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Section-B
Unit-IV (Digestion & Disposal)

Sludge digestion or Anaerobic Digestion

Sludge digestion is a biochemical phenomenon involving organisms, enzymes, food and environment. The principal objective of sludge digestion is to subject the organic matter present in the settled sludge of the primary and final sedimentation tanks to anaerobic or aerobic decomposition.

- Anaerobic or sludge digestion consists of two distinct stages which occurs simultaneously in digesting sludge.

⇒ The first stage, known as acid fermentation, consists of hydrolysis and liquefaction of high molecular-weight organic compounds and conversion of to organic acids by acid forming bacteria. Eg:- Acitic acid, butyric acid

⇒ The second stage, known as methane fermentation, is gassification of the organic acids to methane and carbon dioxide by acid splitting methane-forming bacteria. The sequence of reactions brings about a reduction of volatile solids present in the

sludge thereby permitting easy dewatering on a sand bed or a vacuum filter.

Due to low microbial growth rate, the production of biological sludge in the anaerobe processes is very low.

Types :-

(1) Conventional or low rate digestor
(2) High rate digestor

1) Conventional or low rate digestor :→
It is carried out in a single stage where digestion, sludge ~~digestion~~ thickening and supernatant formation takes place simultaneously in the same unit.
It may single stage or in two stages.
In two stage process two tanks are provided - first tank meant for digestion and the second is used for storage, thickening.

2) The high rate digestion process differs from the conventional single-stage process in that the solids loading rate is much greater, the sludge is intimately mixed and it is heated to achieve

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Design of digester elements :->

(i) Number of units :-
Conventional digesters are designed as a single unit for plants treating upto 4 mld. For larger plants, units are provided in multiples of two, the individual capacity not exceeding 3 mld.
High rate digesters are designed comprising primary and secondary digestion tanks, each unit generally capable of handling sludge from treatment plants upto 20 mld.

(ii) Tank Shape & Size :-
Circular tanks are most common for sludge digestion and they should preferably be not less than 6 mm nor more than 55 m in dia.

(iii) Water Depth & F.B :->
Side water depth may be kept b/w 4.5 to 6 m, but should not exceed 9 m even for very large tanks. For fixed dome or conical roofs, F.B. should be not less than 0.4 m while for floating covers, not less than 0.6 m. For slab roof, 0.8 m is recommended.

(iv) Roofing :->
Sludge digester may either have floating roof or fixed roof. Gas domes are provided in the roof at or near the centre of circular tanks.

(v) Mixing of digester contents :->
Conventional digesters are mechanically stirred with revolving arms dipping a little below the scum level.

7] Final disposal of Sludge :->
Sludge can be finally disposed off by the following methods :-
1) Spreading on farm land
2) Dumping
3) Land filling
4) Sludge lagooning
5) Disposing in water or sea

1) Spreading on farm land :->
Dewatered sludge may be disposed of by spreading over farm land and ploughing under after it was dried. Wet dewatered sludge can be incorporated into soil directly by injection. After a sludge cake is formed due to evaporation of water, it is covered with dry earth. After about a month, the whole land is ploughed and used for cultivation.

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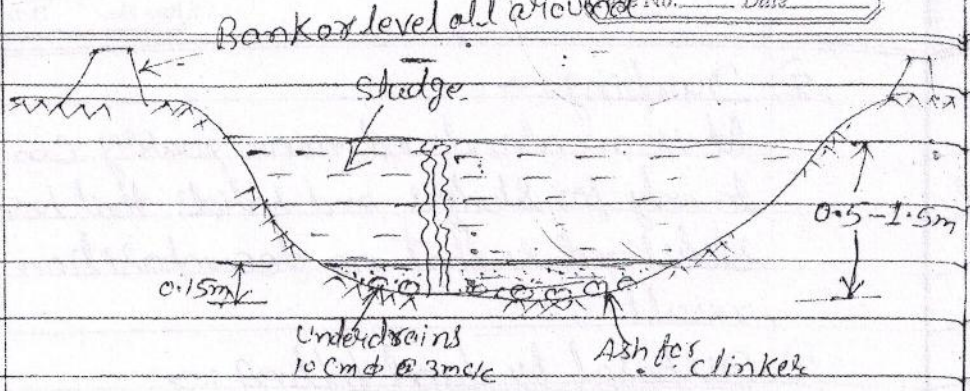
2) Dumping:→
It is an abandoned mine quarry can be resorted to only for sludges and solids that have been stabilized so that no decomposition ~~or~~ will result.

3) Disposal by land filling:→
If a suitable site is convenient, a sanitary landfill can be used for disposal of sludge, grease, grit and other solids, whether stabilised or not. However, dewatering is recommended before such disposal, so that the cost of hauling the sludge is reduced. The sanitary land fill methods ~~or~~ is most suitable if it is also used for disposal of the other solids wastes of the community.

4) Sludge Lagooning:→
A lagoon is a shallow earth basin into which untreated or digested sludge is deposited. Untreated-sludge lagoons stabilize the organic solids by anerobic and aerobic decomposition, which may give rise to objectionable odours. Hence, the lagoons should be located away from the town. The depth of the lagoon may vary from 0.5 to 1.5 m. The detention time vary from 1 to 2 months.



5) Disposal in water or Sea:→

This is not common method of disposal because it is contingent on the availability of a large body of water adequate to permit dilutions. At some sea cost sites, the sludge either raw or digested may be barged to sea far enough to make available the required dilution and dispersion. The method requires careful consideration of all factors for proper design and sitting of outfall to prevent any coastal pollution or interference with navigation.

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