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A Survey on Heavy Metal Concentration in Downstream Wells of Landfill (Case of Mashhad, Iran)

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ABSTRACT

This study at first level focused on definitions and descriptions of some landfills and landfills sites all around the world and survey on how important they are for regional governments and responsible in duty as a very important responsibility for locals and their health. At the second level we had a look on heavy metals concentration which are by many definitions as follows: lead, nickel, chromium, copper and cadmium, of course it should be mentioned that this study has been done only by archive and library studies. At the third level we go to compare the heavy metal concentration in mashhad landfill site with others mentioned in this paper as examples, of course we have had lots of limitation in this study, this is only start point. The results showed that indeed there are not many differences between mashhad and others as a whole.

Keywords: Landfill, Heavy metal, Concentration, Wells.

INTRODUCTION

A landfill site (also known as a tip, dump, rubbish dump or dumping ground and historically as a midden is a site for the disposal of waste materials by burial and is the oldest form of waste treatment[1]. Historically, landfills have been the most common method of organized waste disposal and remain so in many places around the world. Some landfills are also used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling). A landfill also may refer to ground that has been filled in with rocks instead of waste materials, so that it can be used for a specific purpose, such as for building houses. Unless they are stabilized, these areas may experience severe shaking or liquefaction of the ground during a large earthquake.

Operations

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Typically, in non-hazardous waste landfills, in order to meet predefined specifications, techniques are applied by which the wastes are:

1. Confined to as small an area as possible.
2. Compacted to reduce their volume.
3. Covered (usually daily) with layers of soil.

Figure 1: A landfill in Poland

During landfill operations the waste collection vehicles are weighed at a weighbridge on arrival and their load is inspected for wastes that do not accord with the landfill's waste acceptance criteria. Afterward, the waste collection vehicles use the existing road network on their way to the tipping face or working front where they unload their contents. After loads are deposited, compactors or bulldozers are used to spread and compact the waste on the working face. Before leaving the landfill boundaries, the waste collection vehicles pass through a wheel cleaning facility. If necessary, they return to the weighbridge in order to be weighed without their load. Through the weighing process, the daily incoming waste tonnage can be calculated and listed in databases for record keeping. In addition to trucks, some landfills may be equipped to handle railroad containers. The use of 'rail-haul' permits landfills to be located at more remote sites, without the problems associated with many truck trips. Typically, in the working face, the compacted waste is covered with soil or alternative materials daily. Alternative waste-cover materials are chipped wood or other "green waste",[2] several sprayed-on foam products, chemically 'fixed' bio-solids and temporary blankets. Blankets can be lifted into place at night then removed the following day prior to waste placement. The space that is occupied daily by the compacted waste and the cover material is called a daily cell. Waste compaction is critical to extending the life of the landfill. Factors such as waste compressibility, waste layer thickness and the number of passes of the compactor over the waste affect the waste densities.

Impacts

Landfills may cause a number of problems. Damage can include infrastructure disruption, such as damage to access roads by heavy vehicles. Pollution of the local environment may occur as well, such as contamination of groundwater or aquifers by leakage or sinkholes[3] or soil contamination. Pollution of local roads and water courses from wheels on vehicles when they leave the landfill can be significant and can be mitigated by wheel washing systems.

Methane generated by decaying organic wastes may be released into the atmosphere. Methane is a greenhouse gas many times more potent than carbon dioxide, and can itself be a danger to inhabitants of an area because it is flammable and potentially explosive. Landfills may become a reservoir of disease organisms and disease vectors such as rats and flies, particularly from improperly operated landfills, which are more common in developing countries. Other issues include injuries to wildlife and nuisance problems such as dust, odor, vermin, noise pollution and reduced local property values.

Figure 2: Landfill operation in Hawaii. Note that the area being filled is a single, well-defined "cell" and that a rubberized landfill liner is in place (exposed on the left) to prevent contamination by leachates migrating downward through the underlying geological formation.

Though offsite impacts of landfills are of primary concern to regulators, the status of the resident microbial community in a landfill may determine the efficiency with which natural attenuation of contaminants proceeds on site. For example, Gomez et al. (2011) showed that bacterial diversity, including diversity of pollutant degraders was variable within a major landfill site in Medellin, Colombia and was related to the level of contamination within a particular zone.[4]

Some local authorities have found it difficult to locate new landfills. Communities may charge a fee or levy to discourage waste and/or recover the costs of site operations. Many landfills are publicly funded, but some are commercial businesses, operated for profit.

Regional practice

The examples and perspective in this section may not represent a worldwide view of the subject, they are only some cases of the matter and as follow for more compare:

Figure 3: A landfill in Perth, Western Australia.

Figure 4: South East New Territories Landfill, Hong Kong.

1-Canada

Landfills in Canada are regulated by provincial environmental agencies and environmental protection acts (EPA).[5] Older dumps tend to fall under current standards and are monitored for leaching.[6] Some former dumps have been converted to parkland and close to residential developments. Historically, Canadians used the euphemism "nuisance grounds" to refer to a landfill site.[7] This was still used in 2012, in, for example, the Rural Municipality of Montcalm.[8]. According to studies the heavy metal concentrations in this landfill site goes to lead as heavy metal and causes many diseases in local residents.

2-European Union

In countries of the European Union, individual states are obliged to enact legislation to comply with the requirements and obligations of the European Landfill Directive. In the UK this is the Waste Implementation Programme. This program recently named as healthy programme and there are not any heavy metal concentrations masses in downstream wells.

3-India

Trash and garbage is a common sight in urban and rural areas of India. It is a major source of pollution. Indian cities alone generate more than 100 million tons of solid waste a year. Street corners are piled with trash. Public places and sidewalks are despoiled with filth and litter, rivers and canals act as garbage dumps. In part, India's garbage crisis is from rising consumption. India's waste problem has also been criticised as a stunning failure of governance.[9]

In 2000, India's Supreme Court directed all Indian cities to implement a comprehensive waste-management program that would include household collection of segregated waste, recycling and composting. The Organization for Economic Cooperation and Development estimates that up to 40 percent of municipal waste in India remains simply uncollected.

In 2011, several Indian cities embarked on waste-to-energy projects of the type in use in Germany, Switzerland and Japan.[10] For example, New Delhi is implementing two incinerator projects aimed at turning the city’s trash problem into electricity resource. These plants are being welcomed for addressing the city’s chronic problems of excess untreated waste and a shortage of electric power. They are also being welcomed by those who seek to prevent water pollution, hygiene problems, and eliminate rotting trash that produces potent greenhouse gas methane. The projects are being opposed by waste collection workers and local unions who fear changing technology may deprive them of their livelihood and way of life.[11] And A2Z Group, Website headquartered in Gurgaon, Delhi has set up Integrated Resource Recovery Facilities with an aggregate MSW capacity of 3,800 tons per day (“TPD”) in six cities, along with the collection and transportation (“C&T”) of MSW of an aggregate capacity of 910 TPD in two cities. They also have the processing and disposal (“P&D”) of MSW of an aggregate capacity of 488 TPD in six cities in India.

4-United Kingdom

Landfilling practices in the UK have had to change in recent years to meet the challenges of the European Landfill Directive. The UK now imposes landfill tax upon biodegradable waste which is put into landfills. In addition to this the Landfill Allowance Trading Scheme has been established for local authorities to trade landfill quotas in England. A different system operates in Wales where authorities are not able to 'trade' between themselves, but have allowances known as the Landfill Allowance Scheme.

5-United States

In the U.S., landfills are regulated by each state's environmental agency that establishes minimum guidelines; however, none of these standards may fall below those set by the United States Environmental Protection Agency (EPA). Some informal experiences by researchers of different universities of united states reported that the levels of cadmium , lead and nickel are higher than standard norms. Some of these items are the same with iran’s mashhad landfill site.

6- **Iran, Mashhad**

The landfill site of Iran's Mashhad located at southeast part of the city and in a distance of 5 kilometers and occupying 220 hectares of the area. The soil of this region formed from granite, metamorphosis, and sedimentary rocks which belong to the first and third geological era. Water depth of the region is generally 90 meters and granite rocks forms the bedrock up to the one kilometer depth. Producing about 3000 tons of daily garbage, caused that Mashhad locate at the second rank of producing the waste materials after Tehran. According to studies of Geography department of Ferdowsi university of Mashhad the curve rocky form of this landfill site made it one of the unconquerable sites all around the world and there were not any meaning full results about the heavy metal concentrations in downstream wells of this site, although some scholarship experiences by university student said that there were nickel and cadmium in this wells, but it is not true and the reason maybe the watersheds of flat grounds but not the landfill site.

Microbial degradation

Bacteria that digest plastic have been found in landfills. [12]

Reclaiming materials

Landfills can be regarded as a viable and abundant source of materials and energy. In the developing world, this is widely understood and one may thus often find waste pickers scavenging for still usable materials. In a commercial context, landfills sites have also been discovered by companies, and many have begun harvesting materials and energy .[13] Well known examples are gas recovery facilities.[14] Other commercial facilities include waste incinerators which have built-in material recovery. This material recovery is possible through the use of filters (electro filter, active carbon and potassium filter, quench, HCL-washer, SO_2-washer, bottom ash-grating, etc.). An example of these is the AEB Waste Fired Power Plant.[15][16] The AEB waste incinerator is hereby able to recover a large part of the burned waste in source materials. According to Marcel van Berlo (who helped build the plant), the processed waste contained higher percentages of source materials than any mine in the world. He also added that when the plant was compared to a Chilean copper mine, the waste fired plant could recover more copper.[17] However, because of the high concentration of gases and the unpredictability of the landfill contents, which often include sharp objects, landfill excavation is generally considered dangerous. Furthermore, the quality of materials residing within landfills tends to degrade and such materials are thought to be not worth the risks required to recover them.

Alternatives and results

The alternatives to landfills are waste reduction and recycling strategies. Secondary to not creating waste, there are various alternatives to landfills. In the late 20th century, alternative methods of waste disposal to landfill and incineration have begun to gain acceptance. Waste-to-energy incineration, anaerobic digestion, composting, mechanical biological treatment, pyrolysis and plasma arc gasification have all begun to establish themselves in the market.

In recent years, some countries, such as Germany, Austria, Sweden, Denmark, Belgium, the Netherlands, and Switzerland, have banned the disposal of untreated waste in landfills. In these countries, only the ashes from incineration or the stabilized output of mechanical biological treatment plants may still be deposited.

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