ASSESSMENT OF THE TOXIC EFFECT OF METHYL TERTIARY BUTYL ETHER ON WATER SOURCES IN NIGER DELTA, NIGERIA

BY

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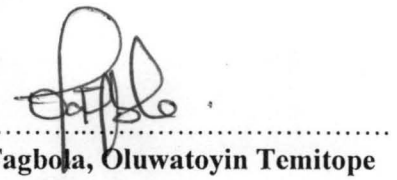
(ENVIRONMENTAL POLLUTION AND WASTE MANAGEMENT).

FEBRUARY, 2009.

DECLARATION

I hereby declare that this M.Tech Thesis Tittled: **Assessment of the Toxic Effect of Methyl Tertiary Butyl Ether on Water Sources in Niger Delta, Nigeria** is my own research work and that is has not been submitted to any other institution for whatsoever reason. The information derived from published and unpublished works have been duly acknowledged.



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9/4/09

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CERTIFICATION

This Thesis Titled: **Assessment of the Toxic Effect of Methyl Tertiary Butyl Ether on Water Sources in Niger Delta, Nigeria** by: **Fagbola, Oluwatoyin Temitope (M.Tech/SSSE/2006/1539)** meet the regulations governing the award of the Degree of Master of Technology (M.Tech) of the Federal University of Technology, Minna and is approved for its contribution to scientific knowledge and literacy presentation.

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DEDICATION

I dedicate this work to my late father **Chief Joshua Abesi Fagbola** who was and always would be my source of inspirations.

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My greatest gratitude goes to the Lord Almighty who kept me till this time. My sincere thanks to my supervisor **Dr. A.A. Jigam** who sacrificed time and energy to supervise this work. My gratitude also goes to graduating student of Biochemistry Department who assisted in some laboratory work of this project.

To my mum for her love and spiritual support (may you live long to enjoy the fruit of your labour). To my siblings **(Olu, Funmi, Femi, Laide, Renike, Sanmi, Deji and Fehintola)** thanks for your support.

To my friend and **brother Isaac Gado**, thank you for all your support. To my dear friends **Simbo Adenuga, Bisi and Tunde Oluwalasinu** keep being who you are.

ABSTRACT

The environmental impact of petroleum and associated products has assumed a critical dimension especially in the Southern part of Nigeria. Methyl Tertiary Butyl Ether is a widely used petroleum additives, specifically an oxygenate which has become a common contaminant of ground and other water sources where such industries are located. The health hazards posed by this compound in water was evaluated by survey methods, verbal interview and laboratory test. This is with the aim to ascertain the nature and extent to which the compound has polluted the water in the area under study. The findings indicated that a high percentage of people were convinced that water pollution is a problem in Nigeria, that oil companies use toxic additives to maximize profits to which the government pays little attention. The related health hazards are enormous which include respiratory, kidney, heart diseases and cancers of vital organs. Even agricultural output has not been spared resulting in low fish output, this pollution has endangered other assorted aquatic species. Laboratory analysis of this water in mice produced adverse effects on weights, red blood cells, biochemical parameters and even sensitive enzymes. In order to curtail the negative impact of MTBE on the environment, less toxic substitutes should be used and the government should enforce standards in the petroleum industries and also educate the general populace residence in area prone to this pollution.

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CHAPTER ONE

INTRODUCTION

1.1 Pollution

Pollution is the introduction of contaminants into an environment of whatever predetermined or agreed upon proportions or frame of reference; these contaminants cause instability, disorder, harm or discomfort to the physical systems or living organisms there in (Wikipedia, 2008). Pollution can take the form of chemical substances, or energy, such as noise, heat or light energy. Pollutants can be foreign substances or energies, or naturally occurring; when they are considered contaminants and when they exceed natural levels. Pollution is often classed as point source or non point source pollution.

Sometimes the term pollution is extended to include any substance when it occurs at such unnaturally high concentration within a system that it endangers the stability of that system. For example, water is innocuous and essential for life and yet at very high concentration, it could be considered a pollutant: if a person were to drink an excessive quantity of water, the physical system could be so over burdened that breakdown or even death could occur. The potential of excessive noise to induce imbalance in a person's mental state, resulting in malfunctioning and psychosis has been used as a weapon in warfare.

Every pollutant has it own health risk profile. Estimates indicate that the proportion of the global burden of disease associated with environmental pollution hazards ranges from 23 percent (WHO, 1997) to 30 percent (Smith et al., 1999; Kjellstrom, 2008). These estimate include infectious diseases related to drinking water, sanitation and food hygiene; respiratory diseases related to severe indoor air pollution from biomass burning; and vector borne diseases with a major environment component, such as malaria. These three types of

diseases each contribute approximately 6 percent to the updated estimate of the global burden of diseases (Kjellstrom et al., 2008).

1.2 Water Pollution

Water pollution is the contamination of water bodies such as lakes, rives, oceans and groundwater caused by human activities which can be harmful to organisms and plants which live in these water bodies.

Although natural phenomena such as volcanoes, algae blooms, storms and earthquakes also cause major changes in water quality and the ecological status of water, water is typically referred to as polluted when it impaired by anthropogenic contaminants and either does not support a human use (like serving as drinking water) or undergoes a marked shift in its constituents biotic communities. Water pollution has many causes and characteristics. The primary sources of water pollution are generally grouped into two categories based on their point of origin. Point-source pollution refers to contaminants that enter a waterway through a discrete "point source". Examples of this category include discharges from a wastewater treatment plant, outfalls from a factory, leaking underground tanks, etc. The second primary category, non-point source pollution, refers to contamination that, as its name suggests, does not originate from a single discrete source. Non – point source pollution is often a cumulative effect of small amounts of contaminants gathered from a large area. Nutrient runoff in storm water from sheet flow over an agricultural field, or metals and hydrocarbons from an area with high impervious surfaces and vehicular traffic are examples of non-point source pollution. The primary focus of legislation and efforts to curb water pollution for the past several decades was first aimed at point sources. As point

sources have been effectively regulated, greater attention has come to be placed on non-point source contributions, especially in rapidly urbanizing / suburbanizing or developing areas.

The specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens and physical or sensory changes. While many of the chemicals and substances that are regulated may be naturally occurring (iron, manganese, etc.) the concentration is often the key in determining what is a natural component of water, and what is a contaminant. Many of the chemical substances are toxic. Pathogens can produce waterborne diseases in either human or animal hosts. Alteration of water's physical chemistry include acidity, electrical conductivity, temperature, and eutrophication. Euthrophication is the fertilization of surface water by nutrients that were previously scarce. Water pollution is a major problem in the global context. It has been suggested that it is the leading worldwide cause of deaths and diseases and that it accounts for the deaths of more than 14,000 people daily. Some organic water pollutants are:-

- ✓ Insecticides and herbicides, a huge range of organohalide and other chemicals.
- ✓ Bacteria, often is from sewage or livestock operations.
- ✓ Food processing waste, including pathogens.
- ✓ Tree and brush debris from logging operations.
- ✓ VOCs (Volatile Organic Compounds), such as industrial solvents, from improper storage.
- ✓ DNAPLs (Dense Non – Aqueous Phase Liquids), such as chlorinated solvents, which may fall at the bottom of reservoirs, since they don't mix well with water and are more dense.

- ✓ Petroleum Hydrocarbons including fuels (gasoline, diesel, jet fuels, and fuel oils) and lubricants (motor oil) from oil field operations, refineries, pipelines, retail service stations underground storage tanks, and transfer operations.

Note: VOCs include gasoline – range hydrocarbons.

- ✓ Detergents
- ✓ Various chemical compounds found in personal hygiene and cosmetics products.
- ✓ Disinfection by –products (DBPs) found in chemically disinfected drinking water.

Some Inorganic Water Pollutants Include:

- ✓Spill of oil over the seas is the biggest danger.
- ✓Heavy metals including acid mine drainage.
- ✓ Acidity caused by industrial discharges (especially sulfur dioxide from power plants).
- ✓ Pre – production industrial raw resin pellets, and industrial pollutant chemical waste as industrial by products.
- ✓ Fertilizers, in runoff from construction sites, logging, slash and burn practices or land clearing sites.
- ✓ Microscopic, that is, large visible items polluting the water are termed marine debris, and can include such items as:
- ✓ Nurdles, small ubiquitous waterborne plastic pellets.
- ✓ Shipwrecks, large derelict ships.

1.3 Transport and Chemical Reactions of Water Pollutants

Most water pollutants are eventually carried by the rivers into the oceans. In some areas of the world the influence can be traced hundred miles from the mouth by studies using hydrology transport models. Advanced computer models such as SWMM or the DSSAM model have been used in many locations worldwide to examine the fate of pollutants in aquatic systems. Indicator filter feeding species such as copepods have also been used to study pollutant fates in the New York Bight, for example. The highest toxin loads are not directly at the mouth of the Hudson River, but 100 kilometers south, since several days are required for incorporation into planktonic tissue. The Hudson Discharge flows south along the coast due to coriolis force. Further south then are areas of oxygen depletion, caused by chemicals using up oxygen and by algae blooms, caused by excess nutrients from algae cell death and decomposition. Fish and shellfish consume copepods, then large fish eat smaller fish, etc. each successive step up the food chain causes a stepwise concentration of pollutants such as heavy metals (e.g. mercury) and persistent organic pollutants such as DOT. This is known as biomagnification which is occasionally used interchangeably with bioaccumulation. (Caprino and Tonga, 1988).

The big gyres in the oceans trap floating plastic debris. The North Pacific Gyere for example has collected the so-called "Great Pacific Garbage Patch" that is now estimated at 100 times the size of Texas. Many of these long – lasting pieces wind up in the stomachs of marine birds and animals. This results in obstruction of digestive pathways which leads to reduced appetite or even starvation. (Merck, 1989).

Many chemicals undergo reactive decay or chemically change especially over long periods of time in groundwater reservoirs. A noteworthy class of such chemicals are the

chlorinated hydrocarbons such as trichloroethylene used in the dry cleaning industry (note latest advances in liquid carbon dioxide in dry cleaning that avoids all use of chemicals). Both of these chemicals, which are carcinogens themselves, undergo partial decomposition reactions, leading to new hazardous chemicals (including dichloroethylene and vinyl chloride) (ARCO, 1980).

Groundwater pollution is much more difficult to abate than surface pollution because groundwater can move great distances through unseen aquifers. Non – porous aquifers such as clays partially purity water of bacteria by simple filtration. (adsorption and absorption), dilution and in some cases, chemical reactions and biological activity: however, in some cases, the pollutants merely transform to soil contaminants. Groundwater that moves through cracks and caverns is not filtered and can be transported as easily as surface water. In fact, this can be aggravated by the human tendency to use natural sinkholes as dumps in areas of Karst topography (Kjelsher, 1986) .

There are a variety of secondary effects stemming not from the original pollutant, but a derivative condition. Some of these secondary impacts are:-

- ✓ Silt bearing surface runoff can inhibit the penetration of sunlight through the water column, hampering photosynthesis in aquatic plants.
- ✓ Thermal pollution can induce fish kills and invasion by new thermophilic species. This can cause further problems to existing wildlife.

1.4 Sources of Chemical Water Pollution

Chemicals can enter waterways from a point source or a non – point source. Point-source pollution is due to discharge from a single source, such as an industrial site. Non-

point source pollution involves many small sources that combine to cause significant pollution. For instance, the movement of rain or irrigation water over land picks up pollutants such as fertilizers, herbicides and insecticides and carries them into rivers, lakes reservoir, coastal waters, or groundwater. Another non – point source is storm-water collects on roads and eventually reaches rivers or lakes.

Paper and pulp mills consume large volumes of water and discharge liquid and solid waste products into the environment. The liquid waste is usually high in biological oxygen demand, suspended solids, and chlorinated organic compounds such as dioxins (World Bank 1999). The storage and transport of the resulting solid waste (wastewater treatment sludge, lime sludge and ash) may also contaminate surface waters. Sugar mills are associated with effluent characterized by biological oxygen demand and suspended solids, and the effluent is high in ammonium content. In addition, the sugarcane rinse liquid many contain pesticide residues, leather tanneries produce a significant amount of solid waste, including hide, hair, and sludge. The wastewater contains chromium, acids, sulfides, and chlorides. Textiles and dye industries emit a liquid effluent that contains toxic residues from the cleaning of equipment. Waste from, petrochemical manufacturing plants contains suspended solids, oils and grease, phenols and benzene. Solid waste generated by petrochemical processes contains spent caustic and other hazardous chemicals implicated in cancer.

Another major source of industrial water pollution is mining. The grinding of ores and the subsequent processing with water lead to discharges of fine silt with toxic metals into waterways unless proper precaution are taken, such as the use of sedimentation ponds. Lead and zinc ores usually contain the much more toxic cadmium as minor component. If the cadmium is not retrieved, major water pollution can occur. Mining was the source of

most of the widespread cadmium poisoning (Itai – Itai disease) in Japan in 1940 – 50 (Kjellstrom 1986).

Other metals, such as copper, nickel, and chromium are essential micronutrients, but in high levels these metals can be harmful to health. Wastewater from mines or stainless steel production can be a source of exposure to these metals. The presence of copper in water can also be due to corrosion of drinking water pipes. Soft water or low pH makes corrosion more likely. High levels of copper may make water appear bluish green and give it a metallic taste. Flushing the first water out of the tap can minimize exposure to copper. The use of lead pipes and plumbing fixtures may result in high levels of lead in piped water.

Mercury can enter waterways from mining and industrial premises. Incineration of medical waste containing broken medical equipment is a source of environmental contamination with mercury. Metallic mercury is also easily transported through the atmosphere because of its highly volatile nature. Sulfate-reducing bacteria and certain other micro-organism in lake, river, or coastal underwater sediments can methylene mercury, increasing its toxicity. Methylmercury accumulates and concentrates in the food chain and can lead to serious neurological diseases or more subtle functional damage to the nervous system (Murata and others 2004).

Runoff from farmland, in addition to carrying soil and sediments that contribute to increased turbidity, also carries nutrients such as nitrogen and phosphates, which are often added in the form of animal manure or fertilizers. These chemicals cause eutrophication (excessive nutrient levels in water), which increases the growth of algae and plants in waterways, leading to an increase in cyanobacteria (blue-green algae). The toxics released during their decay are harmful to humans.

The use of nitrogen fertilizers can be a problem in areas where agriculture is becoming increasingly intensified. These fertilizers increase the concentration of nitrates in groundwater, leading to high nitrate levels in underground drinking water sources, which can cause methemoglobinemia, the life-threatening "blue baby" syndrome, in very young children, which is a significant problem in parts of rural Eastern Europe (Yassi et al., 2001).

Some pesticides are applied directly on soil to kill pests in the soil or on the ground. This practice can create seepage to groundwater or runoff to surface waters. Some pesticides are applied to plants by spraying from a distance-even from airplanes. This practice create spray drift when the wind carries the materials to nearby waterways. Efforts to reduce the use of the most toxic and long –lasting pesticides in industrial countries have largely been successful, but the rules for their use in developing countries may be more permissive, and the rules of application may not be known or enforced. Hence, health risks from pesticides water pollution are higher in such countries (WHO 1990).

Naturally occurring toxic chemicals can also contaminate groundwater, such as the high metal concentrations underground water sources in mining areas. The most extensive problem of this type is the arsenic contamination of groundwater in Argentina, Bangladesh, Chile, China, India, Mexico, Nepal, Taiwan (China), and parts of Eastern Europe and the United States (WHO 2001). Fluoride is another substance that may occur naturally at high concentrations in parts of China, India, Sri Lanka, Africa, and the Eastern Mediterranean. Although fluoride helps prevent dental decay, exposure to levels greater than 1.5 milligrams per liter in drinking water can cause pitting of tooth enamel and deposits in bones. Exposure to levels greater than 10 milligrams per liter can cause crippling skeletal fluorosis (Smith 2003).

Water disinfection using chemicals is another source of chemical contamination of water. Chlorination is currently the most widely practiced and most cost-effective method of disinfecting large community water supplies. This success in disinfecting waster supplies has contributed significantly to public health by reducing the transmission of waterborne disease. However, chloride reacts with naturally occurring organic matter in water to form potentially toxic chemical compounds, known collectively as disinfection by-products (International Agency for Research on Cancer 2004).

1.5 Exposure to Chemical Water Pollution

Drinking contaminated water is the most direct route of exposure to pollutants in water. The actual exposure via drinking water depends on the amount of water consumed, usually 2 to 3 liters per day for an adult, with higher amounts for people living in hot areas or people in heavy physical work. Use of contaminated water in food preparation can result in contaminated food, because high cooking temperature do not affect the toxicity of most chemical contaminants.

Inhalation exposure to volatile compounds during hot showers and skin exposure while bathing or using water for recreation is also potential routes of exposure to water pollutants. Toxic chemicals in water can affect unborn or young children by crossing the placenta or being ingested through breast milk.

Estimating actual exposure via water involves analyzing the level of the contaminant in the water consumed and assessing daily water intake (WHO, 2003). Biological monitoring using blood or urine samples can be a precise tool for measuring total exposure from water, food and air (Yassi et al., 2001).

1.6 Health Effects

No published estimates are available for the global burden of diseases resulting from the overall effects of chemical pollutants in water. The burden in specific local areas may be large, e.g. Bangladesh, other examples of a high local burden of disease are the nervous system diseases of methylmercury poisoning (Minamata disease), the kidney and bone diseases of chronic cadmium poisoning (Itai-Itai disease), and the circulatory system diseases of nitrate exposure (Methemoglobinemia) and lead exposure (anemia and hypertension) (Kjelstrow, 1986).

Acute exposure to contaminants in drinking water can cause irritation or inflammatory of the eyes and nose, skin and gastrointestinal system; however, the most important health effects are due to chronic exposure (for example liver toxicity) to copper, arsenic, or chromium in drinking water. Excretion of chemicals through the kidney target the kidney for toxic effects, as seen with chemicals such as cadmium, copper, mercury and chlorobenzene (WHO, 2003).

1.7 Research Questions

1. The negative effect of refinery additives especially MTBE on the waters in the environment.
2. How does MTBE affect the health of people in Niger Delta.

1.8 Statement of the Problem

Water pollution has contributed to increased derpit all legal and constitutional provisions to the contrary, the effect of such a increased the death of many water life. This

has also results in anxiously health hazards. It is against this background that the research assessed the impact of MTBE in water sources in the southern parts of Nigeria and in view to proffering workable solution to the problems.

1.9 Objectives of the Study

To assess the negative effect of MTBE in the water sources of Southern Nigeria significantly, the study is set out to:-

1. Assess the effect of MTBE in the environment.
2. Determined health implihed of water pollution as result of MTBE on the inhabitants of the Southern part of Nigeria and examine the effect on water body.
3. Evaluate the impact of water pollution on the means of livelihood of the people of the southern part of Nigeria.
4. Make recommendations on how to control water pollution and put a stop to it.

1.10 Significance of the Study

It would be of benefit to all stakeholders involved in the Southern part of Nigeria e.g. Government, NGO, Host countries.

It will uncover the negative impact of MTBE as a petroleum additives causing water pollution and ways of minimizing it. It will serve as a reference materials to stakeholder and any other involvement party. It will serve as a right foot of stacy fruster investigation for academician.

1.11 Scope of the Study / Limitation of the Study

The scope covers the water pollution in Niger Delta of the Southern part of Nigeria and limitation of the study if the in accessibility to medical information in the hospitals and information involving the processing of refined crude oil in the refineries, also unwillingness of people to fill the questionnaire due to the security sake.

CHAPTER TWO

LITERATURE REVIEW

2.1 Occurrence and Use

MTBE is a synthetic solvent used almost exclusively as an oxygenated in unleaded gasoline to improve combustion efficiency. It also has had limited use as a therapeutic drug for dissolving cholesterol gallbladder stones (Leuschner et al., 1994). MTBE is not known to occur naturally. Reformulated gasoline with MTBE has been used nationwide to meet the 1990 Federal Clean Air Act Amendments requirements for reducing carbon monoxide and ozone. About 40% of the US population lives in areas where MTBE is included in oxyfuel or reformulated gasoline. Federal and state law required the exclusive sale of reformulated gasoline in California beginning in 1996. currently, MTBE is added at 11%s volume to almost all of the gasoline used in California (a small percentage of the gasoline used in California contains ethanol as an oxygenated, rather than MTBE).

Due to its use as a fuel additive, MTBE is a high volume production chemical. It was the second most-produced chemical in the US in 1997. California produced 181 million gallons of the 2.9 billion gallons of MTBE estimated to be produced in the US in 1997. in addition, MTBE is imported for use in California. It can be manufactured from isobutene, also known as isobutylene or 2-methylpropene (Merck, 1989), which is a product of petroleum refining. It is produced primarily by combining methanol with isobutene, but can also be produced by combining methanol with TBA (A TSDR, 1996).

MTBE is present in ambient air in California. Potential sources of MTBE in ambient air are the manufacture and distribution of oxyfuel and reformulated gasoline, vehicle refueling and evaporative and tailpipe emissions from motor vehicles. Monitoring for MTBE

was initiated by the California Air Resources Board in 1996. preliminary data suggest a statewide concentrations in the South Coast of about 4 ppbv. These values are similar to limited data other states.

MTBE has become a drinking water contaminant in California because of its high water solubility and persistence in solution. Potential sources of drinking water contamination are leaking underground storage tanks, recreational power – boating and refinery waste water. MTBE has been detected in groundwater in connection with leaking underground storage tanks by water quality management authorities in Santa Clara, Orange, Solano and San Francisco countries, among others. MTBE can reach concentrations of 10 ppm near the source of the fuel release. MTBE has been detected in lakes and reservoirs, with concentrations higher in reservoirs that allow use of gasoline – powered boats. Affected California lakes include Lake Tahoe, Shasta, Donner, Merced, Havasu, clear lake and Canyon Lake. Beginning in 1997, monitoring of drinking water sources for MTBE was instituted by the California Department of Health Services. As of June, 1998, MTBE was detected in 25 of 671 public water systems and 46 of 3173 drinking water sources monitored. Six groundwater wells have reported concentrations above 20 j1g/L, the lower limit of the US EPA Hazard Advisory Level of 20-40 ppb. Two groundwater well fields in Santa Monica and on in Santa Clara have been shut down due to MTBE contamination.

2.2 Hydrocarbon

Benzene

Benzene is a systematic toxicant in humans at any concentration and a cause of a plastic anemia (deficient red blood cell production). The major effect of benzene in the body is depression of bone marrow leading to pancytopenia, (a general depression of erythrocytes

(red blood cells), leukocytes (white blood cells) and thrombocytes (platelets). A widespread reduction in erythrocytes in a population will lead to a general increase in morbidity. This has been commented upon, anecdotally, in Alberta in relation to the contrast between relatively high property and relatively high use of the health care system, Generally a higher socio economic standard is expected to lead to reduced use of the health care system.

Benzene is a know human carcinogen, causing leukemia; it is non mutagnic. An annual time weighted average concentration (TWA. For a risk of 1 in a million is an annual average concentration of 0.096 g/m3. (Ruth, 1986). The odour threshold of benzene is 4.5mg/m^3 and the odor is described as sweet. An odor threshold is the concentration when an average person becomes aware of an odor we draw attention to the quite important observation that an average person will become aware of the presence of benzene at a concentration 4500/0.096 = 46,800x maximum acceptable value to annual exposure of a risk of 1:1,000,000. an average person can be at risk of leukemia and never be aware, take steps to protect or otherwise act in defense of their health and integrity.

Xylene, o, m-, p-,

Xylene have two methyl groups substituted into the benzene ring, either adjacent (=ortho), separated by one ring carbon (=meta) or separated by two ring carbon atoms (=para), xylenes are unequivocal developmental toxins, leading to delayed development, decreased fetal body weight an altered enzyme activities (Hathaway, 1996). There is evidence of behavioral neurotoxicity in individuals occupationally exposed to short term levels of xylene. It appears to cause CNS depression and minor effects in the liver and kidney. In human studies 200 ppm are definitely irritating to the eyes, nose and throat.

(Hathaway 1996). Xylenes are fetotoxic including delayed development decreased feta body weights and altered enzyme activities; they may cause CNS depression in acute exposure resulting in dizziness, staggering, drowsiness and unconsciousness.

The odor threshold of xylene is 348ug/m^3 and the acceptable daily intake from air is 0.120ug/m^3. This means that an average person who becomes aware of the odor of xylene is exposed to 348/0.120=2,900 x an acceptable daily intake. A mother with delayed development or decreased birth weight in her new born experiences an immense personal trauma.

Styrene

Styrene (vinyl benzene, ethynyl-benzene) is an irritant of the skin and mucous membranes an a CNS depressant. Upper respiratory tract and eye-irritation have been reported at 50 ppm. Women who worked in the most exposed jobs had offspring with adjusted birth weights of 4% less than the offspring of unexposed women. There is a disagreeable odor with eyes and nose irritation. This may not be a sufficient warning of prolonged exposures this will contribute to the general eye, nose, throat and mucous membrane irritation and the odor will be found very disagreeable. The odor threshold is 0.2021ug/m^3 and an acceptable daily intake by air has not been established, (Hathaway, 1996).

Naphthalene

Naphthalene is a hermolytic agent, destroying the membrane of the red blood cells with the liberation of hemoglobin and an irritant of the eyes that may cause cataracts. Initial

symptoms include eye irritation headache, confusion, excitement malaise, profuse sweating, nausea, vomiting abdominal pain, irritato of the bladder. The metabolites are hemolytic, that is the biological damage is secondary to the naphthalene. Headache, nausea and confusion reported to occur after inhalation of the vapor. Extrapolation from animal data is difficult because of varying result. The odor threshold of naphthalene is 1.5mg/m^3 and an acceptable daily intake is estimated as 96mg/m^3 an average exposed person aware of the naphthalene (mothbalss) is exposed to 1500/96 = 15.6 times a safe limit.

2.3 Adverse Health Effects

Chronic Chemical Exposure

Raw Fuel:- Associations between several cancer sites and fuels have been carefully examined by Siemiatycki et. al (1957) they examined cancers and exposure to petroleum fuels, specifically automotive gasoline, aviation gasoline, mineral spirits, kerosene, jet fuel, diesel fuel, heating oil, cutting fluids, hydraulic fluids, lubricating oils, other minerals oils and crude oil. They found statistically significant association between many sites and minimal (any) exposure. Statistically significant association are those with the lower confidence interval greater than 1. statistically significant associations at the 90^{th} percentile were found between the following sites and fuels.

Health Effects of Hydrocarbons

Stress

Stress was broadly defined by Sely in 1950 as the response of an organisms to stimulation or change and is characterized by activation of both the autonomic nervous system and the hypothalamus pituitary adrenal (HPA) AXIS. The rustling neuro-chemical

changes affect the immune system both directly and indirectly. It has been recognized that there is an association between the CNS and the immune system as it relates to the development of auto-immune disease. Auto-immune disease is a condition in which the immune system reacts to itself and includes MS. Type II diabetes, rheumatoid arthritis, graves disease, hashimotos disease and lupis. It seems to be associated with chronic stress from chronic exposure after one incident that seems life threatening. In this it shows many properties in common with, and may be related to PTSD. (Todd and Davenport, 1995).

The onset of rheumatoid arthritis usually follows one of two patterns: occurring after a single abrupt life event or after a long standing series of unpleasant experiences. The former category includes bereavement, separation, divorce, termination of employment or abrupt financial loss. The later includes long term discord with spouse or co-worker, an increase in work pressure or pressures of childcare. Autoimmune thyroid disease includes graves hyperthyroidism, hashimotos hypothyroidism, as well as sub-acute and chronic forms of thryroiditis that may actually represent a continuum of thyroid dysfunction. Stressful life events associated with chemical exposure to crude oils appear to recede the onset of the disease (Johson and Sunder, 2001).

Multiple Sclerosis patients in general report a stressful life event occurring just prior to the onset of the disease. Many of these reports are somewhat anecdotal, s the data of onset of the disease is difficult to determined as well as the definition of an ideal control population. (Barbara, 2001).

The crude rate of MS in Alberta in one area (black diamond health district) exposed to extensive flaring is unofficially estimated to be about 400 new cases annually per 100,000 pop. Compared this to an average standardized incidence rate of all-cancer in for all of

Alberta of 380 cases per 100,000 women and 451 cases per 100,000 men in 1998 (Swann, 2001).

It is now recognized that the neuron – endocrine and immune systems can be influenced by external stress once it is perceived by the CNS. Chronic stress may cause significant dysfunction of the immune response leading to increased susceptibility to disease. It has been proposed that elevations of neuro-endocrine hormoned may be responsible for the immune suppression following acute or chronic stress (Glaser an Kieoff – Glasser, 1993).

Cyclical Chemical Exposure and Stress

Chemical Sensitivity: The influence of xenobiotic chemicals on the human limbic system has been widely investigated. The limbic system is that portion of the brain that controls emotions and is strongly influenced by chemical pollutants. Bell et al., have established that the answers to five questions are significantly associated with chemical sensitivity in an individual. Sixty percent of 643 person questioned. Reported feeling ill from one or more of the five chemical: 15% identified the smell for at least 4 chemicals as making them ill. Women tended to be more susceptible than men. The syndrome of feeling ill from smells has been defined as cacosmia. The five question screen includes feeling ill form pesticides, from car exhaust, from drying paint, from new carpet and from perfume.

Irritability, joint and muscle pain, daytime tiredness, constipation, indigestion, headache, trouble sleeping at night, memory trouble, difficulty concentration, daytime sleepiness or grogginess and ringing in the ears are all associated with feeling ill from

smells. The more of these signs/ symptoms that one can answer "yes" to, the greater is the individuals chemical sensitivity.

Mainstream medical practitioners sometimes dismiss complaints of chemical sensitivity as "all in your head". The medical profession is moving, however glacially to recognized the phenomenon and have developed criteria for chemical sensitivity, the criteria include:-

- ✓ The disorders is acquired in relation to some documentable exposure, symptoms include more than one organ system;
- ✓ Symptoms recur and abate in response to predictable stimuli;
- ✓ Symptoms are elicited by exposure to chemicals of diverse structural classes;
- ✓ Symptoms are elicited by exposures that are demonstrable though low;
- ✓ Exposures must be very low and no single widely used test of organ function can explain the symptoms.

The sensitized person will experience adverse effects at chemical concentrations that are very much below anything expected in conventional testing. These concentrations are quite low and generally are dismissed as inconsequentially. We showed here that a great variety of hydrocarbons will be formed in a flare and the downwind plume will contain these, particulates and potentially dioxins. If the gas flared is sour an even larger variety of sulfur containing hydrocarbons will be formed. These are particularly malodorous and noticeable at low level. We have shown that the level at which a selection of hydrocarbons can be sensed is much above an acceptable daily intake prepared in an ultra conservative approach.

If something is present but cannot be smelled the limbic system will nevertheless react, though the observer will not be initially aware. The limbic system is a part of the basic defense of the organism and reacts to immeasurable small amounts. Therefore it is clear to

us that a heightened state of awareness will result in susceptible individuals reacting defensively, though initially they are not aware of this heightened state. This condition can be repeated over months or years and depending on the amount of material present, the receptor, you will hardly be aware that they have been reacting. With each cyclical repeat the organisms react to progressively lower amounts of stimulus. This is very classical conditioning, it has been shown by Bell et al., (1993) that the optimum conditions to induce chemical sensitization are cyclic waves of stimulus. This corresponds exactly to cyclical stimulus such as hydrocarbons from a flare carried by changing winds to a receptor.

In the presence of malodors hydrocarbons or sour gas flaring emission the level can be below the threshold for smell until a large gust bring the concentration to a level of awareness with predictable consequences. An explosion of rage followed by a nearly instantaneous headache, sore arching muscles and rapid constriction of the bronchus and lungs. The rage is a direct reaction from the limbic system fight or flight mechanisms. The headache is form of a constriction of blood vessels in the brain. The sore, aching muscles take longer to appear because they depend on the circulation to distribute the chemicals systematically. The subsequent let down is when the biochemical state of arousal is reduced toward normal and "you" have time to think, again. The chemicals circulating in the brain operate on the aminergic neuro – transmitter with mood altering effects.

Nigerian Oil

The global energy demand and reliance on fossil fuels especially petroleum is consistently on the increase. Industrial activity especially refining and distribution of petroleum products have interconnected the world e.g. Petroleum could be refined in the USA and exported all over the world. The additives e.g. MTBE used for such processes are

hence expected to consumer nations (ARCO, 1980). Nigeria resorted to massive importation of refined petroleum products from the late 1980's up till the present time in order to meet domestic demands. This became necessary as 90% of the country's refineries except those in Warri and Port Harcourt were either producing at below 10% installed capacity or had completely been shut down due to disrepair and obsolete machineries. Most of the imported products contained additives, oxygenates e.g. MTBE etc. commonly used in the exporting countries to improved combustion quality and maximize yields and hence profits. Indigenous refinieries caught up with this trend and the net outcome was the sharp increase in environmental pollutants such as MTBE in water sources not only in the vicinity of refineries but all over the country (Caprino and Tonga, 1998).

Therefore the study area is mostly concentrated with this additives MTBE because most of the imported petroleum products comes through the region before it is sent to other parts of the country apart from the refining of crude oil in the area as well.

2.4 Background of the Study

The Niger Delta

The Niger Delta, the delta of Niger River in Nigeria, is a densely populated region sometime called the oil rivers because it was once a major producer of palm oil. The area was the British oil rivers protectorate from 1885 until 1983, when it was expanded and became the Niger coast protectorate. The Niger Delta, as now refined officially by the Nigerian government, extends over about 70,000km^2 and makes up 7.5% of Nigeria's land mass. Historically and cartographically, it consists of present day Bayelsa, Delta and Rivers States, in the year 2000, however, Obasanjo's regime expanded its definition to include Abia

State, Akwa Ibom State, Cross River State, Edo State, Imo State and Ondo State. Some 31 million people of more than 40 ethnic groups speaking some 250 dialects live in the Delta.

The South-South Niger Delta include Akwa Ibom State, Bayelsa State Cross River State, Delta State and Edo State. During colonial period, the core Niger Delta was a part of Eastern region of Nigeria which came into being in 1951 (one of the three regions and later one of the four regions). This region included the people from colonial Calabar and Ogoja divisions, (see old Calabar Kingdom), the Igbo people and the Ijaw with Igbo as the majority and Professor Eyo Ita of Calabar as the head (premier) of the region under NCNCE (National Council of Nigeria and Cameroon) as the ruling party in the region. NCNC late became national convention of Nigeria citizens after Western Cameroon decide to cut away from Nigeria and became a part of Cameroon.

In 1953, the region (Eaters Region) had a major crises due to the expulsion of professor Eyo Ita from office by the majority tribe, using the platform of the Ibibio union, the minorities in the region (Onon – Igbo), mainly people of the old Calabar kingdom, the ijaw and Ogoja demanded a state of rgion of their own the Calabar Ogoja rivers (COR) state. The struggle for the creation of COR state continued and was a major issue on the status of minorities in Nigeria during debates in Europe for Nigerian independence. The present south – south political zone seems some what close to the COR state movement but not quite as the original COR state would include the coastal south states only; namely; Akwa Ibom State, Bayelsa State, Cross River State, Delta State and Rivers State.

A Second Phase of the struggle saw the declaration of independent Niger Delta by Isaac Jasper Adak Boro during Ironsi's administration, just before the civil war. During the Nigerian civil war, southern state was created which had the colonial Calabar division (old

Calabar kingdom) and colonial Ogoja division and Rivers State for the other minorities, especially the Ijaw, Kalabari, Ogoni etc. southeastern stat was renamed cross river state and was later spilt into cross river state and Akwa Ibom State was later divided into rivers state, Delta State and Bayelsa State.

Phase Three saw the request for justice and the end of marginalization of the area by the Nigerian Government with Ken Saro Wiwa as the lead figure for this phase of the struggle. The indigenes cried for lack of development even though the Nigerian oil money is from the area. They also complained about environmental pollution and destruction of their land and rivers by oil companies. Ken Saro Wiwa and other leders were killed by the Nigerian Federal Government under Sanni Abacha.

Unfortunately, the struggle has gotten out of control and the present phase, the phase four, has become militant in nature. Nigeria needs to stay strong and united and the government needs to help solve the Niger Delta crisis. Western Niger Delta consists of the Western section of the coastal south – south Nigeria which include river state, Delta State and Bayelsa State. The Western Niger Delta is an heterogeneous society with several ethnic groups with ijaw as the majority, other ethnic groups include: Urhobo, Ezon, Isoko, Itsekiri, Kolokunu, Ekpetiama Igbriria, Atissa, Biseni, Nemba, Ogbia, Ogbein, Ogoni, Etche, Ogba / Egbema and Ikwere (Igbo). Their livelihoods are primarily based on fishing and farming.

Eastern Niger Delta

Eastern Niger Delta consist of the eastern section of the coastal south Nigeria which includes Akwa Ibom State and Cross River State. The Eastern Niger Delta region has the Efik people (Annag/Efik/Ibibio, Oron and Eket people who are all related with a common language and ancestors were all referred to as Efik or Calabar people in early Nigerian

history). The Eastern Niger Delta is a very homogeneous society. The people of this area share common ancestors and a common language (with some dialect). Their capital city at calabar located at the coastal southeast of Nigeria (eastern Niger Delta) served as the major trading and shipping center during the pre – colonial and colonial period. Calabar also served as the first capital of Nigeria and the point of entry of Western religion and western education into southern Nigeria. the combined population of the Ibibio, Anang andEfik people is the fourth largest single language group in Nigeria.

The Ijaw and the Annang / Efik/Ibibio may be related as historical record has it that they all migrated into Nigeria from the Cameroon highland upon arrival in African from Egypt.

Oil Revenue Sharing Formula

Year	Federal	State	Local	Special Projects	Derivation Formula
1958	40%	60%	0%	0%	50%
1968	80%	20%	0%	0%	10%
1977	75%	22%	3%	0%	10%
1982	55%	32.5%	10%	2.5%	10%
1989	50%	24%	15%	11%	10%
1995	48.5%	24%	20%	7.5%	13%
2001	48.5%	24%	20%	7.5%	13%

Source: Compiled from Research Instrument, 2008.

- ✓ State allocation are based on 5 criteria: equality (equal shares per state), population, social development, lad mass and revenue generation.
- ✓ The derivation formula refers to the percentage of the revenue oil producing states retain from taxes on oil and other natural resources produced in the state, world bank report.

Activities of local indigenous people against commercial oil refineries and pipelines have destabilized the region, recently foreign employees of shell, the primary corporations operating in the region, were taken hostage by outraged local people. Such activities have also resulted in greater governmental concern wit the area and the mobilization of the Nigerian army and coastguard in the region. In April, 2006, a bomb exploded near an oil refinery in the Niger Delta region, a warning against Chinese expansion in the region, MEND state; we wish to warn the Chinese government and its oil companies to steer well clear of the Niger Delta. The Chinese government by investigating in stolen crude places its citizens in our line of fire (CRS, 2008).

As a result of this sharing formula, violence activities has continued to increase in Niger Delta leading to vandalization of pipelines, hostage taking etc. which has also lead to continuous increase of water pollution in the environment.

Government and private initiatives to develop the Niger Delta region have been introduced recently. These include the Niger Delta Development Commission (NDDC), a government initiatives and the development initiatives (DEVIN) a community development non- governmental organization (NGO) based in port Harcourt in the Niger Delta. Uz and Uz transnational a company with strong commitment to the Niger Delta, has introduced ways of developing the poor in the Niger Delta, especially in Rivers State.

CHAPTER THREE

MATERIALS AND METHODS

3.1 Research Design

This choice of design is used on the nature of the study. This is going to be the use of survey, documentary and scientific research approach.

3.2 Population & Sample

The population for the study would involve the people in the Niger Delta Area. The sample size is 300 people, the break down is as follows:-

60 elders, 120 youths and 120 women. Also mice were used as MTBE toxicity test animals, this is to confirm the toxic nature of MTBE in living system.

Needed Instrument

The data that needs to be collected are:-

1. Frequent Illness around the area.
2. Frequent occurrence of leukemia and lymphoma's.
3. Physical parameters of indivodels e.g. weight.

3.3 Research instruments / Materials

The instrument in this study is questionnaire and oral interview. Also for the laboratory experiment some laboratory apparatus, reagents, chemicals and the pollutant itself (MTBE) and mice is required.

3.4 Validity and Reliability

(a) **Content Validity:-** To ensure that the instrument measures exactly what it is intended to measure, the questions will be relevant clear and unambiguous. Furthermore, the questions will cover all the dimensions of the variables included in the study. Scientific practical will test some of the variables included in the study so as to buttress the result.

(b) **Reliability Test:-** The reliability of the instrument would be determined by the response obtained from the respondents from the Southern part of Nigeria and the results from the laboratory research.

Pre-Testing of the Questionnaire

Pre – test shall be carried out to see how the questionnaire would work out. That some set of people to be used informal study will be used for the pre test exercise.

Testing of Laboratory Animal

Few mice were dosed with sample of the water collected from the highly polluted area to see the result of what happens to the mice. Mice would also be used for the main experiments.

3.5 Methods of Data Collection

Data will be obtained from both primary and secondary sources. The primary sources is to be obtained from the questionnaire administered to the respondent and the

effect of the polluted water on mice used in the laboratory while the secondary sources composed of data obtained from pushohed literature, journals and internet as well.

3.6 Method of Data Analysis

In analyzing the data percentages (%) will be used to determined the relationship between the variables.

3.7 Data Collection Problems

1. Unwillingness of people to fill the questionnaire because of security purpose.
2. Inaccessibility to hospital records around the areas to know the frequent causes of deaths.

CHAPTER FOUR

RESULTS

This chapter contains result of statistical analysis conducted on the relevant data adopted for the study. Data presentation is done with extensive use of tabulation and percentages (%).

4.1 Data Presentation

Table 4.1.1 – Table below show the response of the extent of water pollution in Nigeria compare to other parts of the world.

No. of Respondents	Percentage	Option
160	53%	Strongly Agree
140	37%	Agree
110	10%	Undecided
30	___	Disagree
0	___	Strongly Disagree

Virtually all the respondents affirmed that this rate of water pollution in Nigeria compared to other parts of the world is higher. It was observed that 53% stele they strongly agree, while 37% claimed they agree and 10% were not decisive. This brings to the conclusion that water pollution is on the high side in Nigeria.

Table 4.1.2 – The table below shows the response to the maximization of profits petroleum products by oil companies using deadly additives.

No. of Respondents	Percentage	Option
100	33%	Strongly Agree
80	27%	Agree
120	40%	Undecided
8	___	Disagree

		Strongly Disagree

33% of the respondents strongly agree that in order to maximize profit of petroleum products and companies uses deadly additives. Though 40% were undecided while 27% didn't agree, it is from this that can be concluded that oil companies makes use of some deadly additives to maximize profits.

Table 4.1.3 – The table below show response to the contribution of Nigeria government to cubby pollution of water sows by oil companies and others have been slow to be implemented.

No. of Respondents	Percentage	Option
170	57%	Strongly Agree
80	27%	Agree
20	6%	Undecided
30	10%	Disagree
0	___	Strongly Disagree

57% of respondents strongly agree that the Nigeria government efforts at cubbing pollution of water sources by oil companies others has been very slow to implement, while 27% agreed, 6% were not decisive and 10%disagreed. It can then be concluded that Nigerian government effort at curbing pollution of water sources has been slow to be implemented.

Table 4.1.4 – The table below shows the response to the contribution of water pollution to health hazard experienced by people.

No. of Respondents	Percentage	Option
155	52%	Strongly Agree
75	25%	Agree

20	7%	Undecided
50	16%	Disagree
0	____	Strongly Disagree

52% of respondents strongly agreed that water pollution has been able to contribute immensely to health hazards experienced by people in the area, 25% agreed, 7% were not decisive while 16% disagreed. It can be concluded that water pollution is one of the major causes of health hazard in the area.

Table 4.1.5 – The table below shows the response to the report of water pollution caused by oil companies haven gone uninvestigated.

No. of Respondents	Percentage	Option
180	60%	Strongly Agree
95	31%	Agree
20	7%	Undecided
8	2%	Disagree
0	____	Strongly Disagree

60% of respondents strongly agreed that report of water pollution caused by oil companies have gone uninvestigated, 31% agreed, 7% were not decisive and 2% disagreed. From these submissions it can be concluded that many reports on the negative effects of water pollution have apparently gone uninvestigated.

Table 4.1.6 – The table below show the response to the effect of water pollution mostly affect local communities where their major occupation is agriculture.

No. of Respondents	Percentage	Option
170	57%	Strongly Agree
100	33%	Agree
10	2%	Undecided
20	8	Disagree

0	____	Strongly Disagree

57% of respondents strongly agree that the effect of water pollution mostly affect local communities where the companies are situated, 33% agreed, 2% were not decisive while 7% disagreed. It could be concluded that local communities where the companies where the companies (oil) are situated mostly affected.

Table 4.1.7 – The table below shows the response to water pollution as oil spill and destruction of pipeline causes how farm yield and fish harvesting.

No. of Respondents	Percentage	Option
190	63%	Strongly Agree
80	27%	Agree
30	10%	Undecided
____	____	Disagree
____	____	Strongly Disagree

63% of respondents strongly agreed that water pollution as a result of oil spill and destruction of pipeline causes low fish harvesting, 27% agreed while 30% were not decisive. It could therefore be concluded that low yield in fish farming is as a result of water pollution.

Table 4.1.8 – The table below shows the response to water pollution has led to destruction of sore water life thereby rendering farming practice impossible.

No. of Respondents	Percentage	Option
200	68%	Strongly Agree
75	25%	Agree
25	7%	Undecided
____	____	Disagree
____	____	Strongly Disagree

68% of respondents strongly agreed that the resultant effect of water pollution has led to destruction of some water life, rendering farming practice impossible, 25% agreed while 7% were not decisive. This could be concluded that farming practice is made impossible as a result of destruction of water life by pollution.

Table 4.1.9 – The table below shows the response to the continuous consumption of water from this polluted area has led to increased risk of premature deaths.

No. of Respondents	Percentage	Option
150	50%	Strongly Agree
70	23%	Agree
20	7%	Undecided
0	20%	Disagree
60		Strongly Disagree

50% of respondents strongly agreed that the intake of polluted water has resulted to increased risk of premature deaths, 23% agreed, 7% were not decisive while 20% believed otherwise (disagreed). It can then be concluded that premature deaths results from consumption of polluted water.

Table 4.1.10 – The table below shows the response to kidney responding and heart problem common in this part of the country.

No. of Respondents	Percentage	Option
180	60%	Strongly Agree
100	33%	Agree
20	7%	Undecided
____	____	Disagree
____	____	Strongly Disagree

60% of respondents strongly agreed that respiratory, kidney and heart problem are frequent in the southern part of the country, 33% agreed, while 7% were not decisive. It can then be concluded that these health problems are frequent.

Table 4.1.11 – The table below shows response to water pollution in the southern part of Nigeria is unfriendly to natural ecosystem and biodiversity.

No. of Respondents	Percentage	Option
70	23%	Strongly Agree
150	50%	Agree
80	27%	Undecided
____	____	Disagree
____	____	Strongly Disagree

23% of respondents strongly agreed, 50% agreed that water pollution is unfriendly to natural ecosystem and biodiversity, 50% agreed while 27% were indecisive. It can then be concluded that water pollution is unfriendly to natural ecosystem and biodiversity.

4.2 The result from the laboratory research shows the following as a result of the consumption of water from the area of study.

1. Weight variation – there was consistent loss in weight among the test animals as compared with the controls.
2. Packed cell volume – there was progressive deadline in the test compared with the controls.
3. Serum biochemical parameters – there was progressive decline in glucose and total protein while triglycerides appreciated with time.
4. Enzymes – SG0T, SGPT and ALP were seen to increases progressively.
5. Serum electrolysis – sodium level showed slight changes whiles potassium and chloride ions were elevated in mice with MTBE water.

CHAPTER FIVE

DISCUSSION, SUMMARY, CONCLUSION & RECOMMENDATION

5.1 DISCUSSION

The global energy demand and reliance on fossil fuels especially petroleum is consistently on the increase. Industrial activity especially refining and distribution of petroleum products have interconnected the world e.g. Petroleum could be refined in the USA and exported all over the world. The additives e.g. MTBE used for such processes are hence exported to consumers nations (ARCO, 1980). Nigeria resorted to massive importation of refined petroleum products from the late 1980's up till the present time in order to meet domestic demands. This became necessary as 90% of the country's refineries except those in Warri and Port Harcourt were either producing at below 10% installed capacity or had completely been shut down due to disrepair and obsolete machineries. Most of the imported products contained additives, oxygenates e.g. MTBE etc. commonly used in the exporting countries to improved combustion quality and maximize yields and hence profits. Indigenous refineries caught up with this trend and the net outcome was the sharp increase in environmental pollutants such as MTBE in water sources not only in the vicinity of refineries but all over the country (Caprino and Tonga, 1998).

The result has presented in chapter four are mostly an affirmation of many reports regarding the environment impact of petroleum products. People generally responded in the affirmative about the enormous extent to which water has been polluted in the southern part of Nigeria, toxic additives. These were in agreement with the fundings of Patt (2009), Eronu (2008) and Anger and Johnson (1985). The facts that the Nigerian government has done little to curb water pollution by oil has also been shown. The response to the contribution of water

pollution to the ill health experienced by people has also been clearly demonstrated. Literature reports (Siemiatyeki et al., 1988) have long established the connection between petroleum products and different diseases. Ruth, 1986) reported the effects of the mutagenic, leukamic and caranogenic effects of benzene in human beings. Methyl tertiary butyl ether, the additive under study has been widely investigated as a Caranogen (Benoggi et al., 1995, 1997), (Burleigh layer et al., 1992; Bird et al., 1997) report have indicated that MTBE has become a drinking water contaminant in California because of its high water solubility and persistence in solution. Potential sources of drinking water contamination are leaking underground storage tanks, recreational power – boating and refinery waste water MTBE has been detected in groundwater in connection with leaking underground storage tanks by water quality management authorities in Santedara, orange, Solano and san Francisco countries, among others. MTBE can reach concentration of 10 ppm near the source of the fuel release. MTBE has also been detected in lakes and reservoirs with concentrations of higher in reservoirs that allow use of gasoline – powered boats. Overwhelming evidence has been obtained in the present work in which relates water pollution to increase risks of premature deaths oral interview conducted along side with results of questionnaire stated various diseases such as lymphomas, leukemia, kidney disorder, heart problems and respiratory problems as a result of consumption of water polluted by MTBE which had been reported earlier(frith.;1988). The results of the laboratory research conducted on mice using polluted water agreed thus,which were even worse than earlier reported (Belpoggi et al. 1997; Bird et al., 1997).

Also, there was reported cases of weight loss as a result of the continuous intake of the water polluted by this compound (Wilson et al; 2001) this was supported by the results from the oral interview conducted and the laboratory research conducted on the mice.

5.2 SUMMARY

The major findings show links between water pollution; mortality can arise from pollution; agricultural produce is affected by water pollution and laboratory analysis also shows the link between MTBE and its health effect in mice.

5.3 CONCLUSION

- ✓ The toxicity of MTBE as additive or petroleum in water has been established.
- ✓ The effect of the compound not commonly reported in oil refineries agrees with the survey carried out in the area.
- ✓ The adverse effects of the compound on the environment has been established.

5.4 RECOMMENDATIONS

The adverse health effect of MTBE as a water pollutant can be minimized if exposure to such chemical is curtailed. Novel oxygenate of low toxicity should be developed and used in place of MTBE. Government regulatory agencies should enforce strict compliance with standards for oxygenates especially MTBE in oil companies imported fuel should be screened before it is sent around the country. More efforts should be put in place to reduce vandalization of pipelines in this area. The populace should be sensitized about the toxic effect of MTBE as an environmental pollutant.

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APPENDICES

Appendix I: Sample Questionnaire

I am M.Tech Environmental Management Student of Federal University of Technology, Minna carrying out a study to assess **THE TOXIC EFFECT OF METHYL TERTIARY BUTYL ETHER ON WATER SOURCES IN SOUTHERN PARTS OF NIGERIA.**

The purpose of this questionnaire is to collect relevant data to compliment this research work, your accurate response and cooperation is highly solicited.

Each data you supply will be treated with utmost confidentiality.

Thank you.

Part I

1. Sex: Male ( ) Female ( )
2. Age: ( )
3. Qualification: Primary ( ), Wasc/Neco/Equivalent ( ), OND ( ), Bsc. / HND ( ), Msc. / MPA ( ).
4. Local Government of Residence _____

Part II

Please tick from the list of options provided which best describes you view.

i. Strongly Agreed (SA)

ii. Agree (A)

iii. Undecided (UD)

iv. Disagree (D)

v. Strongly Disagree (SD)

1. IN ORDER TO MAXIMIZE THE PRODUCTION OF PETROLEUM OIL COMPANIES MAKES USE OF SOME DEADLY ADDITIVES_____.
2. INTERNATIONAL COMMUNITY, NIGERIA GOVERNMENT AND OIL COMPANIES ARE ALL IN AGREEMENT THAT WATER POLLUTION HAS A NEGATIVE EFFECT AND NEED TO BE STOPPED_____.
3. VANDALIZATION OF PIPELINES IS PROMINENT IN THE SOUTHERN PART OF NIGERIA_____.
4. NIGERIAN GOVERNMENT EFFORT OF CURBING POLLUTION OF WATER SOURCES BY OIL COMPANIES AND OTHERS HAVE BEEN SLOW TO BE IMPLEMENTED _____.
5. WATER POLLUTION HAS CONTRIBUTED TO THE HEALTH HAZARDS EXPERIENCED BY PEOPLE IN THE SOUTHERN PART OF THE COUNTRY_____.
6. SO MANY REPORTS OF WATER POLLUTION CAUSED BY OIL COMPANIES HAS GONE UNINVESTIGATED _____.
7. WATER POLLUTION CAUSED BY OIL COMPANIES AND OTHERS MOSTLY AFFECT LOCAL COMMUNITIES WHERE THEY ARE SITUATED_____.
8. WATER POLLUTION AS A RESULT OF OIL SPILL AND DESTRUCTION OF PIPELINES CAUSES LOW YIELD IN FISH FARMING _____.

9. WATER POLLUTION HAS LED TO THE DESTRUCTION OF SOME WATER LIFE, RENDERING THE OCCUPANTS INABILITY TO CARRY OUT FARM PRACTICE AGAIN _____.

10. THE CONTINUOUS CONSUMPTION FROM THIS POLLUTED AREA HAS INCREASED RISK OF PRE MATURE DEATHS_____.

11. THE EXPOSURE OF THE SOUTH PEOPLE TO POLLUTED WATER HAS VIOLATED THEIR FUNDAMENTAL HUMAN RIGHT TO LIFE AS GUARANTEED IN THE AFRICAN CHALET ON HUMAN AND PEOPLE'S RIGHT UNDULY INCLUDING THE RIGHT OF EVERY INDIVIDUAL TO ENJOY THE BEST ALTERNATE STATE OF PHYSICAL & MENTAL HEALTH _____.

12. ARE KIDNEY PROBLEM, RESPIRATORY AND HEART PROBLEM COMMON IN THIS PART OF THE COUNTRY _____.

13. WATER POLLUTION IN THE SOUTHERN PART OF NIGERIA IS UNFRIENDLY TO NATURAL ECOSYSTEM AND BIODIVERSITY _____.

Appendix 2: Weight Variations in Mice Chronically Dosed with MTBE

	Body Weights (g)	
Period (Weeks)	**Test**	**Control**
1	23.63	25.48
2	22.88	27.20
3	21.40	26.50
4	19.43	28.00
5	17.35	28.80

Appendix 3: Variations in PVC of Mice Chronically Dosed with MTBE

	Mean PVC	
Period (Weeks)	**Test**	**Control**
1	32.55	36.28
2	31.50	35.00
3.	28.00	37.00
4	27.00	38.00
5	22.00	36.50

Appendix 4: Fasting Serum Glucose Levels in Mice Chronically Dosed With MTBE

	Glucose Level (mg/dL)	
Period (Weeks)	**Test**	**Control**
1	95.68	100.00
2	93.15	102.50
3.	89.25	106.00
4	86.25	98.00
5	87.00	104.50

Appendix 5: SGOT Activity in Mice Chronically Dosed with MTBE

	SGOT activity (I.U)	
Period (Weeks)	**Test**	**Control**
1	33.75	36.00
2	36.75	37.00
3.	41.00	34.00
4	45.00	38.00
5	47.00	38.00