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WASTE TREATMENT- A REVIEW

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ABSTRACT: When people think about solid waste management, they likely associate it with garbage being dumped in landfills or incinerated. While such activities comprise an important part of the process, a variety of elements is involved in the creation of an optimal integrated solid waste management (ISWM) system. For example, treatment techniques act to reduce the volume and toxicity of solid waste. These steps can transform it into a more convenient form for disposal. Waste treatment and disposal methods are selected and used based on the form, composition, and quantity of waste materials.

KEYWORDS: waste, treatment, solid, management, disposal, composition, quantity, transform

I. INTRODUCTION

Here are major waste treatment and disposal methods:

Thermal Treatment

Thermal waste treatment refers to the processes that use heat to treat waste materials. Following are some of the most commonly used thermal waste treatment techniques:

- Incineration is one of the most common waste treatments. This approach involves the combustion of waste material in the presence of oxygen. This thermal treatment method is commonly used as a means of recovering energy for electricity or heating. This approach has several advantages. It quickly reduces waste volume, lessens transportation costs and decreases harmful greenhouse gas emissions. [1,2]
- Gasification and Pyrolysis are two similar methods, both of which decompose organic waste materials by exposing waste to low amounts of oxygen and very high temperature. Pyrolysis uses absolutely no oxygen while gasification allows a very low amount of oxygen in the process. Gasification is more advantageous as it allows the burning process to recover energy without causing air pollution.
- Open Burning is a legacy thermal waste treatment that is environmentally harmful. The incinerators used in such process have no pollution control devices. They release substances such as hexachlorobenzene, dioxins, carbon monoxide, particulate matter, volatile organic compounds, polycyclic aromatic compounds, and ash. Unfortunately, this method is still practiced by many local authorities internationally, as it offers an inexpensive solution to solid waste.

Dumps and Landfills

Sanitary landfills provide the most commonly used waste disposal solution. These landfills are desired to eliminate or reduce the risk of environmental or public health hazards due to waste disposal. These sites are situated where land features work as natural buffers between the environment and the landfill. For instance, the landfill area can be comprised of clay soil which is quite resistant to hazardous wastes or is characterized by an absence of surface water bodies or a low water table, preventing the risk of water pollution. The use of sanitary landfills presents the least health and environmental risk, but the cost of establishing such landfills is comparatively higher than other waste disposal methods.

Controlled dumps are more or less the same as sanitary landfills. These dumps comply with many of the requirements for being a sanitary landfill but may lack one or two. Such dumps may have a well-planned capacity but no cell-planning. There may be no or partial gas management, basic record keeping, or regular cover. [3,4]

Bioreactor landfills are the result of recent technological research. These landfills use superior microbiological processes to speed up waste decomposition. The controlling feature is the continuous addition of liquid to sustain optimal moisture for microbial digestion. The liquid is added by re-circulating the landfill leachate. When the amount of leachate is not adequate, liquid waste such as sewage sludge is used.

II. DISCUSSION

Biological Waste Treatment

Composting is another most frequently used waste disposal or treatment method which is the controlled aerobic decomposition of organic waste materials by the action of small invertebrates and microorganisms. The most common composting techniques include static pile composting, vermin-composting, windrow composting and in-vessel composting.

Anaerobic Digestion also uses biological processes to decompose organic materials. Anaerobic Digestion, however, uses an oxygen and bacteria-free environment to decompose the waste material where composting must have air to enable the growth of microbes.[5,6]

Biological treatment of certain organic wastes, such as those from the petroleum industry, is also an option. One method used to treat hazardous waste biologically is called landfarming. In this technique the waste is carefully mixed with surface soil on a suitable tract of land. Microbes that can metabolize the waste may be added, along with nutrients. In some cases a genetically engineered species of bacteria is used. Food or forage crops are not grown on the same site. Microbes can also be used for stabilizing hazardous wastes on previously contaminated sites; in that case the process is called bioremediation.

The chemical, thermal, and biological treatment methods outlined above change the molecular form of the waste material. Physical treatment, on the other hand, concentrates, solidifies, or reduces the volume of the waste. Physical processes include evaporation, sedimentation, flotation, and filtration. Yet another process is solidification, which is achieved by encapsulating the waste in concrete, asphalt, or plastic. Encapsulation produces a solid mass of material that is resistant to leaching. Waste can also be mixed with lime, fly ash, and water to form a solid, cementlike product.
Surface storage and land disposal

Hazardous wastes that are not destroyed by incineration or other chemical processes need to be disposed of properly. For most such wastes, land disposal is the ultimate destination, although it is not an attractive practice, because of the inherent environmental risks involved. Two basic methods of land disposal include landfilling and underground injection. Prior to land disposal, surface storage or containment systems are often employed as a temporary method.

Temporary on-site waste storage facilities include open waste piles and ponds or lagoons. New waste piles must be carefully constructed over an impervious base and must comply with regulatory requirements similar to those for landfills. The piles must be protected from wind dispersion or erosion. If leachate is generated, monitoring and control systems must be provided. Only noncontainerized solid, nonflowing waste material can be stored in a new waste pile, and the material must be landfilled when the size of the pile becomes unmanageable.[7,8]

A common type of temporary storage impoundment for hazardous liquid waste is an open pit or holding pond, called a lagoon. New lagoons must be lined with impervious clay soils and flexible membrane liners in order to protect groundwater. Leachate collection systems must be installed between the liners, and groundwater monitoring wells are required. Except for some sedimentation, evaporation of volatile organics, and possibly some surface aeration, open lagoons provide no treatment of the waste. Accumulated sludge must be removed periodically and subjected to further handling as a hazardous waste.

Many older, unlined waste piles and lagoons are located above aquifers used for public water supply, thus posing significant risks to public health and environmental quality. A large number of these old sites have been identified and scheduled for cleanup, or remediation, around the world.
Secure landfills

Landfilling of hazardous solid or containerized waste is regulated more stringently than landfilling of municipal solid waste. Hazardous wastes must be deposited in so-called secure landfills, which provide at least 3 metres (10 feet) of separation between the bottom of the landfill and the underlying bedrock or groundwater table. A secure hazardous-waste landfill must have two impermeable liners and leachate collection systems. The double leachate collection system consists of a network of perforated pipes placed above each liner. The upper system prevents the accumulation of leachate trapped in the fill, and the lower serves as a backup. Collected leachate is pumped to a treatment plant. In order to reduce the amount of leachate in the fill and minimize the potential for environmental damage, an impermeable cap or cover is placed over a finished landfill.

III. RESULTS

A groundwater monitoring system that includes a series of deep wells drilled in and around the site is also required. The wells allow a routine program of sampling and testing to detect any leaks or groundwater contamination. If a leak does occur, the wells can be pumped to intercept the polluted water and bring it to the surface for treatment.

One option for the disposal of liquid hazardous waste is deep-well injection, a procedure that involves pumping liquid waste through a steel casing into a porous layer of limestone or sandstone. High pressures are applied to force the liquid into the pores and fissures of the rock, where it is to be permanently stored. The injection zone must lie below a layer of impervious rock or clay, and it may extend more than 0.8 km (0.5 mile) below the surface. Deep-well injection is relatively inexpensive and requires little or no pretreatment of the waste, but it poses a danger of leaking hazardous waste and eventually polluting subsurface water supplies.
Remedial action

Disposal of hazardous waste in unlined pits, ponds, or lagoons poses a threat to human health and environmental quality. Many such uncontrolled disposal sites were used in the past and have been abandoned. Depending on a determination of the level of risk, it may be necessary to remediate those sites. In some cases, the risk may require emergency action. In other instances, engineering studies may be required to assess the situation thoroughly before remedial action is undertaken.[9,10]

One option for remediation is to completely remove all the waste material from the site and transport it to another location for treatment and proper disposal. This so-called off-site solution is usually the most expensive option. An alternative is on-site remediation, which reduces the production of leachate and lessens the chance of groundwater contamination. On-site remediation may include temporary removal of the hazardous waste, construction of a secure landfill on the same site, and proper replacement of the waste. It may also include treatment of any contaminated soil or groundwater. Treated soil may be replaced on-site and treated groundwater returned to the aquifer by deep-well injection.

A less costly alternative is full containment of the waste. This is done by placing an impermeable cover over the hazardous-waste site and by blocking the lateral flow of groundwater with subsurface cutoff walls. It is possible to use cutoff walls for this purpose when there is a natural layer of impervious soil or rock below the site. The walls are constructed around the perimeter of the site, deep enough to penetrate to the impervious layer. They can be excavated as trenches around the site without moving or disturbing the waste material. The trenches are filled with a bentonite clay slurry to prevent their collapse during construction, and they are backfilled with a mixture of soil and cement that solidifies to form an impermeable barrier. Cutoff walls thus serve as vertical barriers to the flow of water, and the impervious layer serves as a barrier at the bottom.

IV. CONCLUSIONS

Composting toilet, also called biological toilet or dry toilet, waterless sewage-treatment system that decomposes human excreta into an inert nitrogen-rich material similar to humus. Because they eliminate the water use associated with typical toilets, composting toilets circumvent the costs associated with traditional sewage treatment. Composting toilets hold and process waste material to capture the nutrients in human waste, such as nitrogen and phosphorus, for local reuse. In addition to being well suited to rural areas and water-scarce regions, composting toilets are being increasingly used in institutional and suburban settings. Urban use is limited because of the more stringent health regulations and the lack of space required for compost storage. Users are often environmentally conscious and seek to decrease their impact on water resources, or they may be in areas where water and sewer infrastructure is at capacity or otherwise limited.

In traditional household systems, the dirty water from sinks, showers, and washing machines (gray water) is combined with wastewater from toilets (black water) and discharged to a sewer or on-site septic tank. Since composting toilets do not use water to move waste from the toilet to the next stage of waste treatment, they do not produce black water or discharge wastewater. Whereas waste in a privy or outhouse is typically covered with lye and buried or removed for traditional sewage treatment elsewhere, composting toilets biologically process waste on-site, allowing it to be used as a soil nutrient. If properly maintained, a composting toilet can reduce waste down to 30 percent of its original volume.[8,9]

Composting toilets vary in complexity of design, energy requirements for optimal operation, and capacity. The simplest form is a “humanure” system, which can be built with a large bucket, some pieces of wood, and a pile of hay. Self-contained units within households can have mechanical batch stirrers, electrically powered rotating chambers, and heating elements to drive off excess moisture. Site-built and single-chamber systems can be built with few moving parts. In remote areas, for example, a solar-powered fan connected to an aeration chimney is all that is needed to ensure effective year-round processing of waste. The common goal is to ensure safe aerobic conditions for bacterial decomposition in the compost. A bulking agent such as sawdust or coir is usually required after each use, and some systems allow for the addition of food scraps as well. All systems have a method to remove exhaust from the compost reactor or catchment basin, often using a small fan, and manage leachate with gravity or a heating element. They must also provide a means to easily remove the finished product. In addition to the bulking agent, ash and soda lime can be added to make the compost more alkaline and facilitate pathogen die-off. Although very basic systems may have an odour, well-designed systems are ventilated and promote decomposition by aerobic bacteria and thus do not have an offensive smell if they are maintained properly.

Commercially built composting toilets can be grouped into two types by size and intended use. Small all-in-one systems process waste in a small reactor below the toilet bowl. Models resemble a flush toilet and are popular in residences because they require little modification to existing bathrooms. Larger, centralized systems use gravity or a small amount of water (a microflush) to direct waste to the compost reactor. These systems are ideal in high-use settings, as well as in off-the-grid applications where solar energy may be the only available source of power. They can be multistory and often require subfloor or basement space to accommodate their larger compost reactors.[10,11]

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