Solid Waste Management

Lecture 3

4th year 2017

Solid Waste Landfill

The term landfill refers to an entire disposal facility in a contiguous geographic space where municipal waste is placed in or on land.

Landfills are the final depository of a waste after all other waste management options have been carried out.
An appropriate treatment may be needed to process the waste for final disposal. Some of the processing may include minimizing or eliminating hazardous properties, stabilizing the waste, and/or reducing its volume.
After placement in a landfill, a portion of organic waste (paper, food waste, and yard trimmings) decomposes. Landfill gas is produced by microorganisms under anaerobic conditions and is comprised of approximately 50% CH_4, 50%CO_2, and trace amount of nonmethane organic compounds (NMOC). Landfill gas generation occurs under a four phases process:

1- CO_2 is produced under aerobic conditions.
2- After Oxygen (O_2) is depleted, CO2 and hydrogen (H_2) are produced under anaerobic condition.
3- Then CO2 production depletes in proportion to the CH4 that is produced.
4- Finally, CH4, CO2 and nitrogen (N2) production stabilize.

Significant Land Fill Gas LFG production typically begins one two years after waste disposal in a landfill and can contain for 10 to 60 years or longer.

Landfills are the second largest anthropogenic sources of CH4, Methane generation in landfills is a function of several factors, including:
(1) The total amount of waste;
(2) The age of the waste, which is related to the amount of waste landfilled annually;
(3) The characteristics of the MSW, including the biodegradability of the waste; and
(4) The climate where the landfill is located, especially the amount of rainfall.
Methane emissions from landfills are a function of methane generation, as discussed above, and
(1) The amount of CH4 that is recovered and either flared or used for energy purposes, and
(2) The amount of CH4 that leaks out of the landfill cover, some of which is oxidized.

Landfills primarily use the “area fill” method which consists of waste placement on a liner, spreading the waste mass in layers, and compaction with heavy equipment. Daily cover is then applied to the waste mass to prevent odors, blowing litter, scavenging, and vectors (carriers capable of transmitting pathogens from one organism to another). Landfill liners may be comprised of compacted clay or synthetic materials to prevent off-site gas migration and to create an impermeable barrier for leachate. A final cover or cap is placed on top of the landfill, after an area or cell is completed, to prevent erosion, infiltration of precipitation, and for odor and gas control.

Sanitary landfill facilities are generally located in areas where the potential for degradation of the quality of air, land, and water is minimal. Similarly, a sanitary landfill should be located away from an airport to avoid air accidents between birds and aeroplanes. The location should preferably be outside 100-year flood plain and should not be located in the close proximity of wild life sanctuaries, monuments and other important places which is ecologically important. Location of sanitary land fill should also consider seismic (earthquakes & volcanic eruptions) sensitivity of the area to avoid environmental damage during earthquake. Table 5.1 shows important factors to be considered while evaluating a landfill site.

Table 5.1 Important factors to be considered while evaluating a landfill site

Sl. No.	Factor	Remark
1	Access to land	Existing road/railway/water way should be considered
2	Climate	Rainfall, temperature, humidity, wind speed, snow fall etc., need to be considered
3	Disaster history of the location	Earth quake, cyclone, draught, flood, tsunami, hurricane, terrorism, war, sabotage, industrial accidents etc. shall be evaluated
4	Extent of land available	Should be capable of accepting waste to an extent so that an investment is feasible
5	Final use of land	Long term use of land needs to be evaluated
6	Geology and hydrogeology	Groundwater quality and quantity as well as permeability of the geological strata need to be studied
7	Haul distance	Distance from source/transfer station decides to economy of operation especially when a site receives waste from more than one source
8	Local and national legislation	Regulatory issues decide the ultimate location 9.
9	Local environment	The local environment with respect to biota, monuments, religious setting, physio-chemical environment like noise, air

		quality, water quality, land use pattern shall be considered
10	Public acceptability	Local public shall accept the idea and project for success of the project
11	Soil characteristics	Soil characteristics and availability of cover material need to be evaluated
12	Surface water hydrology	Drainage pattern, distance from major water bodies, water shed Contours and slope need to be studied boundaries shall be considered
13	Topography	Contours and slope need to be studied

In comparisons to other possibilities, landfill should be the last option to manage waste. For example, Denmark which generates about 13 million tons of waste per year has banned land filling waste suitable for incineration. Landfill is the physical facility specifically designed, constructed and operated for the disposal of waste. Even after well-planned waste reduction, recycling and transformation programs, the residual waste from such operations still ends up on a landfill.
It can also be classified into general or hazardous waste disposal site based on the waste disposed. Landfill will undergo the following activities during its life time:

(1) planning,
(2) Site selection,
(3) Site preparation,
(4) Landfill bed construction,
(5) Leachate and gas collection system incorporation,
(6) Land filling,
(7) Monitoring,
(8) Closure of landfill, and
(9) Post closure monitoring.

Landfill process during operation involves:

(1) Waste dumping at the working face,
(2) Waste spreading, shredding and compaction, and
(3) Waste covering.

At solid waste disposal sites (SWDS) the degradable organic carbon in waste is decomposed by bacteria under anaerobic [Anaerobic digesters **manage organic wastes,** produce gas and digested materials, minimize odors, reduce pathogens, and reduce solid wastes. Anaerobic digesters are also called “anaerobic digestion systems”, “biodigesters” or simply “digesters”] conditions into methane (CH_4) and other compounds. The CH_4 emissions from SWDS are important contributors of global anthropogenic CH_4 emissions.