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THE (LANDFILL RESIDUE & INDUSTRIAL WASTEWATER) INITIATED BY

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ABSTRACT

Soil contaminated caused by leachate and industrial wastewater is extremely dangerous to human life and also gives negative impact on the groundwater and the soil structure. This project aims to study the parameters of soil contaminated by leachate and industrial wastewater. Besides that, to compare the quality standards of the dissolved soil with leachate and industrial wastewater with Standard Environmental Quality Act 1974. The sample for the leachate and wastewater was taken at the landfill Jerangau, Jabor and mechanic workshop near Gambang, Kuantan. Then, the uncontaminated soil sample was taken near the Kolej Kediaman 2, KK2, UMP. Non-contaminated soil is mixed with leachate and industrial wastewater experiment was conducted in soil and geotechnical laboratory also in environmental laboratory to study the parameters that have been contaminated soil. The test that had been conducted during the laboratory are Atterberg limits test, moisture content, proctor test, pH test, suspended solid test, COD and BOD test. From the experiment showed that the result for contaminated soil increase for the plastic index, pH value, suspended solid, COD and BOD compared to the uncontaminated soil. Then for the permeability and proctor test, the result showed that contaminated soil decrease compared to the uncontaminated soil.

ABSTRAK

Pencemaran tanah yang disebabkan oleh air larut resap dan air sisa industri sangat berbahaya kepada kehidupan manusia juga turut memberikan impak negatif terhadap air bawah tanah dan juga struktur tanah tersebut. Projek ini bertujuan untuk mengkaji parameter tanah yang dicemari oleh air larut resap dan air sisa industri. Disamping itu juga, untuk membandingkan standard kualiti tanah yang dilarut dengan air larut resap dan air sisa industri dengan Akta Kualiti Alam Sekitar 1974. Sampel air larut resap telah diperolehi dari tapak pelupusan sampah, Jerangau, Jabor manakala untuk sampel air sisa industri diambil dari bengkel kereta berhampiran dengan pekan Gambang, Kuantan. Sementara itu pula, sampel tanah yang tidak tercemar diperolehi dari kawasan berhampiran Kolej Kediaman 2, KK2, UMP. Eksperimen ini telah dijalankan dimakmal tanah dan geoteknik juga dimakmal alam sekitar untuk mengkaji parameter tanah yang tercemar. Antara ujikaji yang telah dijalankan dimakmal adalah Atterberg had, kandungan kelembapan, ujian proctor, ujian pH, COD and BOD. Daripada eksperimen menunjukkan keputusan bahawa nilai plastik indeks, pH, pepejal terampai, COD dan BOD semakin meningkat berbanding dengan tanah yang tidak tercemar. Manakala untuk keputusan bagi ujikaji kebolehtelapan dan kandungan kelembapan bagi tanah yang tercemar semakin menurun berbanding tanah yang tidak tercemar.

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LIST OF ABBREVIATIONS

MSW	Municipal Solid Waste
LNAPL	Light Non Aqueous Phase Liquids
DNAPL	Dense Non Aqueous Phase Liquids
KK2	Kolej Kediaman 2
SS	Suspended solid
COD	Chemical Oxygen Demands
BOD	Biochemical Oxygen Demands
EQA 1974	Environment Quality Act 1974
Cu	Copper
Ni	Nickel
Cd	Cadmium
Zn	Zinc
Cr	Chromium
RCRA	Resource Conservation and Recovery Act
LL	Liquid limit
PL	Plastic limit
PP	Plastic Index

CHAPTER 1

INTRODUCTION

1.1 Background Of Study

Nowadays, the rapid economic development and population growth, inadequate infrastructure and expertise and land scarcity lead to the management of municipal solid waste (MSW) become one of Malaysia's most critical environmental issues. With the rapidly increase number of people, our country now has to face the issue of rubbish or the municipal solid waste that society use and throw away every day.

In general, the per capita generation rate is about 0.5-0.8 kg/person/day in which domestic waste is the primary source: Other than that, the garbage is not well managed by the parties concerned, particularly in areas of housing, schools, hospitals and commercials.

Municipal solid waste management became a major concern and is presently one of the main public subjects under discussion because it will give a large impact to society and environment. Furthermore, the rubbish will produce pollution and encompass dangerous bacteria. The effective management will reduce the problems

associated by solid waste to solve these issues. From that, some action will take to appreciate the problems occurs with waste disposal whether solid or liquid.

In addition, the municipal solid waste currently was dumped at the landfill without having any shredding and segregation process. Other than that, lack of control municipal solid waste will affect health and environment like the waste disposal in open areas that would cause air and water pollution. Furthermore, the open dumping area will produce bad odour and the much water from municipal solid waste that induces to compost leachate production.

Leachate is a hazardous liquid produced in landfills as a result of interaction of moisture with municipal solid waste. Inadequate disposal methods of municipal solid waste into the dump yards results in pollution of soil, groundwater systems, also give a big effect to the foundation in future and lastly it also will produce a methane that very dangerous because can cause an explosion.

1.2 Problem Statements

In recent times, the effect of leachate on groundwater and other water resources has attracted much attention due to humidity and the Malaysian government has taken precautionary measures to provide treatment on the leachate to produce standard A water before it is discharged.

Contamination of groundwater is mainly due to industrialization and urbanization that has gradually developed from time to time without taking into account the environmental effect. The quality physical and chemical parameters due to the weather of late rock sources and anthropogenic activities also will also affect the groundwater.

Groundwater in most cases is safer and reliable to use than surface water. Part of the reason for this is that the water surface is more susceptible to pollution. This situation cannot say that underground water resistant to pollution. Although it is not exposed as surface water, contaminated materials can still flow to the lake and by the household. Any chemical that dissolves and penetrates the soil is the main candidate for groundwater contamination.

A potential contamination problem could still achieve miles away via groundwater. For example, chemicals and wastewater also abundant in a rock industrial plant can infiltrate the soil and eventually enter the aquifer system that the whole community use for their private wells. These conditions can have adverse effects that once groundwater is contaminated and it is a very expensive operation to remove the tarnish.

Migration of waste or leachate from landfill sites through the discharge of pollutants that seep into the soil sediments will pose high risk to groundwater if not dealt with adequately. Lately, the importance of water quality on human health has attracted attention to the protection of groundwater. Moreover, the contaminated of groundwater by leachate or wastewater will give bad effect on a person's health.

Without any awareness, some hazardous substances will dissolve slowly in water. When the material is absorbed into the groundwater faster than will dissolve, some of the materials will remain in liquid form. Besides that, in the Figure 1.1 show, when the liquid is less dense than water, it will float above the water, like oil on water. Pollutants in the form of light are called non aqueous phase liquids (LNAPL's). If the liquid is more dense than water, solid contaminants are called non-aqueous phase liquids (DNAPL's). The DNAPL's sink to form pools in the aquifer then he pool continues to contaminate the aquifer then slowly dissolve and carried away by moving groundwater. As DNAPL's flow downward through the aquifer, small particle of liquid is trapped in spaces between soil particles. This form of waste called groundwater pollution.

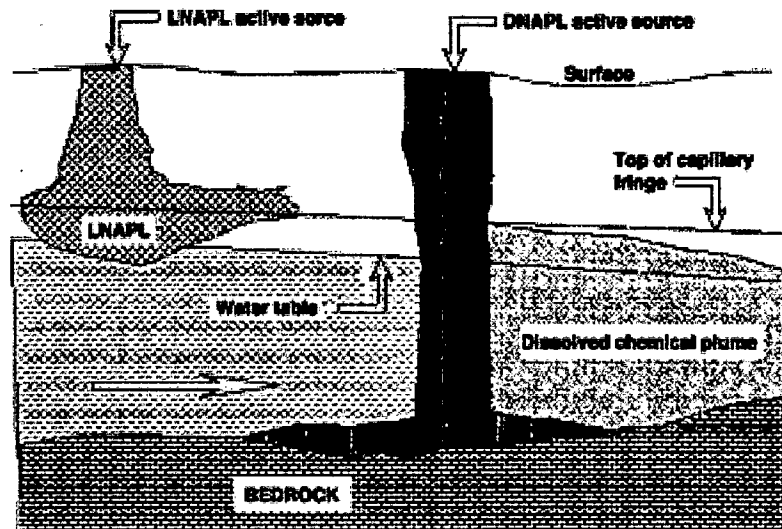


Figure 1.1: The comparison of LNAPL and DNAPL (<http://www.sciencedirect.com>)

Furthermore, the main sources of groundwater contamination because of open dumping by solid waste disposal that has been closed and will be upgraded to a sanitary landfill, but still have people use it without thinking about consequences.

In addition, waste management has become increasingly complex due to the increase in human population, industrial and technological revolution. Most of them are not aware of the consequences and impact on the composition of the soil and underground water resources. Issues such as removal of chemical leaching or waste water in place should not always easily see by the people. Absorption and the content of chemicals into the soil will not only interfere with groundwater system to occur but also will disturb the soil structure, which would lead to death of many essential organisms in the soil.

Furthermore, the nature of the soil has a strong foundation for buildings. The strength of soil itself can support the basic building erected area. When open dumping area happened without any control or limitation if effect the composition of soil will be changed. Other than that, nature will disturb the soil and in this case is the result building foundation is no longer safe to use during the period of time.

As a result of dumping untreated waste has resulted in soil strength will be affected and some will occur to reduce the grip and friction on the foundation of the building. This situation will result in failure to work on the building foundation. Rate of cation exchange capacity of the soil will also be increase is in the open dumping area. The change in chemical properties in the soil due to the addition of contributed leachate that may be detrimental to foundation concrete in the real field.

1.3 Objectives

The goals of this study are:

- i. To analyse the parameter of the soil that disturbed by leachate and wastewater.
- ii. To compare the standard quality between leachate from landfill and industrial wastewater.

1.4 Scope Of Study

This study focuses on a parameter of the soil that effect by leachate from the landfill and wastewater from the industries. This is because the disturbing parameter of the soil will give a big impact in our life. The good quality of soil is need to make sure groundwater and also the significant of soil's properties is undisturbed by the leachate and wastewater. Therefore, this study was be conducted in check the parameter of the soil based on their physical and chemical properties.

The sample of leachate was obtained from Jabor Jerangau Landfill Restoration in Kuantan, Pahang and also at the Mechanic Workshop near Gambang, Kuantan. For the sample of soil was obtained near Kolej Kediaman 2 (KK2), Universiti Malaysia Pahang. The parameter for this study was divided to physical and chemical parameter. The laboratory was conduct tests such as Atterberg limits, proctor test, PH soil, moisture content, permeability, suspended solids (SS), COD (Chemical Oxygen Demands) and BOD (Biochemical Oxygen Demands) test. Each of the tests was repeated 5 times order to obtain the average results.

1.5 Significant Of Study

This study is important because from the result, presented the parameter of the soil that already contaminated. Then, from the result also, it helps to identify the contamination that happened at the area. Furthermore, early prevention can be planned to manage the leachate and wastewater.

Besides that, the leachate and wastewater that will discharged should come within the ambit of the Environment Quality Act 1974 to ensure that only the wastewater and leachate as specified in the act go through the soil.

Moreover, this research was given the result whether the nature soil trap can control the pollution or not. Since the pollution go through the groundwater, the cost to clean is very high. By introduce some information for people about these issues of leachate and wastewater can control before it is become more serious and will disturb our life cycle.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter was reviewing the parameters of the contaminated soil and disturbed by the leachate and wastewater. Apart from the parameters of land was inspected and tested briefly to get the results of the soil characteristics.

This test is very important and had been done to see the effects and the changes in soil parameters as influenced by the leachate and wastewater. Information and data are based on references books and internet journals. Source of leachate and wastewater were collected from the selected landfill and also from industry. Test like examining the rate of soil strength, soil moisture content, impermeable rates also done to ensure that the system of soil and soil under water is was not polluted.

This chapter was reviewing the parameters of the contaminated soil that disturbed by the leachate and wastewater. Apart from the parameters of land had been inspected and tested briefly to get the results of the soil characteristics. From the result of the parameter, the soil was labelled as contaminated or not.

This test is very important and should be done to see the effects and changes in soil parameters as influenced by the leachate and wastewater. Information and data are based on reference books and internet journals. Source of leachate had been collected from the landfill at Jabor, Jerangau and also the wastewater from the mechanic workshop at Gambang, Kuantan. Then the soil sample was taken near the Kolej Kediaman 2 (KK2), UMP. The tests like examining the rate of soil strength, soil moisture impermeable rates, Chemical Oxygen Demand (COD), Biochemical Oxygen Demand (BOD), pH, suspended solids (SS) also done to ensure that the structure of soil and groundwater are not contaminate.

The primary purpose of this study was to compare leachate from the landfill or the wastewater from industries generated the pollution and make harmful to soil structure. By doing this research was enlighten the community about the effects of leachate and wastewater on the ground. And not only that, as noted in previous chapters as well leachate could disturb of the soil's structure.

So this research was helped and shared with communities about the worse of leachate and wastewater when suddenly go through the soil without takes any precaution.

2.2 Definition Of Soil Contamination

Contamination of the soil is a hazardous substance whether solid or liquid that is mixed with the soil that occurs in nature. Typically, contaminants in the soil physically or chemically attached to soil particles, or, if they are arrested, locked in small spaces between soil particles. The presence of xenobiotic chemicals resulting from

human action or changes in other daily activities in the natural soil environment can contribute to soil contamination.

Besides that, the contamination of land will lead to failure and impairment or loss of one or more functions and features of the land. In addition, from Figure 2.1 showed the land contamination can be considered as the presence of man-made chemicals or other changes in the natural soil environment. The generation and movement of solid wastes can be determined by performing a detailed material balance analysis for each sources of waste generation (Tchobanoglous et al., 1993).

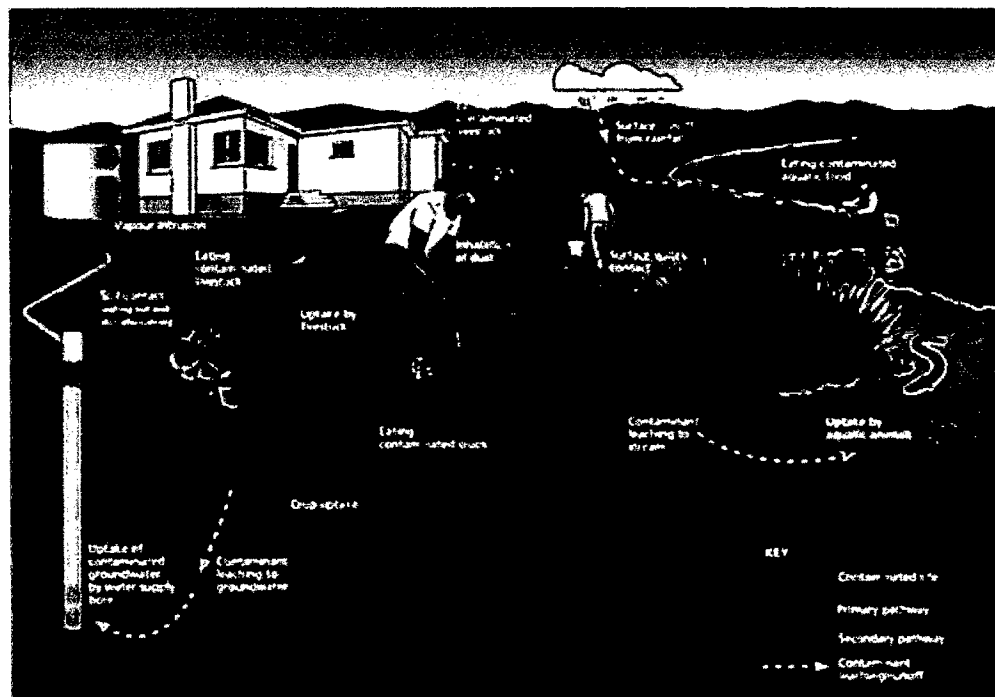


Figure 2.1: A diagram of ground soil and groundwater contamination.

(<http://www.mfe.govt.nz>)

Furthermore, (Section 78A (2) of the Environmental Protection Act) defines contaminated land as “ any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that

the significant harm is being caused or there is a significant possibility of such harm being caused or pollution of controlled waters is being, or is likely to be, caused.

However, regardless of how the contamination of environmental soil contamination is a serious problem not only for the environment but also for those due to the presence of land contamination endanger health of individuals.

Besides that, the sewage sludge has for a long time been used in agriculture as a source of plant nutrients and organic will generated to the soil contaminated. Figure 2.2 shown how the leachate mixed with the soil. The sludge from industrial areas, however, often contains significant quantities of heavy metals such as copper (Cu), nickel (Ni), cadmium (Cd), zinc (Zn) and chromium (Cr). Several studies have shown that metals influence microorganisms by adversely affecting their growth, morphology and biochemical activity, resulting in decreased biomass This reaction could expand the native soil double layers.(Calace et al. 2001).

The water can be from all forms of water that fall from the air or flow from the surrounding land into the landfill or from the waste itself. While the liquid moves into the landfill, many organic and inorganic materials are transported in the MSW leachate. As a result, various organic and inorganic compounds leach out from the solid waste (McBean et al.1995). Containment elements, such as landfill liners and compost factory leachate lagoons, should be designed to prevent leachate from migrating to the surrounding environment (Rowe et al., 1995; Mitchell et al.1995). Otherwise, leachate poses a serious threat to the underlying soil and aquifers (Kjeldsen, 1993).

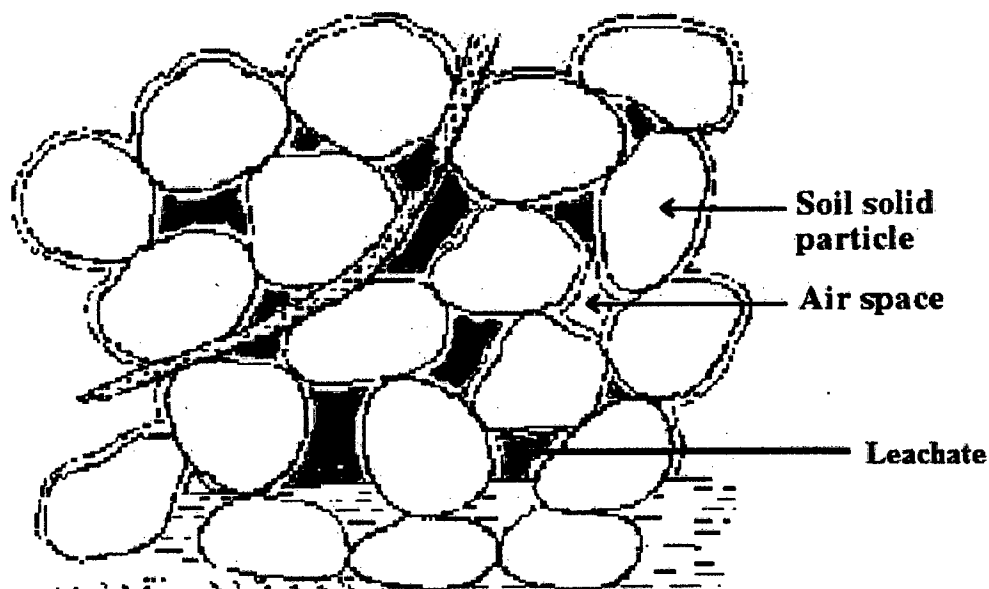


Figure 2.2: A diagram of leachate mixed with particle of soil (<http://www.scribd.com>)

Usually experimental results of the soil parameters that have been contaminated by leachate from landfill sites and industrial areas are very flexible. This is because the contents of each chemical found in both leachates were different. So the result for each experimental set of parameters varies according to the chemical content itself.

2.3 Effect Of Leachate And Wastewater To Soil

Leachate from landfill sites and wastewater from industrial varies in composition depending on the age and type of waste disposal sites that it contains. It normally contains both dissolved and suspended material. Leachate and wastewater generation are caused mainly by precipitation, percolating through the waste and landfills. Also through the water that comes out during the process waste delivery to the landfill area.

Once in contact with solid waste decomposes, percolating water becomes polluted and where it then flows out the waste, called leachate. Turnover additional leachate was produced during the decomposition of carbon materials that produce a variety of other substances, including methane, carbon dioxide and a complex mixture of organic acids, aldehydes, alcohols, and simple sugars.

Risk can be overcome by the generation of leachate disposal sites that are designed and engineering, such as websites built on geological material impermeable or web site using an impermeable liner made of clay geomembranes or engineering. The use of layers is now compulsory in both the United States and the European Union (EU), except where the waste is considered inert.

In addition, the materials of the most toxic of the factory are difficult to control. Despite the statutory controls more stringent leachate and wastewater from modern websites found to contain various contaminants that may be either related to the level of some activities that may violate applicable law or may reflect the use of any variety of difficult materials in household products and entering the domestic waste stream in the law.

These soils are considered to be a good foundation material. Due to very high permeability of lateritic soils open dumping of municipal solid waste may lead to environmental problems. Large areas of land are currently used for open dumping purpose. At one of the dumping yard around 250 MT of municipal solid waste is being dumped without shredding and segregation (Ravishankar, 2004) in Engineering Geology Journal by B.M Sunil, S.Shrihari and Sitaram Nayak. Due to heavy rainfall (3500 mm annually) during monsoon leachate from such landfills flows out without any hindrance into the adjacent areas resulting in contamination of soil and groundwater. Substantial releases of leachate (due to open dumping) might have occurred during the past few years and the lateritic soil at the dump yard revealed extensive contamination. Leachate and wastewater contamination may lead to significant effect on the behaviour of soils such as in Figure 2.3.

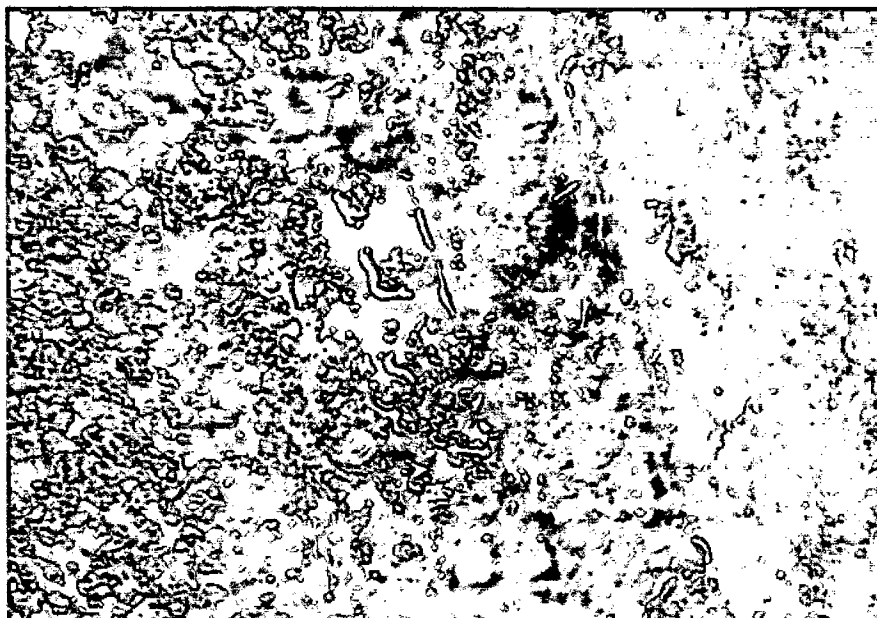


Figure 2.3: The contaminant soil (<http://www.oiltankservice.com>)

From the Table 2.1, the past work (Mesri and Olson, 1970) has shown that the index and engineering properties of soil contaminated with leachate tend to change due to chemical reactions between the soil mineral particles and the contaminant. In connection with any possible applications, knowledge of the behaviour of contaminated soil is required and hence the present investigation.

Table 2.1: The index and compaction characteristics of soils (www.elsevier.com)

NO	Gs	ATTERBERG LIMITS			GRAIN-SIZE DISTRIBUTION				COMPACTION CHARACTER	
		WL (%)	WP (%)	WS (%)	GRAVEL (%)	SAND (%)	SILT (%)	CLAY (%)	(w)opt (%)	(ρ_{dmax}) (kN/m ³)
1	2.64	41	28	22	21	58	16	5	19.5	15.5
2	2.61	43	28	22	2	70	22	6	24.1	14.7
3	2.63	49	28	18	21	49	22	8	24.5	14.9
4	2.65	50	29	21	8	62	19	11	16	14.8
5	2.7	45	25	23	14	64	14	8	25.6	15.3

The hydraulic conductivity (k) of soil liner must not increase due to chemical and biological attack from waste leachate (Bezzar and Ghomari, 2008). In fact, k is a measure of the resistance of the soil to flow of leachate. The k value for a liner system should be less than 1×10^{-3} cm/s (Daniel and Benson, 1990).

2.4 Contaminant

The most common waste involved is municipal solid waste from the landfill and also from the factory. This occurrence of this phenomenon is correlated with the growing of people and the modernisation of our country. From this activities will generated the pollution or contamination to the environment.

The term "environmental contaminant" is another name for pollution. A contaminant is any potentially undesirable substance (physical, chemical or biological). It usually refers to the introduction of harmful human-made substances. However, some substances that may have harmful effects at high levels, like cadmium, occur naturally in ecosystems and may also be introduced through human activities. Tissue samples taken from Porcupine caribou, for example, show traces of cadmium which is naturally present in the lichens the caribou eat.

Contaminants can be man-made substances produced by factories, such as DDT or toxaphene. It is the substance's long life and its ability to spread over a wide area that makes an industrial contaminant such a problem. Chemicals used in other parts of the world enter into the upper atmosphere and end up falling to the ground here, contaminating our homelands. Contaminants may be found in everywhere such soil, plants, air, water, sea animals, land animals, and birds