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Perspective

Hazardous Wastes and Landfill Leachate Management Solutions

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INTRODUCTION

Toxic organic and inorganic pollutants, heavy metals, ammonia nitrogen compounds and other dissolved and suspended contaminants are common in leachate. Careful Landfill Leachate (LFL) management is required to limit leachate quantity and avoid the tragic outcome of leachate pollution. In contrast to solid waste incineration management, LFL disposal has major ecological and health consequences in most poor nations, mostly due to groundwater, soil and air contamination. This could be linked to cities'/municipalities' lack of cost-effective treatment technologies or acceptable disposal rules. As a result, ecological assessment and long-term management of LFL collection and disposal treatment are strongly advised.

Waste treatment processes evolved around the start of the twentieth century and rubbish collection and disposal became prevalent in urban areas. The first landfills were purposefully dug holes or trenches into which waste was dumped and then covered with dirt. Through LFL, this practice damaged the earth and neighboring soil. The scientific and technology community began to recognize the risks and negative environmental repercussions of landfilling in the twenty-first century). Trash production has shifted dramatically away from biodegradable materials and towards non-biodegradable, artificial plastic and toxic rubbish, all of which contribute to environmental damage.

DESCRIPTION

Several industrialized countries have passed legislation to regulate landfills in order to minimize and mitigate environmental damage. Reduce, reuse and recycle garbage whenever feasible to avoid dumping it in landfills.

There was a lack of awareness of the activities occurring in landfills, such as the formation of gases from LFL and the potential environmental damage; waste management at landfills remains a cause of concern worldwide. The trash sector in the European Union (EU) is undergoing significant modifications as a result of the adoption of waste treatment legislation and regulations. Regardless of these advancements, the EU's waste output is increasing, with an average of 2.5 billion tonnes produced year; 36% of this was recycled, while the remainder was landfilled or burned.

Unfortunately, only 600 million tonnes of this material could be recycled, highlighting a serious deficiency in present trash disposal methods. Fundamentally, a paradigm shift is required to recognize waste as an issue that must be addressed. Landfilling raises environmental problems and challenges. Landfills release off-gases such methane (CH_4) and hydrogen sulphide, which harms air quality. Greenhouse gas emissions can be lowered by improving waste management practices, hence lowering environmental and health issues as well as landscape damage.

The most serious issue related with trash landfilling is the production of LFL, a type of hazardous Wastewater (WW) that can pollute groundwater and can be treated using Aerobic Granular Sludge (AGS) technology. This method takes mature AGS from an AGS bioreactor that is running, stores it in various forms and conditions (depending on the procedures employed) and reactivates the stored AGS when needed. MSW LFL is also a highly concentrated organic WW with a complicated composition. It is a major source of contamination that endangers the quality of groundwater and surface water. Before being discharged into the environment, leachates must be thoroughly treated.

Physical, chemical and biological technologies have been created for the treatment of LFL. Some disadvantages of biological LFL treatment employing aerobic ponds include low removal of Organic Matter (OM) and some harmful contaminants. On the other hand, anaerobic treatment of WW has attracted widespread interest among researchers and sanitary engineers, owing primarily to its cost advantages over traditional aerobic techniques.

Classification of leachates

LFL is classified mostly based on the age of the landfill. Certain factors, such as waste content, rainfall penetration and temperature, may have an impact on LFL features. LFLs are classified as recent/young, middle/moderate or mature/old based on the landfill age in which they were generated.

Landfill Leachate (LFL)

LFL is a chemical mixture that poses a serious threat to human health and the environment. LFL is formed from waste liquids and percolates through landfills, accumulating suspended and soluble components originating from or consequences of rubbish deterioration. Groundwater, precipitation and rain infiltration through uncapped landfills has a major impact on LFL production.

The landfill directive establishes the principles and rules for regulating LFL inclusion at landfill sites. The guideline specifically states that a leachate treatment system must be built prior to the emergence of young LFL. A leachate treatment technique should ensure that LFL created by landfills is contained within the site. Furthermore, stated that the system should have established measures to reduce seepage from the landfill *via* the base or side in order to reduce the interaction between the leachate and the landfill linear, preventing an increase in liquid levels to the point where the leachate overflows and causes uncontrolled release into the surrounding environment.

It is of 2 types.

Recent LFL: Recent/young "fresh" LFL (5 years old) is created at landfills that have only recently began receiving garbage and where waste decomposes quickly. The pH of the waste is near neutral (6.5) during the breakdown of OM and the O_2 contained in the trash is consumed by natural microbes. Current LFL values are greater than 0.3 are characterized by the Biochemical Oxygen Demand (BOD) and the Chemical Oxygen Demand (COD).

Middle LFL: A middle/moderate landfill (10 years) frequently contains significant levels of biodegradable OM, which encourages rapid anaerobic fermentation and the creation of massive volumes of Volatile Fatty Acids (VFAs).

CONCLUSION

Despite following minimum removal criteria, leachate pollution causes substantial ecological and public health problems, particularly in developing nations with ineffective waste treatment techniques. Leachate degrades groundwater aquifers and terrestrial ecosystems by producing harmful pollutants and greenhouse gases.

To maximize the benefits of organic, inorganic and xenobiotic chemicals for future use, innovative, cost-effective, sustainable and eco-friendly leachate treatment technologies are required to reduce energy consumption, sludge production and toxin formation and recover organic, inorganic and xenobiotic chemicals in a harmless state.