**HAZARDOUS CHEMICAL SOURCES AND EFFECT ON THE ENVIRONMENT**

**TITLE PAGE**

Certification

Dedication

Acknowledgement

Table of Content List of Tables

**ABSTRACT**

**CHAPTER ONE: INTRODUCTION**

1.1Background of the study

1.2 Statement of the problem

1.3 Objective of the study

1.4 Research Questions

1.5 Significance of the study

1.6 Scope of the study

1.7Limitation of the study

1.8Definition of terms

**CHAPTER TWO: REVIEW OF LITERATURE**

Literature Review

**CHAPTER THREE: RESEARCH METHODOLOGY**

3.1 Research Design

3.2 Population of the study

3.3 Sample size determination

3.4 Sample size selection technique and procedure

3.5 Research Instrument and Administration

3.6 Method of data collection

3.7 Method of data analysis

3.8 Validity and Reliability of the study

3.9 Ethical Consideration

**CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS**

4.1 Data Presentation

4.2 Answering Research Questions

**CHAPTER FIVE: SUMMARY CONCLUSION AND RECOMMENDATION**

5.0 Summary

5.1 Conclusion

5.2 Recommendation

References

Appendix

**ABSTRACT**

This study was carried out on hazardous chemical sources and effect on the environment using SAIDI Nigeria Limited as case study. To achieve this 2 research hypothesis were formulated. The survey design was adopted and the simple random sampling techniques were employed in this study. The population size comprise of the entire Staff of SAIDI Nigeria Limited, Abuja. In determining the sample size, the researcher purposively selected 40 respondents while 30 respondents were validated. Self-constructed and validated questionnaire was used for data collection. The collected and validated questionnaires were analyzed using frequency tables and percentage. While the hypothesis were tested using Chi-square statistical too. SPSS v23. The result of the findings reveals that; the use of hazardous chemicals does have a negative effect on the workplace environments; environmental change as a result of the use of hazardous chemicals does affects workers. Based on the findings, the researcher recommended that the basic requirements in the work health and safety legislation should be sufficiently provided by the organization; The administrative personnel and suppliers of chemicals (through the use of global harmonized system) should scrupulously determine the nature of any kind of chemical I.e. whether or not a chemical is hazardous; Hazard chemicals should contain relevant hazard statements, precautions and pictograms on the label and safety data sheet.

**CHAPTER ONE**

**INTRODUCTION**

**1.1 BACKGROUND OF THE STUDY**

Chemicals are present in every workplace, from the cleaning chemicals being used to the industrial manufacturing processes, and welding fumes. Generally, a hazardous substance is one which may pose a risk to the health of anyone coming into contract with it in the workplace. The contract maybe in the production, hand line, storage, transport or disposal of the substance.

All chemical pose a risk to the health and safety of persons in the workplace to some extent and for this reason there are some basic requirements in the work health and safety legislation.

Hazardous substances have the potential to harm the health and safety of people at the workplace. Control of hazardous substance is of various ways due to the nature. (Hazardous Health Manuel, University of Uyo, 2000).

Many chemicals have both health and physiochemical hazards. Manufacturers and suppliers of chemicals are required to determine whether or not a substance is hazardous. They do this by referring to the global harmonized system (GHS) of classifying and labelling chemicals. If a chemical or chemical mixture is classified as hazardous it will have relevant hazard statements, precautions and pictograms on the label and safety data sheet (Goldman et al., 1988).

Some years ago the national health and safety commission (more recently known as the Australian safety and compensation commission – ASCC) estimated that about 2,300 workers die each year as a result of exposure to hazardous substances. Hazardous substances are found in almost all work places.

Hazardous substances should be eliminated from the workplace if possible. This will eliminate the risk. If it is not possible, then the preferred order of hazardous control must be followed, as prescribed in the various parts of chapter 4 (hazardous substances and materials) of the 2007 OHS regulation, and described in the plan.

Knowledge of the physical properties of a chemical can give an indication of the nature or extent of potential health effects given certain environmental conditions, and enables decisions to be made in respect of correct use and storage producers.

**1.2 STATEMENT OF THE PROBLEM**

Acute air pollution and other health related risk associated with the use of hazardous chemicals in manufacturing and engineering industries has caused more harm than good to workplace environment, hence has imposed a huge challenge on the these industries. Therefore, solid waste pollution, release of chemicals or other wastes will require continued vigilance to help manage the high risk involved. According to Fedix (2003), chemicals pose a risk to the health and safety of persons in the workplace to some extent and should not be handled with less concerns. It is therefore upon this note that this research tends to investigate the effect of hazardous chemicals on working environments.

**1.3 OBJECTIVES OF THE STUDY**

This study is carried out with the major intent of unveiling the sources of hazardous chemicals and its effects on the workplace environments. Other specific objects includes;

1. Identify if the use of hazardous chemicals has a negative effect on the workplace environments.
2. Investigate if environmental change as a result of the use of hazardous chemicals affects workers
3. Make recommendation on how hazardous chemicals can be identified and handled.

**1.4 RESEARCH HYPOTHESIS**

H01: The use of hazardous chemicals does not have a negative effect on the workplace environments.

H02: Environmental change as a result of the use of hazardous chemicals does not affects workers.

**1.5 SIGNIFICANCE OF THE STUDY**

This study shall be most relevant the all manufacturing and engineering firms in Nigeria as it will bring to their adequate understanding on the need to pay a huge attention on the environmental discomfort created by the use of hazardous chemicals to the workers and residents of the same location. More so the recommendation that will be proffered in this study will make a difference when applied adequately. Students and researchers who may in time to come carry out research on a topic of this nature will find this study relevant as it will serve a source of information.

**1.6 SCOPE OF THE STUDY**

This study will cover the following aspects;

Investigation on if the use of hazardous chemicals has a negative effect on the workplace environments and also if environmental change as a result of the use of hazardous chemicals affects workers. Hence this study is delimited to SAIDI Nigeria Limited.

**1.7 LIMITATION OF STUDY**

The major limitations to this study are:

Financial constraint– Insufficient fund tends to impede the efficiency of the researcher in sourcing for the relevant materials, literature or information and in the process of data collection (internet, questionnaire and interview).

Time constraint– The researcher will simultaneously engage in this study with other academic work. This consequently will cut down on the time devoted for the research work.

**1.8 DEFINITION OF TERMS**

**Chemical:** a distinct compound or substance, especially one which has been artificially prepared or purified.

**Hazardous Chemical**: Hazardous chemicals are substances, mixtures and articles that can pose a significant risk to health and safety if not managed correctly.

**Environment**: This is the surroundings or conditions in which a person, lives or operates.

**CHAPTER TWO**

**LITERATURE REVIEW**

**INTRODUCTION**

Our focus in this chapter is to critically examine relevant literatures that would assist in explaining the research problem and furthermore recognize the efforts of scholars who had previously contributed immensely to similar research. The chapter intends to deepen the understanding of the study and close the perceived gaps.

Precisely, the chapter will be considered in two sub-headings:

* Conceptual Framework
* Chapter Summary

**2.1 CONCEPTUAL FRAMEWORK**

**Hazard**

Hazard is a term associated with a substance that is likelihood to cause an injury in a given environment or situation. Industrial hazard may be defined as any condition produced by industries that may cause injury or death to personnel or loss of product or property. The forms of hazard includes; Chemical hazards, Physical hazards and Biological hazards.

**Chemical/substance hazard.**

For this study purpose, the term hazardous substance means a substance or mixture of substances which by virtue of chemical, physical or toxicological properties, either singly or in combination, constitutes a hazard. The term threshold quantity means for a given hazardous substance or category of substances that quantity, prescribed in national laws and regulations by reference to specific conditions, which if exceeded identifies a major hazard installation. The term major hazard installation means one which produces, processes, handles, uses, disposes of or stores, either permanently or temporarily, one or more hazardous substances or categories of substances in quantities which exceed the threshold quantity. The term major accident means a sudden occurrence - such as a major emission, fire or explosion - in the course of an activity within a major hazard installation, involving one or more hazardous substances and leading to a serious danger to workers, the public or the environment, whether immediate or delayed.

**The Effects Of The Physical Hazards Of Chemicals In The Workplace**

In addition to the potential for serious injuries and diseases to workers handling the chemicals in the workplace, there is significant potential for property damage to the facility, and in the worst case situation, impact on surrounding parts of the community and the general environment.

The physical hazards of chemicals in the workplace can result in injuries to workers if not properly controlled. The physical characteristics of chemicals are often related to health issues as well. Aspects such as volatility rate, for example, can determine the potential for exposure in a workplace. The proper control of such hazards requires knowledge of the potential effects of chemicals in the workplace, as well as how such effects might be made worse if chemicals are not handled or stored as required. The GHS also has a list of classification criteria for the physical hazards of chemicals.

Physical hazards are generally regarded as inherent properties of the chemical involved, but in many cases, a precipitating factor is required to trigger an effect. Therefore, a highly flammable liquid that is handled and stored away from sources of ignition such as flames is not likely to result in any harm. If physical hazards are not managed properly, this may result in a catastrophic event that will subsequently lead to extensive exposure to health hazards too. For example, a fire in a chemical plant can lead to a toxic mixture of chemicals developing, and being emitted into the environment. Or the corrosive aspects of a chemical that is improperly stored can lead to a leak or release of the chemical, which may in turn pose serious health effects for workers, the community and the general environment. Control of such adverse effects requires extensive knowledge of workplace conditions, the chemicals involved, and the possible synergistic effects of the chemicals being handled or stored in the same areas. Monitoring of the situation, as well as regular maintenance, are key to successful control.

**Impact Of Chemical Exposures On Workers’ Health**

Chemicals can cause effects on every system of the human body. If a chemical is in a physical form that allows it to enter the body easily, and is present in quantities sufficient to result in a given dose or amount of exposure, there are many impacts that such exposure can have. The acute effects of chemical exposures, such as poisoning or fatality based on a single exposure2 have been broadly recognized as compared to those that result from repeated minor exposures over time, because of the immediate associated symptoms.

One difficulty in determining the extent of the health effects in the workplace related to chemical exposures is the lack of recognition of the types of effects that can occur, and the long latency period that may elapse before some of the effects are seen. Making the connections between an exposure 20 years ago, and a case of cancer today, have also been hampered by lack of information about the effects of chemical exposures, as well as insufficient record keeping regarding effects resulting from exposure to chemicals.

The significant impact on an individual who has developed a disease as a result of chemical exposures may be incalculable. Certainly, the victims of such diseases often lose the ability to work, and support themselves and their families. The effects of the disease also impact the day-to-day quality of life, and the ability to maintain normal activities. In some cases, the victims die, and their families must deal with the loss of their loved one, as well as a loss of economic well-being and stability. Enterprises also pay the price of such diseases through lost productivity, absenteeism, and workers’ compensation programmes.

The toll of occupational disease due to chemical exposures is extensive. Although the burden of disease from chemicals remains unknown, as not all of them can yet be assessed at global level, the World Health Organization (WHO) circulated a note on the global burden of disease attributable to chemicals in September of 2012 at the International Conference on Chemicals Management.3 It included information which encourages additional research on the economic and social costs of unsound chemicals management, including the cost of inaction and the implications for health. The annex to the note includes a systematic review published by WHO on known and unknowns on burden of disease due to chemicals.4

The study reviews available information on the global burden of disease involving chemicals through various media, including air, water, occupational exposures and direct ingestion. The findings of the study show that in 2004, for which data were available, globally, 4.9 million deaths (8.3% of total) and 86 million Disability-Adjusted Life Years (DALYs)5 (5.7% of total) were attributable to environmental exposure and management of selected chemicals. These figures include both occupational and non-occupational exposures, such as indoor smoke from solid fuel use, outdoor air pollution and second-hand smoke, with 2.0, 1.2 and 0.6 million deaths annually. These are followed by occupational particulates, chemicals involved in acute poisonings, and pesticides involved in self poisonings, with 375,000, 240,000 and 186,000 annual deaths respectively. The study considered only those selected industrial and agricultural chemicals for which data were available.6 According to these figures, the global burden of disease amounted to 1.7% globally (in DALYs), or 2.0% of all deaths.

While chemicals are not responsible for all occupational diseases, exposure to chemicals is certainly key to the development of many such diseases. Achieving Decent Work includes preventing the occurrence of occupational diseases due to chemical exposures. The ILO estimate that 2.34 million people die each year from work-related accidents and diseases. From these fatalities, the majority or 2.02 million correspond to occupational and work- related diseases; the annual global number of cases of non-fatal work-related diseases is estimated to be 160 million. In addition to causing immeasurable human suffering to victims and their families, such diseases cause major economic losses for enterprises and societies, including reduced productivity and work capacity. Around 4 per cent of the world gross domestic product (GDP), equivalent to about USD $ 2.8 trillion, is lost due to work-related accidents and diseases in direct and indirect costs.

In 2013, the report for the World Day on Safety and Health at Work addressed the prevention of occupational diseases. While the focus was not limited to those caused by chemical exposures, the theme is entirely consistent with this year’s topic of safety and health in the use of chemicals. The number of physical, chemical, biological and psychosocial factors affecting workers’ health is constantly on the rise. The International Labour Organization (ILO) has been responding to the challenge of preventing occupational diseases with, among other tools, the elaboration of an international reference List of occupational diseases revised periodically by an international tripartite meeting of experts. The List is complemented by the elaboration of criteria for the identification and recognition of occupational diseases which are periodically incorporated in the ILO List. The List of occupational diseases reflects the state of the art in the identification and recognition of occupational diseases and is designed to assist countries in their prevention, recording, notification and, if applicable, compensation of diseases caused by work.7 Most of the occupational diseases in the list are caused by chemical agents. The prevention of occupational diseases caused by chemical exposures will save lives, improve the quality of life for other workers, and reduce the significant social costs of chemical exposures.

to describe their OELs. One of the most widely referenced is the Threshold Limit Value (TLV). The TLVs are recommended levels with no legal requirement, and are prepared by the American Conference of Governmental Industrial Hygienists (ACGIH). While they are not mandatory limits, some countries have adopted them and made them legal in their systems. Thus the TLVs have a broad reach with regard to exposure limits in workplaces around the world. Other terms that have been used by countries or organizations include Permissible Exposure Limit, Recommended Exposure Limit, and Maximum Allowable Concentrations (MACs). A database that includes many of the OELs recommended or required around the world has been made available in Germany.9 These OELs have also been focused in many cases on a single health effect, rather than approaching a chemical holistically and determining all of its potential hazards. Therefore, there may be an OEL for benzene and its potential to cause leukemia in workers—but there is no recognition in the same standard that benzene is highly flammable, and needs to be handled to minimize the risks of that effect. For example, a country may have adopted a standard for lead, which included an occupational exposure limit (OEL) for lead exposures, as well as protective measures to ensure the safe handling and use of lead in the workplace. Such individual standards have often adequately addressed the problems with a single chemical; nevertheless the reality of the situation is that there are so many chemicals to which workers may be exposed that this substance-by-substance approach will never be able to adequately protect them. In addition, where governments or organizations have created lists of recommended occupational exposure limits for several hundred chemicals, it has become clear that the resources to keep these lists up to date are significant. Thus many of these lists contain outdated OELs, that don’t reflect the latest data on the chemical, that are no longer made, or are used so infrequently that few workers are exposed to them. There is no current priority system for selecting the chemicals to be addressed in most situations, and highly hazardous chemicals, and/or widely used chemicals in today’s workplaces, may not be addressed at all.10 While there may always be a need for some OELs to address exposure to particular hazardous chemicals, it is clear that alternative approaches that can cover most chemicals in a workplace are needed.

**Control Of Exposure To Hazardous Chemicals In The Workplace**

Occupational exposure limit values (OEL) are standards developed as guidelines to assist in the control of health hazards and used by industrial hygienists in making decisions regarding safe levels of exposure to various chemical and physical agents found in the workplace when establishing control measures. Deriving and implementing OEL for individual chemicals has been the primary approach. The OEL is either a recommended or required numerical limit for workplace exposure. These limits commonly establish a time-weighted average exposure level that is expected to prevent most health effects from occurring in workers exposed full-time to a chemical. There may also be limits for short-term exposures or ceiling levels that should not be exceeded in any circumstance. Many different terms have been used by countries or organizations.

**Impact Of Chemicals On The Environment**

Chemicals in the environment have been proven to have significant impact, from climate change to the destruction of wildlife species and contamination of drinking water. Clearly, a more judicious use of chemicals, and controlled release and disposal of them, is critical to ensuring our future environmental safety and health. It must also be done with clear regard for the safety and health of workers.

For many years, the chemical waste of facilities was indiscriminately disposed of in the ground, air, and water sources in the area. This situation has changed to a large extent in those countries where appropriate controls and practices to clean up and prevent their recurrence have been established. However, there are other countries that are still dealing with significant pollution. In some cases, environmental effects are seen as a necessary adjunct to increased development and economic growth. The long-term costs to society need to be adequately addressed when decisions are made regarding what is acceptable in terms of impact on the environment. For developed countries, much of the emphasis has been on correcting mistakes of the past, and establishing and implementing policies to prevent them in the future. Developing countries and economies in transition have the opportunity to learn from mistakes made in developed countries, and the experiences of having to correct them, by applying prevention through design principles to new facilities. One important aspect of this situation is the realization that pollution crosses borders. While one country may have programs to prevent improper emissions and disposal of waste, a neighbouring country may not—and pollution travels in the air, as well as in waterways. Thus to truly have an effective national programmes for the environment, there must be an international coordinated strategy to promote a similar approach for all countries. The GHS also has a list of environmentally agreed criteria for hazard classification.

Environmental protection and occupational safety and health are often dealt by separately in government institutions, without recognizing the impact that each may have on the other. As a result, situations developed where emissions to the environment were controlled by regulations that had no consideration of worker exposures, and the controls implemented actually produced greater exposures inside the facility than those present previously. Clean-up of hazardous waste sites also created significant worker exposure problems, particularly difficult because the chemicals present may be unknown, and the mix of the chemicals could create new hazards. Many jobs being created in the global economy today are so-called Green Jobs, or jobs in industries that are designed to reduce adverse environmental impacts through the development and implementation of alternative technology and practices.13 While Green Jobs are welcome in terms of providing new opportunities for workers to be employed, it is critical that these jobs are established and monitored to ensure that they are not creating new, and possibly unknown, hazards. While supporting the concept that new approaches to chemical use and other aspects of industry are needed to minimize the impact on the environment, it is just as important to ensure that the workers performing these important jobs are adequately protected. One example of this was recently examined by the ILO in a report regarding electronic waste recycling.14 The widespread use of computers has led to an extensive amount of waste as these devices become obsolete quickly. While use of an electronic device for its intended purpose does not result in significant chemical exposures to users, breaking down the components for purposes of recycling can expose the workers involved to hazardous chemicals. In some cases, the items being recycled may be shipped to other countries to perform this more dangerous task of taking the devices apart to recycle the parts. Thus the hazards are also being exported. This has happened in ship-breaking operations, when the ships have outlived their utility, they are shipped to other countries where recycling operations take place, and workers in those countries are exposed.

Thus while achieving the laudable environmental goal of recycling usable materials; new jobs that involve hazardous exposures are being created to perform the work. These jobs are often in not being enforced.15

In 2014, the world marks the 30th anniversary of the worst industrial accident that has ever occurred. In December 1984, over 40 tons of methyl isocyanate gas were released as a result of an unintended chemical reaction in a plant in Bhopal, India. The effects of this tragedy are still being experienced in Bhopal in terms of lingering health effects and significant environmental contamination. The incident has proven to be the precipitating focus to change safety and health practices in the chemical industry and develop mayor hazard control measures. As one of the seminal events that led to the examination of processes for the sound management of chemicals, this accident illustrated the many aspects of sound management that were ignored or underutilized in the operation of the facility, from improper maintenance that led to the leak itself, to allowing a densely crowded community to be built around the plant that housed such a deadly chemical. The loss of life was extensive, and the importance of preventing such occurrences became foremost in the minds of safety and health practitioners. This led to some fundamental changes in approaches towards chemical safety and the management of major hazard installations.

The ILO Convention on the Prevention of Major Industrial Accidents, 1993 (No.174) and its accompanying Recommendation (No. 181) focus on examining the potential risk of catastrophic disaster, and planning appropriate preventive measures and emergency response on the basis of an OSH management system.16 The requirements of this Convention complement the ILO Chemicals Convention by elaborating further on the sound management of chemicals. The ILO has also developed a Code of practice on the prevention of major industrial accidents 17 and a manual on major hazards control to complement the standards.18

**Correlation between the use of chemicals at work and environmental protection**

 The sound management of chemicals with regard to environmental protection involves the same steps as illustrated in the graphic above. As mentioned before, first, the chemicals must be identified, classified, and have information distributed on hazards and protective measures; second, there must be an evaluation of potential exposures or quantities, and subsequently a risk assessment to determine what needs to be controlled; and lastly, appropriate control measures must be implemented, evaluated, and monitored.

The sound management of chemicals is a life cycle approach to chemical management, meaning that each step of the life cycle is subject to such an evaluation to determine the level and type of control. While the use of the chemicals in work processes is one step, proper disposal and the management of emissions and releases are relevant as well. A thorough examination of the potential risks of a chemical in the workplace will include all of the steps in the life cycle, including those related to environmental protection. The protection of workers involved in the disposal, or maintenance of controls related to environmental protection, must also be included in this assessment. An effective chemical management programme will address all of these issues. A thorough approach also addresses the need for preventing catastrophic releases, or containing them should they occur accidentally. As was learned in Bhopal, a workplace leak, inadequate maintenance of equipment, as well as other factors related to placement of the chemicals in the community, all impacted what became a significant environmental disaster in addition to the impact on the workplace. ILO Convention on Major Hazard Control, 1993 (No. 174) and its accompanying tools detail how this type of planning can be addressed in facilities.

**Reduction of Adverse Impacts of Chemicals in the Environment**

Stresses on ecosystems and hence on humans have many important sources, including chemicals, mining, farming and forestry, and perhaps even more serious living conditions, levels of education and health care, and life-style choices. Clearly, this forum could not deal with all those sources and chose to concentrate on some that might be addressed with specific technology assessments and recommendations. Adverse impacts of chemicals in the environment constitute one source.

There is a desire in general on the part of societies to improve their standard of living. This inevitably results in greater consumption of water, food, mineral, and energy resources and of our manufacturing capability. Although wastes and products that follow such consumption result in a greater burden on the environment, it is also true that the higher the living standard, the greater the resources that can be, and generally are, devoted to protecting human health and the environment.

Thus, industrially advanced societies tend to have safer food, water, and air than do less advanced societies. Nevertheless, there remains a conflict between the desire of a growing population for more goods and services and the desire for a healthy environment. One of the many land-use and economic changes resulting from human expansion that generally cause impacts on ecosystems is the introduction of new products. New products that foster new desires or satisfy old needs are sometimes discovered to have environmental impacts that are unacceptable or become unacceptable relative to a continually raised environmental standard.

The last 50 years have seen the introduction of many new chemicals. Many have stood the test of time and shown their benefits to outweigh their environmental risks. For some, however, important adverse environmental effects emerged. The search to replace those without further environmental effects has become a strong driving force in industry, in the scientific community, and in the general public. The focus has been mostly on testing for acute human toxicity with surrogates and on estimating long-term chronic effects in humans, primarily emphasizing cancer, again with surrogates. Increasingly, researchers will strive to include effects on entire ecosystems, and long-term, multi-generational effects on fertility, reproductive quality, and hormonal functions. Of major interest will be chemicals with the potential to be persistent, toxic, and bio-accumulative (PTB). However, chemicals that are persistent but not toxic or bio-accumulative, such as CFCs, have also led to environmental problems, as have chemicals that are persistent and toxic but not bio-accumulative. Evaluations of such chemicals are also needed.

Some of the surprise effects of chemicals have been due to a failure to predict the scale on which technologies might be used once they were shown to be beneficial when used on a limited scale. For example, DDT has side effects that have increased non linearly with the scale of application; as a result, the incremental benefits of a seemingly benign technology reversed when it was applied on a larger scale. New technologies have to be constantly reevaluated in anticipation of scale effects.

According to Forum Participant Comment in quote;

*We desperately need better tools to predict human risk from exposure to toxic chemicals. The information that will be useful will eventually arise from the development of a conceptual toxicity-evaluation scheme resulting from the recent advances in molecular genetics and biochemistry. This will enable scientists to target chemicals and substances of potential concern much more easily without needing a complex (and time-consuming) series of traditional toxicity tests.*

Following are some examples of products or processes that created unforeseen environmental problems after their introduction.

**Products**

1. Pesticides, such as DDT, endrin, dieldrin, and benzene hexachloride (BHC).
2. Alkylbenzene sulfonate (ABS) synthetic detergents.
3. Polychlorinated biphenyls (PCBs).
4. Chlorofluorocarbons (CFCs).
5. Lead used in gasoline and paint.
6. Some chlorinated solvents.
7. Wood preservatives.

**Processes**

1. Chlorination for disinfection (in some situations).
2. Mercury release from chlor-alkali cells.
3. Older coal gasification (now replaced with modern, but expensive, technologies).
4. Dioxin release from incineration and some chemical reactions.

The problem of non-degradable (persistent) pesticides has been known for many years. Because of the excessive accumulation rate in higher species, a group of major pesticides used in the 1960s (DDT, endrin, dieldrin, and lindane) have been banned or greatly limited in use in the United States. Substitute pesticides that are readily degraded in the environment have been developed. New adverse environmental impacts continue to be found, even with some of the substitutes. In some cases, biodegradable substitutes proved to be much more toxic to humans and to require much more sophisticated handling than more persistent substances. At times, a parent pesticide is degraded in the environment but results in daughter products that persist. The search for alternative pesticides or other products that have less adverse environmental impact has been rewarding to society and industry. Such efforts need to be, and will be, continued and will be driven by the marketplace's responding to public and government interests.

Some persistent chemicals with a variety of uses do not bio-accumulate in birds or other higher species but instead partition readily into water and do not bind well to soils, so they migrate through the ground and cause groundwater contamination. Examples are the triazine group of herbicides, dibromo chloropropane (DBCP, a nematocide), and some industrial solvents.

PCBs were once widely used as coolants in electrical systems. Emissions from that use led to great concern over the potential for PCBs to accumulate in the environment, and cause problems similar to those caused by DDT and to accumulate in people, in whom some of the PCBs were known to be toxic.

Another problem persistent chemical was the synthetic detergent, ABS, which was widely used in the 1950s. It persisted in rivers, streams, and ground-waters, causing excessive foaming of water. It did not cause health effects, but it was aesthetically unacceptable in drinking water. Legislation outlawing its use or threats thereof led to substitution with a biodegradable alternative detergent in the early 1960s.

Major environmental problems resulted from lead in gasoline and paint, and its use in these products has been eliminated. That required the development of new formulations for gasoline, new designs for engines, and substitutes for paint pigments.

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The presence of excessive mercury in receiving waters due to use of mercury electrodes in plants producing chlorine and alkali was a major incentive in replacing that technology with membrane cells. Chlorinated solvents have been excellent for cleaning of clothing, machine parts, engines, and electronic components, but their disposal in landfills and their leakage from storage tanks have caused extremely expensive groundwater-contamination problems that have not yet been solved. Substitutes for chlorinated solvents are now widely used, and care in their disposal is required.

Substitutes for the CFCs that cause depletion of stratospheric ozone are being developed. Those which will be used in the near future (hydrochlorofluorocarbons [HCFCs]) are of concern because a decomposition product, trifluoroacetic acid, might be very persistent and, under extreme conditions, have the potential to cause an undesirable environmental impact.

Dioxin can be formed as a byproduct in some chemical processes, including one of the old routes to production of 2,4,5-T, a widely used herbicide. 1 This example illustrates that not only pure products must be evaluated, but also the contaminants that might be present in them, even if at low concentration. Methods of producing 2,4,5-T without producing dioxin are now in use. Dioxin is now known to be produced during combustion under poorly controlled conditions and when even very small amounts of chlorine-containing compounds are present.

Another example of byproducts of concern is the trihalomethanes that are formed from humic materials in drinking water when chlorine is added as a disinfectant. The trihalomethanes are potential human carcinogens, and their concentration in drinking water is now regulated. Other chlorinated byproducts are also formed by chlorination, but their health impacts are less well known. Modifications of water-treatment operations that reduce trihalomethane formation and alternatives to chlorination are therefore being sought.

The potential of any chemical for environmental damage must be assessed before its commercialization, and our capability for doing so should be expanded, although we recognize the possibility that the new Dioxin exists in many congeners and isomers. ''Congener," in this case, is a varying number of chlorine atoms on the dioxin molecules. One isomer of the congener containing four chlorine molecules is widely held to be extremely toxic. The other congeners and isomers are believed to be far less toxic, but the entire subject is far from completely researched. chemical might replace another substance, natural or man-made, already in use that could be even more damaging. Those cases demonstrate the need for continuous review of costs and benefits, which might not be the same for all countries and communities.

**ANTHROPOGENIC CHEMICAL PRODUCTS**

New chemical products intended as pharmaceuticals (and their important metabolites) are extensively tested under rules of the Food and Drug Administration (FDA). The FDA tests cover a wide variety of toxicity but concentrate on human effects. New discoveries intended for pest control or for use as agricultural insecticides, fungicides, or herbicides are subject to somewhat less rigorous testing required by EPA under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). The FIFRA tests concentrate on predictors of human carcinogenic effects, with increasing attention to effects on "off-target beneficial species," such as birds. Costs of testing a chemical under FIFRA can be tens of millions of dollars; costs of FDA testing can be even more. Science and technology can contribute by helping define risks to human health and the environment and defining cost-effective solutions to prevent risks or reduce risks to acceptable levels.

New chemical products not under the FDA or FIFRA are covered by the Toxic Substances Control Act (TSCA). If these chemicals are intended to become articles of commerce, they are subject only to submission to EPA of a request for a "Pre Marketing Notice" (PMN). EPA has 90 days to respond to such a request and often, in the absence of extensive data, relies on structure-activity relationship (SAR) predictions.

These chemicals can be subject to much more testing under the Occupational Safety and Health Act (OSHA) if they are known to be present in the workplace and a risk has been identified. In Europe, new chemicals are subject to more testing but still far less than that required for new drug or agricultural applications. International standardization of testing and international sharing of testing responsibilities and data would reduce costs and speed the availability of reliable and reproducible assessments.

**ANTHROPOGENIC CHEMICAL BYPRODUCTS**

Many anthropogenic chemicals end up in incinerators or wastewater treatment facilities. We need to be concerned about the reaction byproducts formed in such treatment facilities.

Chemicals that are disposed of in landfills (where they might leak from containment), are deliberately emitted (as in the case of hair spray or paint solvent), or are merely discarded will end up in the air, in surface runoff or in groundwater, or simply reside on land.

Today, these chemicals, their degradation products, and the byproducts of their production are, for the most part, investigated only when someone suggests an environmental hazard on the basis of anecdotal environmental monitoring, local tests, or calculations. Under TSCA and OSHA, much more testing of these chemical byproducts can be required, once they are identified. This identification is unlikely to occur without better knowledge of what byproducts might be formed from anthropogenic chemical production and the use and effects such byproducts may have on the environment.

**CHAPTER SUMMARY**

In this review the researcher has sampled the opinions and views of several authors and scholars on hazardous chemicals and its control measures. The works of scholars who conducted empirical studies have been reviewed also. The chapter has made clear the relevant literature.

**CHAPTER THREE**

**RESEARCH METHODOLOGY**

**3.1 Introduction**

This chapter gives the methodology that the researcher used in the study. The research design, population of the study, sampling and sample size, methods of data collection, techniques of data analysis and limitations of methodology.

**3.2 Area of Study**

SAIDI Nigeria Limited is a multi-discipline construction firm with state of the art equipment, professional manpower and field experience. It have served both Private and Governments agencies for over a decade, providing Civil Engineering services, Fabrication, Construction and Consultancy Services.

**3.3 Research Design**

Research designs are perceived to be an overall strategy adopted by the researcher whereby different components of the study are integrated in a logical manner to effectively address a research problem. In this study, the researcher employed the survey research design. This is due to the nature of the study whereby the opinion and views of people are sampled.

**3.4 Population**

According to Udoyen (2019), a study population is a group of elements or individuals as the case may be, who share similar characteristics. These similar features can include location, gender, age, sex or specific interest. The emphasis on study population is that it constitute of individuals or elements that are homogeneous in description.

This study was carried out to examine hazardous chemical sources and effect on the environment using SAIDI Nigeria Limited as case study.

Hence the population size of this study is the entire staff of SAIDI Nigeria Limited, Abuja Metropolis.

 **3.5 Sample and Sampling Techniques**

A study sample is simply a systematic selected part of a population that infers its result on the population. In essence, it is that part of a whole that represents the whole and its members share characteristics in like similitude (Udoyen, 2019). In this study, the researcher adopted the random sampling method to determine the sample size. Out of all the entire population of the selected firm, the researcher randomly selected 40 out of the overall population as the sample size which comprise of 30 junior staff and 10 senior management staff making a sum of 40 staff as sample size.

**3.6 Research Instrument.**

The research instrument used in this study is the questionnaire. A 8 minutes survey containing 6 questions were administered to the enrolled participants. The questionnaire was divided into two sections, the first section enquired about the responses demographic or personal data while the second sections were in line with the study objectives, aimed at providing answers to the research questions.

**3.7 Validity of the Instrument.**

Validity referred here is the degree or extent to which an instrument actually measures what is intended to measure. An instrument is valid to the extent that is tailored to achieve the research objectives. The researcher constructed the questionnaire for the study and submitted to the project supervisor who used his intellectual knowledge to critically, analytically and logically examine the instruments relevance of the contents and statements and then made the instrument valid for the study.

**3.8 Reliability of the Instrument**

The reliability of the research instrument was determined. The Pearson Correlation Coefficient was used to determine the reliability of the instrument. A co-efficient value of 0.68 indicated that the research instrument was relatively reliable. According to (Taber, 2017) the range of a reasonable reliability is between 0.67 and 0.87.

**3.9 Method of data Collection.**

Two methods of data collection which are primary source and secondary source were used to collect data. The primary sources included oral interviews and questionnaires, while the secondary sources include textbooks, internet, journals, published and unpublished articles and government publications.

**3.10 Method of Data Analysis.**

The responses were analyzed using the frequency tables, which provided answers to the research questions. While the hypothesis were tested using Chi-square statistical tool SPSS v23.

**3.11 ETHICAL CONSIDERATION**

The study was approved by the Project Committee of the Department. Informed consent was obtained from all study participants before they were enrolled in the study. Permission was sought from the relevant authorities to carry out the study. Date to visit the place of study for questionnaire distribution was put in place in advance.

**CHAPTER FOUR**

**DATA PRESENTATION AND ANALYSIS**

1. **INTRODUCTION**

This chapter presents the analysis of data derived through the questionnaire and key informant interview administered on the respondents in the study area. The analysis and interpretation were derived from the findings of the study. The data analysis depicts the simple frequency and percentage of the respondents as well as interpretation of the information gathered. A total of forty (40) questionnaires were administered to respondents of which thirty (30) were returned and validated. This was due to irregular, incomplete and inappropriate responses to some questionnaire. For this study a total of 30 was validated for the analysis.

**4.2 DATA PRESENTATION**

The table below shows the summary of the survey. A sample of 40 was calculated for this study. A total of 30 responses were received and validated. For this study a total of 30 was used for the analysis.

**Table 4.1: Distribution of Questionnaire**

|  |  |  |
| --- | --- | --- |
| **Questionnaire**  | **Frequency** | **Percentage**  |
| Sample size | 40 | 100 |
| Received  | 30 | 85.7 |
| Validated | 30 | 85.7 |

**Source: Field Survey, 2021**

**Table 4.2: Demographic data of respondents**

|  |  |  |
| --- | --- | --- |
| **Demographic information** | **Frequency** | **percent** |
| **Gender**Male |  |  |
| 18 | 60% |
| Female | 12 | 40% |
| **Religion** |  |  |
| Christian | 19 | 62% |
| Muslim | 11 | 38% |
| Age |  |  |
| 20-30 | 08 | 27% |
| 30-40 | 10 | 33% |
| 41-50 | 12 | 40% |
| 51+ | 00 | 00% |
| **Education** |  |  |
| HND/BSC | 15 | 50% |
| MASTERS | 10 | 33% |
| PHD | 05 | 17% |
| Marital Status |  |  |
| Single | 11 | 37% |
| Married | 13 | 43% |
| Separated | 03 | 10% |
| Divorced | 00 | 00% |
| Widowed | 03 | 10% |

**Source: Field Survey, 2021**

**4.2 ANSWERING RESEARCH QUESTIONS**

**Question 1:** Does the use of hazardous chemicals have any negative effect on the workplace environment?

**Table 4.3:** Respondent on question 1

|  |  |  |
| --- | --- | --- |
| **Options** | **Frequency** | **Percentage** |
| Yes | 22 | 74 |
| No | 04 | 13 |
| Undecided | 04 | 13 |
| **Total** | **30** | **100** |

**Field Survey, 2021**

From the responses obtained as expressed in the table above, 74% of the respondents said yes, 13% said no, while the remaining 13% were undecided.

**Question 2:** Does environmental change as a result of the use of hazardous chemicals affects workers?

**Table 4.4:** Respondent on question 2

|  |  |  |
| --- | --- | --- |
| **Options** | **Frequency** | **Percentage** |
| Yes | 26 | 87 |
| No | 00 | 00 |
| Undecided | 04 | 13 |
| **Total** | **30** | **100** |

**Field Survey, 2021**

From the responses obtained as expressed in the table above, 87% of the respondents said yes, while the remaining 13% were undecided. There was no record for no.

**TESTING HYPOTHESIS**

**H01:** The use of hazardous chemicals does not have a negative effect on the workplace environments.

**H02:** Environmental change as a result of the use of hazardous chemicals does not affects workers.

**Hypothesis One**

The use of hazardous chemicals does not have a negative effect on the workplace environments.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Response**  | **Observed frequencies** | **Expected frequencies (E)**  | **O-E** | **(O-E)2** | **(O-E)** **E** |
| YesNoUndecided | 22040430 | 101010 | 12-6-6 | 124-36-36 | 12.0-2.2-2.27.6 |

Degree of freedom = (row-1) (column-1)

= (3-1) (2-1)

= 3\*1

=2

At 0.05 level of significance, given the above degree of freedom, table value of X2 (ie X2t) = 5.991.

The decision rule is

Accept Ho if X2t>X2cal, and

Reject Ho if X2t<X2cal

Thus, since the X2t (5.991) < X2cal (7.6), we reject null and accordingly accept alternate hypothesis. This implies that the use of hazardous chemicals does have a negative effect on the workplace environments.

**Hypothesis Two**

Environmental change as a result of the use of hazardous chemicals does not affects workers.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Response**  | **Observed frequencies** | **Expected frequencies (E)**  | **O-E** | **(O-E)2** | **(O-E)** **E** |
| YesNoUndecided | 26000430 | 101010 | 16-10-6 | 256-100-36 | 25.6-10-2.213.4 |

Degree of freedom = (row-1) (column-1)

= (3-1) (2-1)

= 3\*1

=2

At 0.05 level of significance, given the above degree of freedom, table value of X2 (ie X2t) = 5.991.

The decision rule is

Accept Ho if X2t>X2cal, and

Reject Ho if X2t<X2cal

Thus, since the X2t (5.991) < X2cal 13.4), we reject null and accordingly accept alternate hypothesis. This implies that Environmental change as a result of the use of hazardous chemicals does affects workers.

**CHAPTER FIVE**

**SUMMARY, CONCLUSIONS AND RECOMMENDATIONS:**

**5.1 Introduction**

This chapter summarizes the findings into hazardous chemical sources and effect on the environment using SAIDI Nigeria Limited as case study. The chapter consists of summary of the study, conclusions, and recommendations.

**5.2 Summary of the Study**

In this study, our focus was to examine hazardous chemical sources and effect on the environment using SAIDI Nigeria Limited as case study. The study specifically was aimed to identify if the use of hazardous chemicals has a negative effect on the workplace environments; Investigate if environmental change as a result of the use of hazardous chemicals affects workers and Make recommendation on how hazardous chemicals can be identified and handled.

The study adopted the survey research design and randomly enrolled participants in the study. A total of 30 responses were validated from the enrolled participants where all respondent are active staffs of SAIDS Nigeria Limited Ajuba.

**5.3 Conclusions**

Based on the findings of this study, the researcher made the following conclusion.

1. The use of hazardous chemicals does have a negative effect on the workplace environments.
2. Environmental change as a result of the use of hazardous chemicals does affects workers.

**5.4 RECOMMENDATIONS**

Based on the findings of this study, the researcher recommended that

1. The basic requirements in the work health and safety legislation should be strictly provided by the organization.
2. The administrative personnel and suppliers of chemicals (through the use of global harmonized system) should scrupulously determine the nature of any kind of chemical I.e. whether or not a chemical is hazardous.
3. Hazard chemicals should contain relevant hazard statements, precautions and pictograms on the label and safety data sheet.

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**APPENDIXE**

**QUESTIONNAIRE**

**PLEASE TICK [√] YOUR MOST PREFERRED CHOICE(S) ON A QUESTION.**

**SECTION A**

**PERSONAL INFORMATION**

**Gender**

Male [ ] Female [ ]

**Age**

20-30 [ ]

31-40 [ ]

41-50 [ ]

51 and above [ ]

**Educational level**

WAEC [ ]

BSC/HND [ ]

MSC/PGDE [ ]

PHD [ ]

Others……………………………………………….. (please indicate)

**Marital Status**

Single [ ]

Married [ ]

Separated [ ]

**SECTION B**

**Question 1:** Does the use of hazardous chemicals have any negative effect on the workplace environment?

|  |  |
| --- | --- |
| **Options** | **Please Tick** |
| Yes |  |
| No |  |
| Undecided |  |

**Question 2:** Does environmental change as a result of the use of hazardous chemicals affects workers?

|  |  |
| --- | --- |
| **Options** | **Please Tick** |
| Yes |  |
| No |  |
| Undecided |  |