping operations, in specific, the study aims to achieve the following objectives:

1. Identify strategies for managing the disasters of water pollution in hydrocarbons during shipping operations.
2. Identify the extent to which hydrocarbon leakage during shipping operations affects water resources.
3. Identify the extent to which shipping companies apply the laws that seeks to preserve the water wealth.
4. Identify the risks of water pollution caused by hydrocarbon leakage during shipping operations on human life.

1.4 Research Significance

The importance of this study evolves around identifying the methods used to manage the water pollution disasters caused by the leakage of hydrocarbons during shipping operations, having that said, the importance of the study can be seen from two different aspects as follow:

1. **Scientific importance:** highlighting the strategies used to manage the water pollution disasters in hydrocarbons during the shipping operations, the impact of hydrocarbon leakage during the shipping operations on water wealth, and clarifying the extent to which water preservation laws are applied, identifying the impact of water pollution caused by the leakage of hydrocarbons during shipping operations on human life. In addition to that, this study is considered as a starting point for research in this area with a greater focus on the risk of hydrocarbon leakage to the environment.

2. **The practical importance:** The practical beneficiaries of this study include the countries that supervise the water ports, the water trade corridors, the environmental protection societies and the shipping companies, where they can benefit from the results of this study in the development of water pollution disasters management strategies.

Chapter II

Literature Review

2.1 Introduction

The polluted wastes entering the oceans and seas are derived from several sources, some of which being accidental leaks or spills, and others being the essential result of careless and chronic habits in the implementation of hydrocarbons and hydrocarbons products. Most of the hydrocarbons waste in the ocean consists of oily water derived from farms and cities, mainly untreated waste from the nearby industrial facilities and factories, and/or the shipping industry and operations. It has been estimated that mainly 800 million gallons of crude oil sail across the ocean annually along with wasted hydrocarbons coming from waste disposals and land drainage. The erroneous disposal of the used oil within the shipping operations, the offshore production, and drilling of oil, the spills or leaks resulted from the tankers or ships' operations, which generally contribute more than any other factor polluting the marine environment. In addition, hydrocarbon particles from onshore air pollution, the routine ships' maintenance, and the natural seepage from the sea itself (Bautista and Rahman, 2016).

As explained, the pollution of hydrocarbons in the ocean comes from the offshore production of oil and shipping activity. The activities of seabed on the exploration and production of oil establish a small aspect in the main amount of the marine environment pollution of hydrocarbons. The essential cause of such pollution with hydrocarbon elements is shipping operations. Shipping, traditionally, is regarded as "a polluting industry". The shipping operations around the world, such as tanker fleets, have approximately 8000 cargo-filled vessels with capacities around 86000 and 185000 tons. The regular shipping operations, particularly, the tankers transportation and accidents of hydrocarbon elements, cause the dumping of about 700000 - 1850000 tons of such elements into the marine environment every year (Mishra and Kumar, 2015).

Due to the implementation of pipelines for hydrocarbon, the transportation of these elements as oil with tankers significantly decreased.

However, such incidents with this vessel's type and the oil spills happen constantly. For instance, the last incident of oil pollution, which had the attention and publicity of the mass media, occurred in 2011 off the coast of New Zealand. The tanker "Rena" and the followed leaking of oil resulted in an environmental disaster. This oil spill damaged the wildlife, including seals, penguins, whales, dolphins, and rare seabirds (Forth, et al., 2011). It must be emphasized here that such spills and individual disaster are highly significant; yet, the scientific studies demonstrate that hydrocarbons pollution are the most damaging of all to the marine environment. In addition, it should be observed that a small oil amount is seeping constantly in the marine environment being digested within the ocean environment (Anyanova, 2012).

The transported particles of hydrocarbons at sea are far more dangerous to the marine life and environment. Although the effect of these elements and their pollution establish only a tiny part of the general rates of pollution to the sea environment, the pollution and leakage consequences and the transportation's wastes are extremely harmful to the ocean's inhabitants and marine landscape. The spilled oil, for instance, is quite toxic as it has lethal characteristics to the grown animals even in comparatively low concentrations. The spilled oil also cause behavioral and/or physiological disruptions of the sea's species. Moreover, it eventually results in death through the prevention of respiration, ordinary nutrition, and movement functions for the marine life at the seashore and not only of ocean's wildlife at deep (Bautista and Rahman, 2016).

Hydrocarbons leakage, during sea operations, is also quite dangerous for the birds. The leakage can often cause tainting of shellfish and fish. In addition, when witnessing the serious consequences of the gas or oil spills through the oily smell or taste to the known seafood. An oil leak damages directly not only the marine plants corals, and animals; yet, also heavily affect the normal activities of humans near the sea operating through damaging of their fishing gear and boats and/or floating equipment of fishing. The pollution also affects the ocean's shorelines, the seabed, the open waters; corals, and wetlands. The hydrocarbons pollution has the ability to damage the coastal amenities and fisheries, where the most vulnerable aspect of such pollution is the ocean's space (Anyanova, 2012).

The resulted damage is highly unpredictable and does not often rely on the magnitude of the leakage. It often depends on the area's vulnerability, which is affected and closeness to the shoreline. For instance, Tampico Maru ship had a 9.900-ton fuel leakage in 1957 in the Baja California covering more than 12 km of the ocean's coastline. Furthermore, 12.000 tons of oil in Puerto Rico discharged by the "Argea Prima" in 1962, which covered a considerable ocean space at that time. The spill of crude oil caused by the "Ixtoc I" oil platform, releasing 480.000 tons of oil through an explosion in the Mexican Gulf. In 1976, Argo Merchant ship was responsible for the grounding oil spill of 50.000 tons. VLCC "Exxon Valdez" also committed 40.000 tons of spilled oil particularly, the most vulnerable areas of the water, which have caused an ecological catastrophe in 1989 resulting in an extremely costly and long clean-up operation. The same occurrences were also noticed around the world through many years, such as the oil spill of "Atlantic Empress" as 400.000 tons of oil gone into the Atlantic in 1978 causing a significant impact on the ecosystem around the pollution site (Bautista and Rahman, 2016).

2.2 Conclusion

The intentional pollution may not occur too often because any loss of the hydrocarbon elements goes against the commercial gains and interests of the company/ies. The cases of accidental pollution from tanker spillage and collisions or blowouts are still massive. The statistics show that 80-95% of the hydrocarbon leakage at sea derives from the discharges of the hydrocarbon particles produced during drilling and the dumping of oil-based drilling chemicals and muds. Although it is proven scientifically that several chemicals carried at sea are intrinsically far more dangerous to the marine environment, the effect of hydrocarbon particles on the ocean and its ecosystem is extremely dangerous.

The leakage of hydrocarbons, even if it is counted tons of oil into the sea, have the ability to create a thin film on the surface of the water, which is quite deadly for the marine environment. It was also confirmed scientifically that the marine life and environment could recover from quite serious pollution incidents eventually.

Yet, it does not indicate that there is no shorter-term danger to the sea environment, coasts, individuals, and property. Besides, the concerned should think about not only the interests of today but also the interests of the future generations.

Chapter III

Research Methodology

3.1 Research Approach

The current study describes the strategies for managing the disasters of water pollution in hydrocarbons during shipping operations, identify the extent to which hydrocarbon leakage during shipping operations affects water resources, and identify the risks of water pollution caused by hydrocarbon leakage during shipping operations on human life. The aspects and dimensions of the phenomenon studied determined by reviewing the previous studies related to the subject of the study, which seeks to manage the water pollution disasters caused by the leakage of hydrocarbons during shipping operations. Those studies aim to provide the data and facts about the problem of the subject of the study in order to interpret and identify the implications.

3.2 Research Setting

The study describes the water pollution disasters caused by the leakage of Hydrocarbons during shipping operations in the world, but focused on the tankers across the sea from the ports of Arab Gulf Countries. The results of study will be for the interest of ports of the Arab Gulf Countries, as the research will recommend the best practices for managing the disasters of water pollution in hydrocarbons during shipping operations to be used by the shipping companies in Arab Gulf Countries.

3.3 Study Instrument

This researcher used one instrument, which is desk review.

The selected references or studies were chosen in a way that helps researcher to answer the following three questions:

1. What are the strategies for managing the hydrocarbon water pollution disasters during shipping operations?
2. How much does the hydrocarbon leakage during shipping operations affect water?
3. To what extent do the shipping operations apply water reservation laws?
4. What are the risks of water pollution caused by the leakage of hydrocarbons during shipping operations on human life?

3.4 Data Collection

The researcher collected the articles and studies from online scientific databases along with the available governmental reports to review their output regrading water pollution disasters and the managing strategies to solve or mitigate the leakage impact.

3.5 Limitations of the study

- Lack of the reports about the current pollution status in Arab Gulf Countries.
- Lack of the shipping companies reports that describe how the companies apply the laws that seek to preserve the water wealth.

Chapter IV

Results and Discussion

4.1 Introduction

The current chapter provides an elaborated discussion about the data retrieved during the systematic review. In addition, the discussion is focused on the answers of research questions. Major results are highlighted and explained as well.

Oil transportation is presumed to lead to 0.02 to 0.03 percent of the oil reaching the seas on a yearly basis just through the average amount of damage done during normal oil industry practices. This means that even in the absence of major accidents or oil leaks, the oceans are slowly filled with small scale oil slicks that are detrimental to the water habituating organisms and fishes. Oil transportation has also been a more frequent cause of disasters and leakages that have created oil spills capable of destroying the entire flora and fauna of a region. There are several examples of such oil industry disasters that have cost the environment dearly. These disasters have more often than not revealed the inadequate concern for the environment and for human life that the oil companies have displayed. For example, in the case of the Exxon Valdez oil spill of 1989, where a large tanker of oil hit the reef in the Gulf of Alaska and spilled over thirty billion of oil into the ocean (Ott 2010), it was found that the tanker had damaged sonar detection systems that were left without repair by the company as a cost cutting measure. The Exxon Valdez oil spill has been one of the worst environmental disasters due to the fact that the oil spill occurred in a region that was rich in its wildlife and oceanic life. The spill ended up destroying the many of the entre habitats of seals, salmons, sea otters, and seabirds (Li and Boufadel , 2010).

4.2 Marine Life and Oil Pollution: Overview

Oil pollution has a wide spectrum of hazardous environmental effects. Discharge of produced water formation (PWF) and drilling fluids (muds) due to offshore oil and gas production affects the marine ecology profoundly (Ramseur, 2010).

These effects are discernable in the regions like Arabian Sea. Damage to coastal vegetation like the marsh macrophytes and mangrove forests is also a serious threat (Pezeshki et al., 2000). Deletion of bacterioplankton at a large scale due to oil spills damage the food resources for the marine life systems. Huge amounts of discharge of hydrocarbons and carbon dioxide in the atmosphere due to petroleum combustion are another grimly environmental effect of oil pollution. The combined effect is irreparable damage to marine ecology consisting of fishes, sea birds, plankton, amphibians, etc. with deforestation of the coastal regions. Global warming and health hazards should also be mentioned in this context.

Although the formulations of particles and weathering processes may vary considerably among oil models, all are critically dependent on geophysical forcing to determine the fate of the oil spill, especially its motion (Hackett et al., 2009). In this way, it can be easily understood that how intricately we need to institute the struggle against the environmental hazards caused by oil pollution.

Petroleum hydrocarbons cause physical and chemical damage to the plants (Peressutti et al., 2003). Plants may survive fouling by the production of new leaves. But even the relatively non-toxic agents can damage or kill the plants when oil prevents plant gas-exchange physically.

Both acute and chronic effects have been noted in relation to the wastes associated with the offshore oil and gas production. These detrimental effects damage the tropical and temperate marine ecologies. Drilling fluids (muds) and produced formation water (PFW) are the major agents of harmful pollution. Drilling fluids (muds) include crude oils, chemical additives, ester based cutting muds, water based cutting muds, and oil based cutting muds, which drain into the water and affect the marine life by impairing respiratory processes, gas exchange, temperature control, etc. The potential long term effects of offshore oil and gas production industries have been found to be numerous and serious. Acute and chronic toxicity makes sea food harmful to human health. According to Holdway (2002), the toxic effects further impair the functionality of the ecosystem, which eventually cause death to hundreds and thousands of organisms.

Oil pollution has discernable effects even to the microbiological extent. Changes caused by diesel oil pollution in the metabolically active bacterioplankton from an oligotrophic coastal location have recently been studied and analyzed. Hydrocarbon pollution events in the coastal area exploited for the seasonal touristic activities have triggered a series of modifications at the molecular level in the bacterioplankton assemblage in the region (Peressutti et al. 2003). Differences in the diversity in pristine and polluted sites in this coastal area have been found in direct relationship with the alterations of prokaryotic numbers, which have been again in direct consequence to the patterns and extent of oil pollution (Lanfranconi et al. 2010).

Another example of the microbiological impact of oil pollution can be found in the results of a recent research on the dynamics of hydrocarbon degrading bacteriocenosis in relation to oil pollution in Patagonian soil (Peressutti et al. 2003). To understand the current researches conducted through the last decade, it is crucial to assess the environmental impact of oil pollution that was being studied in the late twentieth century too.

The chronic nature of oil pollution due to the physical and chemical activities related to the drilling and transportation of petroleum hydrocarbons has been established. This is rather like environmental slow poisoning (Peressutti et al. 2003). Therefore, field experiments were embarked on to detect the biological effects of the various types of cleaning treatments on the different types of coastal environments. These experiments are very contextual with respect to the recent scientific activities too. As stated by Baker (1978), elucidation of the effects of the refinery effluent toxicity is also critical and field studies are crucial for the purpose.

Further, oil pollution is also caused by the drainage of gross industrial wastes in the water bodies. In this context, point sources include municipal sewerage systems, storm water runoffs, industrial wastes, burnt or unused engine oils, etc. On the other hand, non point sources include sediment, agricultural chemicals, acid mine drainage, spills of oil and other hazardous elements (Whipple et al., 1974). Major oil pollution of the underground water streams has been found to be caused by automobile and industrial lubricants, much of which is disposed off after use by dumping on the ground or the sewers.

In the view of the potential oil spill and pollution patterns, certain parts of the world are being consistently monitored where pollution levels are already high. Northern European waters, Southern European waters, South American waters, and the offshore industry of Brazil have been the primary areas of focus. Scientists are setting up observatories and research facilities for the purpose of computer modeling of the potential threats of possible oil spills. According to Pezeshki and colleagues (2000), this is targeted to financial estimation in relation to both losses due to drainage of oil and hectic clean up and recovery processes.

Here, it should be further mentioned that the ability to monitor and predict marine oil spills depends on access to high-quality information on ocean circulation. Global Ocean Data Assimilation Experiment (GODAE) systems provide data, with global coverage, for currents, temperature, and salinity in the open ocean, and are now being used in oil spill fate forecasting systems. GODAE ocean forcing data can be implemented in various oil spill modeling systems, including both through direct application and through nesting of local hydrodynamic models (Hackett et al., 2009). As explained by Hackett and colleagues (2009), benefits of using GODAE data sets for oil spill modeling are improved prediction accuracy, global coverage, and the provision of alternative predictions for a given area.

4.3 Risks of Water Pollution caused by Hydrocarbon Leakage during Shipping Operations on Human Life

4.3.1 The Ecosystem Effect on Marine Pollution

Today, the danger of oil tankers and rig accidents, large scale oil spills, and harmful drilling fluids has increased manifold. So, it is necessary that the international community takes effective measures to control the effects of oil pollution; otherwise it will be too late. Moreover, the specter of global warming is also related to oil pollution since it is being principally caused by the effects of petroleum combustion.

The certain key findings like the damage to marsh vegetation, coastal vegetation and ecology, aquatic life, etc., which have been discussed through the evidence based literature review,

have influenced the very trends of current understanding. Damage to the marsh macrophytes in the US Gulf coast region (Pezeshki et al. 2000) explains how the vital process of photosynthesis would be impaired at a large scale, thus increasing the proportion of greenhouse gases in the environment.

Chronic and acute toxicity caused by the produced formation water (PFW) and drilling fluids (muds) discharged by the offshore oil and gas production processes (Holdway 2002) would poison the sea food and eventually harm human health. Alterations caused to the microbial life cycle, assemblage patterns, and related biochemical processes (Lanfranconi et al. 2010) would impair the natural processes of biodegradation of hydrocarbons and carbon assimilation. The analysis of the findings in the scientific literature examined so far clearly shows that certain parts of the world, where the oil conveyance or production processes are intense, are prone to accidents and oil spills.

Severe environmental hazards can take place. Therefore, monitoring and forecasting the fate of marine oil spills is one of the most important applications for operational oceanography. Prediction services, whether national or commercial, according to Hackett and colleagues (2009), play an important role both in decision making during incidents and in designing emergency response services. The synthesis in this context shows that damage to the marine ecology and the related microbiological processes would adversely affect carbon assimilation and hydrocarbon degradation. This would increase the proportion of greenhouse gases in the environment.

Moreover, by damaging plant gas exchange through physical compaction, oil pollution can impair plant metabolism and photosynthetic processes in large areas of marsh, mangrove, and other sorts of natural vegetation. Hence, availability of oxygen in the atmosphere will be reduced (Peressutti et al. 2003). Combustion of fossil fuels, particularly the petroleum products add harmful greenhouse gases like carbon dioxide to the atmosphere. This can be regarded as an indirect environmental effect of oil pollution. This is, however, in direct relation to global warming. The natural events and cycles that influence the climate are bringing about global climatic changes due to the direct and indirect effects of oil pollution.

The pattern and amount of warming can be explained on the on the basis of petroleum combustion, oil spills, dumping of lubricants, etc. The greenhouse gases emitted due to the human activities related to the consumption of oil are detrimental to the climate of our planet. Deforestation is making the situation worse, since the scope of storage of carbon dioxide is increasingly becoming narrower.

However, there are other heat trapping agents like methane and nitrous oxide. Moreover, emission of chlorofluorocarbons (CFCs) causes depletion to the ozone layer, which is again responsible for global warming (Peressutti et al., 2003). But due to the very large amount of petroleum combustion every year throughout the world, according to Houghton (2009), carbon dioxide remains at the prime focus of the greenhouse effect and global warming.

Oil spilled at sea is one of the most studied forms of marine pollution, due to the catastrophic and highly visible character of accidents, as well as oil's devastating effects on marine life. Because quick action can reduce the effects of spilled oil, the ability to forecast its drift and fate is needed by coastal societies, and many national services have been developed over the last few decades. Oil spill forecasting is typically carried out using a numerical model of the weathering and motion of the oil in the sea. Weathering, which includes evaporation, emulsification, natural dispersion, and other oil-specific processes, is determined by the chemical properties of the particular oil type under the influence of ambient environmental conditions (Holdway, 2002). The most common numerical formulation for oil represents the oil mass as a cloud of discrete particles (or super particles), as stated by Hackett and colleagues (2009), each of which represents a volume of oil that is subject to weathering and motion induced by geophysical forces.

Although the formulations of particles and weathering processes may vary considerably among oil models, all are critically dependent on geophysical forcing to determine the fate of the oil spill, especially its motion (Hackett et al. 2009). In this way, it can be easily understood that how intricately we need to institute the struggle against the environmental hazards caused by oil pollution.

The contaminants of petroleum chemical products (mostly aromatic hydrocarbons and aliphatic) not only affect the water's quality and contaminate it, but also damage anything alive in the water as well from living creatures to microorganisms. Generally, the most seen sources of petroleum contamination of the soil and sea are the oil spills.

Oil spills happen when transporting the tankers of crude oil, which happen because of accidents with the pipelines, tankers, etc.

These leakages or accidents can directly contaminate massive regions of soil and make them useless economically as well as quite dangerous to the main health of living creatures and organisms.

Some biological characteristics make some microorganisms more likely to be exposed to hydrocarbons particles than others do; especially, the habitat and depth of the microorganisms and species.

Under most situations, the hydrocarbons leakage will be visible on the water surface; therefore, decreasing the exposure of the most subtidal creatures and species to the leakage. Distinguished exceptions involve the organisms with canopies that can reach the water surface, such as some seagrass and kelp species. The mammals and birds of the marine environment, which must pass regularly through the air-water venue interface in order for them to breathe, are especially vulnerable to hydrocarbons exposure, whereas the species of pelagic fish will have smaller exposure to the hydrocarbons. In the hydrocarbons disasters in which the particles float, the major exposure will happen in the intertidal area, where the falling and rising tides bring the species directly in front of the magnitude of the leakage. The pathways of toxicity in various creatures are myriad and several examples could include the oil assimilation, the DNA damage, accumulation of contaminants in tissues, cardiac dysfunction, impacts to immune functioning, mass mortality of larvae and eggs, and the vapors inhalation. The organisms will differ in their reaction to the leakage event because of their physiological and morphological characteristics, which are mainly dictated by the differences of underlying genetic.

Therefore, expectations for how the local organisms will respond to any hydrocarbons leakage can be gleaned from the necessary data on the impact of former leakage on genetically related organisms. For example, the barnacle inhabitance is flexible to even direct exposure to the hydrocarbons, whereas the amphipod organisms experience long-lasting and strong population decreases in response to the leakage.

4.3.2 The Social Impact of Marine Pollution

Oil can influence the ecological procedure that causes direct damage, e.g., individual's health is affected from consuming seafood contaminated with oil toxins. Besides, the stressors of hydrocarbons leakage can alter the intermediary procedures; for example, the economic effects on the fishers from the hydrocarbons leakage. Furthermore, these stressors can directly affect individuals, for example, the health impacts from inhaling the hydrocarbons' vapors.

The reviewed studies indicate several essential processes and variables that affect the social and health impacts. Regarding the physical wellbeing, a direct or indirect approach and contact with the hydrocarbons particles through, for instance, tainted and contaminated seafood, consumption, or vapors inhalation can cause mainly deleterious of health extending from dizziness and nausea to certain cancers types and several dangerous matters with the central nervous system.

Although the long-term toxicity of hydrocarbon effects on individuals are less known, they have been associated with causing DNA degradation, cancers, volatile organic compounds (VOCs), reproductive and birth defects, irreversible endocrine and neurological damage, and an impaired cellular immunity. The VOCs are usually used as diluents in hydrocarbons transportation and processing and are regarded as the main pollutants in the crude oil with several effects on health depending on the amount and type of the chemical(s) implemented in a certain operation.

There is a huge level of community and cost which is paid due to oil spilling from problems in families which is splits in the families along with marriages failing and there are community problems where the residents and people do not talk to each other for a longer period of time. There are disastrous emotional problems faced by the people who did cleaning of the oil spilling.

Courts also do not take much notice of this claiming these to be unquantifiable and rejects them. Physical illness also increase with a huge percentage and amount , there is a huge number of disorders which are caused by the traumatic disorders and there is a high percentage of stress disorders which are due to problems caused later on. There is an increase in the heart attack rate along with major problems like diabetes, respiratory disorders and problems and also diabetes which is extremely bad for human health (Australian Maritime Safety Authority, 2012).

4.3.3 The Economic Impact of Marine Pollution

The economic impact of an oil tanker spill is difficult to evaluate with precision, given the limitations in available baseline data, long-term forecasting methods, and estimation of nonmarket costs. Although direct property damage is easy to ascertain, causality between oil spills and broader losses in income and market share is difficult to establish. Furthermore, the process of valuation itself is in many ways a socio-cultural construct that varies across contexts. The literature indicates several key variables related to the local economy and decision-making and policy interventions.

Historic oil spills indicate that some industries regularly experience losses caused by direct damage or market impairment. Commercial fisheries and aquaculture businesses are usually affected by the loss of product, caused by direct mortality or habitat loss, or by the loss of access caused by harvesting bans and closures. Losses are also incurred because of a decline in market demand amid fears of tainted products. These losses then ripple throughout the fisheries supply chain, affecting docks, processors, and supply businesses.

Similarly, the tourism industry can be harmed by direct impact to beaches and waterfront properties, as well as by the brand damage incurred by diminished public perception and negative media coverage. Losses may be experienced in tourism subsectors such as accommodations, transportation, guides, activities, and recreational fisheries.

The broader economy may experience pure economic losses caused by reduced disposable income or market demand. However, purely economic losses are especially difficult to measure or establish causality.

4.4 The extent to which hydrocarbon leakage during shipping operations affects water resources

The location, quantity of the hydrocarbons particles, size, and the time of the occurrence of the oil/gas pollution considered as a challenging event to be expected. In addition, the leakage cleanup and immediate recovery from the hydrocarbons elements are challenging and generally rely upon many fundamental factors, including the water temperature water (affecting biodegradation and evaporation), the types of beaches and shorelines involved, and type of oil spilled. Because of the hydrocarbon pollution risks, the action needed to assert the magnitude of the hydrocarbons pollution and understand its position by the available possibilities within a certain society, organization, or a country. Assorting such event leads to the precept: "The reaction required should be in accordance to the level of the occurrence".

4.5 The Extent to which Shipping Companies Apply the Laws that Seeks to Preserve the Water Wealth

Due to the importance of sea waters to every state and their interests in safeguarding and utilizing the coastal waters and also the international waters for trade, there are several provisions in the international law and other conventions that empower the states with some exclusive rights over other states, apart from common rights and responsibilities in the high seas. As the number of shipping companies increase coupled with globalization, the concerns of protecting the coastal waters by the respective states also has become a concern. There is the problem of migration, piracy, safety and security along with other technological, environmental and commercial issues and interests that the respective port states might have with respect to sea waters. Hence, the different articles in the various conventions have laid a number of provisions for enabling the smooth and safe trade in the international trade through sea waters.

It is observed that the customs and traditions of ages in the marine transportation have a major influence in the formulation of the public international law and the customary international law. The subjects of this law are the member states of the various conventions, the ship owners, the flag states, the port states, and the different laws, treaties, conventions, etc. the legal regimes of the seas are defined in these various conventions and the right to innocent passage is the backbone of the marine industry.

The reviewed studies provided some tips for safety for transportation companies after hydrocarbons leakage occurs by commitment the companies by the following procedures:

1. Avoiding any contact with the hydrocarbons/petroleum particles. Keep any individuals and animals far away from the location of the leakage. Establish a fence surrounding the leakage area, if possible, and present a clear warning sign.
2. Avoiding any contaminated food and keeping it away from animals that live in the water affected by the leakage.
3. Utilize a source of water upstream from the occurred leakage.
4. Avoiding any contact with the affected water or bathing, drinking, washing, etc. If an individual falls down in the affected water, make sure to be washed immediately with a firm grip, strong soap, and the constant use of clean water.
5. Provide individuals with necessary information regarding the several dangers of hydrocarbons at the community gatherings and schools.

4.6 The strategies for managing the disasters of water pollution in hydrocarbons during shipping operations.

The response and management variables for disasters directly affect the seriousness of an oil spill. The quick response through implementing a mix of effective and efficient technologies is essential. The response along with the required capacity is important elements as the tanker spills.

Although microorganisms could have the protective mechanisms required to face such a challenge against the toxic effects of the dispersants, such mechanisms in the mammals are still yet to be known. The hydrocarbons bioavailability increases after dispersal, which can mainly expose these creatures directly to increased levels of hydrocarbons leakage and allow the element of hydrocarbon-dispersant to get in the marine system. Although the less destructive measures and strategies like utilizing sorbents and skimmers can increase the mortality of these organisms through trampling by enormous cleanup crews.

The natural dynamic, such as wave action and oil-eating microorganisms, also assist to degrade and disperse any leakage of hydrocarbons particles and could be more effective than the efforts of cleanup teams and individuals. Thus, the lack of cleanup involvement would be preferred sometimes to higher efficient methodologies of response strategies.

Generally, the response regarding any hydrocarbons leakage, essential variables in the marine physical environment will be in control to which areas are directly exposed to the leakage, the quantity of hydrocarbons particles reaching the shoreline, and the residence period of hydrocarbons in the marine system. The surrounding conditions of weather can restrict the endeavors of cleanup strategies and/or alter the direction of hydrocarbons dispersal.

The hydrodynamic settings at the event of the spill are arguably the most essential elements affecting the residence time and dispersal of oil in the marine system and environment and can be easily broken down inside the exposure of the ocean's waves and patterns of currents and tides. The currents and tides at the spill event will highly affect the main direction of the oil spread whereas increased subjection to the ocean's waves will increase the energy of mechanical mixing available for the natural dispersal of oil and the effectiveness of the implemented dispersants.

4.7 Recommendations

In the light of the previous discussion and to avoid the pollution disasters that could be caused by the leakage of hydrocarbons during shipping operations, shipping companies are recommended to apply the following safety measures:

1- Recruiting professional cadres who are fully aware of the leakage hazards and know how to deal with it.

2- Developing clear work policies for all stakeholders.

3- Following strict and practical standards related to the safety of shipping hydrocarbons materials.

4- Using suitable chemical materials to deal with such leakages.

5- Running periodical maintenance to ensure the efficiency of the equipment.

6- Coordinating with all competent authorities to ensure smooth and safe shipping processes.

7- Setting emergency plans to ensure preparedness to deal with leakages.

8- Organizing periodical training for the working staff to keep them up with all measures developed to deal with leakages and refresh their knowledge as well.

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