

Solid Waste Land Fill Technology

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Every living being on earth generates waste during their day to day activities. If you carefully look at the natural environment, you will be able to identify waste generated in various physical appearances, mostly in the solid or liquid form. Waste generated by all living creatures except of humans are naturally recycled in the environment. However, most of the waste generated due to human activities, especially waste generated due to use of artificial man - made items results in an imbalance in the components of the natural environmental processes and adversely affects the environmental balance.

Few decades ago, people in Sri Lanka had simple lifestyles and reasonable area for their households.

The waste generated in the household was disposed within the respective premises. Most people had a pit in the backyard which was used to put waste, which were mostly naturally degradable. When the pit was full, they used to plant a banana tree or a yam (Kiri Ala)

bush which will grow using the organic fertilizer generated through natural mechanisms from the waste in the pit. Leaves and other organic waste from the gardens were either burnt or gathered around trees to decay and provide natural fertilizer to the respective trees. There were very little artificial items other than used tins or glass bottles which were re-used for various purposes. All packing and wrapping items were naturally degradable. For example, all grocery items sold were wrapped in used newspaper, while non – food items were wrapped in used cement covers. Fish and meat items were wrapped in *Habarala* Leaves. Food were wrapped either in Banana Leaves or '*Kolapatha*' from Arecanut Trees. This was a total contrast to what we have been experiencing during the last two to three decades where environmental unfriendly packing items such as polythene and polystyrene foam has come into play.

The changes that occurred within the Sri Lankan economy in the late 1970's paved the way to the use of cheap artificial packing material. With the open economy, global trends invaded Sri Lanka, and items which were not used before, became necessities for Sri Lankans.

The civil unrest in the Northern part of Sri Lanka as well as the insurgency in the Southern parts during the late 1980's resulted in many people migrating to main cities from various parts of the country. The infrastructure within the cities was not developed to cater to the rapidly increasing population. The population increase due to migration as well as the natural growth of the existing population demanded the limited land resource to be shared among more people. This resulted in smaller per capita area of land for each family / individual. The waste disposal mechanisms and relevant infrastructure were not upgraded to cater to the increased waste generated by the population. As a result, local government authorities who were responsible for waste disposal of their area had no alternative, but to use any large unutilized land area within the relevant authority's area limits, to dispose waste. These landfills were not scientifically arranged or designed to handle waste in an environmentally sound manner. Even though the need for sound waste management mechanics were highlighted since of early 1990's lack of necessary skills, knowledge and competence as well as capital constraints did not complement

the implementation of sound waste disposal facilities. However, the officials responsible tried their level best to ensure sanitary levels in the waste disposal facilities available.

Why is it necessary to establish and implement a scientific waste disposal mechanism?

Before answering this question, it is important to analyze the impact of open disposal.

Upon analysis of the waste generated in the country at present, we can identify that majority of the waste, approximately over 60% comprises waste which will naturally decay, as 85% - 90% of such waste comprises water. When rain water falls on the decaying waste, the liquid components produces 'Leachate' which is rich in Nitrate and Phosphates, and which could be used as fertilizer. This is not a quality fertilizer because of numerous contaminants from mixed garbage such as heavy metals and pathogens. However, this Leachate can seep and contaminate ground water and water in fresh water bodies.

In addition, when the waste is disposed through improper or non – scientific mechanisms, the piled up waste, promote anaerobic bacterial action, and the waste will produce 'Landfill Gas' which includes Methane (CH_4) and Carbon Dioxide (CO_2). These gasses are greenhouse gasses and Methane can easily become inflammable under warm weather conditions.

It should also be noted that open dumping of waste including municipal garbage will result

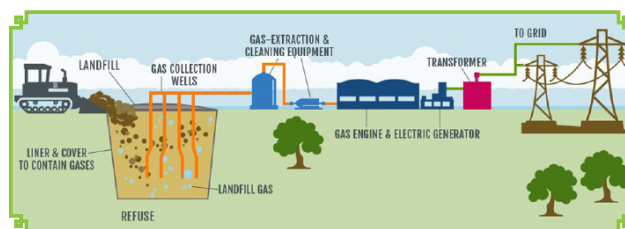
in many social and economic problems. There will be hazardous gases with bad odor which are often produced by these dump yards. The dust generated and litters in the dump yard could be a reason for bad environment. These dump yards will also be a breeding ground for vectors such as flies, mosquitoes or stray dogs which spread illnesses. Scavengers such as crows and pests, as well as mice can increase due to availability of food for such animals in these yards.

We have experienced wild animals such as elephants being attracted to the dump yards. The polythene which gets stuck in the digestive system is a common killer of these animals. There is also a reasonable potential to increase population of crocodiles due to dumping of fish and flesh waste near water bodies. The leachate which contaminates water resources will adversely affect fish and other animals depending on such water. The hazards can accumulate through food chains and food webs, and ultimately harm humans in a very aggressive manner. The increase in certain animals such as crows which are scavengers, will adversely affect the natural balance of environment.

There are several social problems associated with unorganized and unsystematic waste disposal. Drug addicts use these dumps to collect valuable items such as metal which could be sold. Child labour is used by some of them for segregation of garbage. There have been children buried in garbage while searching for these materials.

Sanitary landfill concept as a final disposal mechanism

Burning of waste is carried out by many people across the world. This is an environmental hazard as well as a health hazard for animals and humans. There are many scientific mechanisms to dispose waste. Recycling and composting are key environmental friendly principles within these mechanisms. There is increasing interest among people to convert waste into electricity in most countries. The main barriers for this process are the requirement of initial capital investment, associated recurrent costs and the technological knowledge pertaining to relevant scientific mechanisms. Sanitary landfill concept provides a more cost effective approach and environmentally friendly mechanism for waste disposal. Within this concept, open garbage dumping is the most common approach adopted, but it will lead to the environmental and social problems discussed above. Hence, sites could be scientifically arranged in a manner that will minimize hazards, and such sites are titled 'Sanitary Landfills' or 'Engineered



Landfills'. In these landfills, the gases generated internally within the dumped waste will be controlled, and the leachate should be directed for purification before releasing to the environment or water bodies.

Landfill Technology

Under this topic, we can identify

two main types; the scientific landfills and sanitary landfills. Both mechanisms ensure minimization of problems associated with waste disposal in landfills discussed above.

One of the key challenges in such



landfills is management of seepage of leachate in a manner which would not pollute the environment, especially the water resources. Selection of an appropriate land with suitable soil type and texture is very important. The best is clay soil. The earth should be strong. The soil should be set out systematically and compressed to prevent seepage of leachate to ground water. Sometimes introduction of artificial material to achieve this requirement, such as High Density Poly Ethylene layers (HDPE) can be used for this purpose after calculating the strength required according to the composition of the natural soil layer. Geo Textile covers are used to ensure that sharp and harmful items do not damage the synthetic liner. It is essential to build soil embankments (ආංඳුවැටි) around the selected land area to demarcate the area used for dumping of waste. It is essential that these embankments (ආංඳුවැටි) are also covered with the aforementioned polythene layers. Thereafter, an appropriate mechanism should be developed to drain out the leachate and contaminated water for proper treatment. Terrain on the bottom of landfill need to be developed

to accommodate such a drainage system. Appropriate pipelines made of cement or plastic should be arranged for the purposes of draining out the liquid material for treatment before releasing to the environment. These pipes should have holes on its surface to extract seeping liquid leachate. It is important to ensure that these pipe lines are not blocked, and this could be achieved through positioning an appropriate stone layer (metal) around the pipelines. These covers should be of appropriate thickness sometimes over 1 foot.

These pipelines should be directed to the collection units which are similar to small wells, located at the inner periphery of the landfill. The liquid directed to these units should then be sent for treatment either using surface gravity or by pumping. The liquid generated from the landfill is high in Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) which could adversely affect natural water resources, if released without treatment.

The other main characteristic of a scientific landfill is management of landfill gas generated by anaerobic decomposition activities of bacteria growing on the dumped waste. As explained earlier the main components of this gas will be CH_4 and CO_2 which are greenhouse gases. The adverse effect of CH_4 as a greenhouse gas is about 20 times more than that of CO_2 . The greenhouse gasses induce global warming. The positive aspect of CH_4 is its inflammable character. Hence, it can be used as a bio gas. However, we have experienced several fires in landfills due to CH_4 which has not been properly

managed. This gas can even be explosive if burned in large quantities.

In order to manage CH_4 in an efficient and effective manner, proper gas vents should be placed at appropriate locations within the landfill. This is achieved through laying of horizontal barrels with holes to emit gas in engineered landfills. With regard to sanitary landfills, further management of the gas is necessary without emitting it to the atmosphere. This is achieved through complete burning of the gas.

It is important to design the structure of the landfill properly to ensure stability of the land. Necessary slopes should be designed.

In a scientific landfill, a 'Reception Lobby' has to be in place in order to receive waste. A proper transportation and road network within the landfill is equally important. The road network and parking facilities should be able to cater to several heavy vehicles moving within the premises regularly.

In order to manage incoming waste, it is important to know the exact quantities received. For this purpose, a weighing bridge should be established within the landfill premises. As the landfill is full of different types of waste which could sometimes have health implications, the employees of the landfill should be given relevant safety equipment. The landfill site should have relevant sign boards in place. Tools for emergency situations and adequate lighting conditions for night operations should be maintained. A washing bay should be in place to wash

tyres of vehicles moving out of the landfill and this should be stationed just before the exit gate (s).

The landfill should be separated from other adjoining lands, and the area should be demarcated. Appropriate security mechanisms should be adopted to ensure that unauthorized parties do not dispose litter at these sites.

Managing Internal Operations

Effective management of day to day operations of the landfill has to be one of the main objectives for its success.

Operations within the landfill should be managed in a proper manner to ensure that there is no traffic or other obnoxious event (such as spread of unpleasant odor) to the neighborhoods.

Waste disposal within the landfill should be designed in an appropriately engineered manner. Estimated waste quantities should be directed to respective areas within pre determined time frames. Waste deposition to respective areas should be carried out under a technically competent surveyor's supervision to ensure that the waste is deposited according to the set standards. While compressing the waste, the structural stability of the landfill should be ensured. Appropriate machinery (landfill compactor) should be used for this purpose after scientifically calculating the needs. The compressions should ensure that there is no damage caused to the

underneath liner. If the above conditions are not adhered to, the expected lifetime of the landfill will be shortened.

After conclusion of day's



activities adequate soil capping should be done. Continuous monitoring should be carried out to check whether there is leachate contamination, in order to confirm stability of the liner system. Leachate drainage system and gas management system needs to be observed and monitored. Sound and dust generated due to landfill activities should be controlled adequately and special attention should be paid for control of the unpleasant odor. Documentation pertaining to all activities should be updated and maintained and mechanisms should be implemented to monitor whether the landfill operates within the set scientific parameters. Health and safety of workers as well as of neighborhoods should be ensured.

Landfill after the desired lifespan

After the expected lifespan the final capping should be done. This process is more or less same as the underneath liner compiled with a clay liner and a synthetic liner. The synthetic liner will ensure

minimization of rainwater seepage in order to ensure minimum generation of leachate. On top of that a soil layer should be placed and grass can be grown on it to complete the process.

Even after completing the landfill process, there should be monitoring mechanisms to ensure that the landfill is within the desired standards. There should be further engineering interventions to meet these standards, if

required.

Scientific Landfill as a successful solution

Due to bad experiences with open dumping, people are resistant to sanitary landfills as well. It should be noted that there would be a minimum of adverse effects on the environment, animals and humans if the respective landfill is scientifically designed and monitored throughout to ensure that the landfill complies with set standards.



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