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Design and estimation of bio-toilets

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ABSTRACT

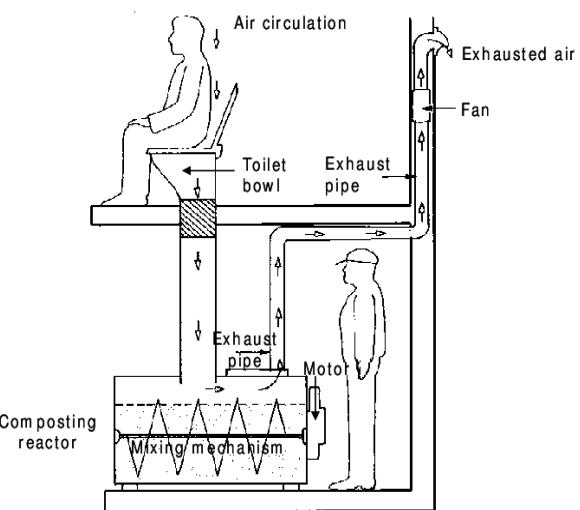
Bio-toilet is type of dry toilet where human waste materials are decomposed by aerobic bacteria. In India, generally, most of population constructs simplified version of toilets, in which waste collected and directly transferred to men holes, without any treatment. This causes contamination in both soil and environment. It is the eco friendly waste management solution. It is affected by temperature, moisture content, amount of water and oxygen availability.

Keywords— Bio-toilet, dry toilet, decomposed, aerobic bacteria, eco friendly, contamination

1. INTRODUCTION

Bio-toilet is type of dry toilet. The bio-toilet is thermophilic compacting toilets which decompose anthropoid excretory waste in the digester tank using certain soaring graded bacteria (aerobic and anaerobic) and after that converting them into methane gas and water. There graded are used in the environment and the water can be recycled and used in toilet again. Bio-toilet is based on aerobic biodegradation of organic waste by particular microbial consortium and work at a wide temperature range. In the bio-toilet urine and faces is mixed with the sawdust in a reactor chamber then the aerobic bacteria decomposed all the human waste and formed cabondioxide and carbon monoxide. The product like nitrogen (N), potassium (K) and phosphorous (P) remained in sawdust and the water is evaporated by chemical heating. after 6 months of the use of bio-toilet the residual sawdust was harvested and used as a soil conditioner. Bio-toilet is differing from traditional toilet because bio-toilet is Environment friendly green toilet it needs only half a litre of water for flush while traditional toilet needs 10 to 15 litter of water. Bio toilet is the portable toilet that has biologically waste water treatment. Bio-toilet design in such as way that they fulfil the criteria such as: economy, safety,

functionality and social and environmental affordability. It is very necessary that the bio-toilet must be constructed with the aim of quickly decomposition of human Excreta, optimizing efficiency, and minimizing environmental problems such as odour and maintains the hygienic condition.



The bio-toilet consists mainly following part a toilet bowl, ventilation, composting reactor and mixing systems. The composting reactor is filled with sawdust and a button activates the mixer after using the toilet. The human excretory products are incorporated quietly and odourless into the sawdust matrix where the aerobic biodegradation occurs. Bio-toilet work with the evaporation of the water contained in human waste material, theory and concepts of drying of solids are found. Indian government restricted the manual scavenging since 2013. With respect to this order Indian railway has decided to start bio toilet in trains. Till now only 15% of people in the

world have flush toilet. In India only 3% toilet present rural and 25% present in urban area. We must enhance this number to improve condition of environment. The first scrap with bio-toilet developed with Defence research and development organization is running in Bundelkhand Express since 18th January 2011. Use of bio-toilet should help the cause of achieving the goal of environment safety.

2. ESTIMATION OF PROJECT AND FACTORS CONSIDERED

Bio-toilets estimation should be précis depends upon population and number of users, because solid waste generally obtained on daily basis. How much waste would be generated or quantity of waste should be known, so that no further obstructions should be generate in functioning of bio-toilets.

It depends on area or locality, where it has to be constructed and availability of water.

Some factors, such as budget, locality, availability of labour and cost, majorly affect estimation. Duration of serviceability, means for how many years it can function, is also considered during estimation and costing.

3. DESIGN CONSIDERATIONS

In recent time configuration of bio-toilets, size of degradable reactor of bio-toilets is determined such as:

- (a) Loading rate of water, such as eviction of urine, water presented in waste during flush and cleaning of toilet bowl, must be taken under consideration as we know; higher water content leads speedy degradation.
- (b) Rate of drying, involves evaporating rate of water presented in urine, waste or cleaning water, taken under consideration, because less amount of water prevents degradation of waste.
- (c) Geo-climatic condition such as, ph, temperature, moisture content, oxygen availability, these are several environmental key factors, which either directly or indirectly affects degradation rate of bio-degradable matter.

For optimum performance bio-degradable, moisture content should be maintained approx between 60 to 65%.

Pathogenic bacteria's, causing pungent smell, controlled by thermophilic conditions, leads to decomposition and improves drying process in composting reactor.

The toilet paper with waste should be considered as a bulk material, because they are cellulosic and usually degraded by fungi and micro-organisms (not dominant in reactor). Mixing of waste in chamber should be done properly.

4. METHODS

Basically, two methods are used to determine evaporation and receiving amount of bio-degradable material coming in continuous manner, on daily basis. Under specific condition, it become crucial to detect time required to dry the matter provided, we try to estimate the influence in different drying conditions, because of limited knowledge of drying process.

4.1 Dry experimental device

Relative humidity of flow and temperature is fixed at constant, generally ranges between 20 to 80 degree Celsius and 20 to 90% respectively process is generally conducted in rectangular sized stainless steel, provided with several circular vessels full of degradable matter.

Vessel immersed in rectangular chamber to circulate water. Through simple mechanism, attachment and detachment of vessel occurs with drying channel by maintaining constant temperature. All vessels are insolent towards heat transfer. By this mechanism, temperature and relative humidity is monitored, before and after, using sensors.

4.2 Drying tests

Usually, air enters in bio-toilets either came from inside of building or directly from atmosphere and exists in toilet room or atmosphere. As per recommendation, temperature and relative humidity should be 23 to 25 degree Celsius and 50 to 65%, respectively. They both are monitored at every 20 minutes and tests are conducted until no more changes are observed.

5. OBJECTIVE OF PROJECT

In India, generally, most of population constructs simplified version of toilets, in which waste collected and directly transferred to men holes, without any treatment.

This causes contamination in both soil and environment. Main objective of construction and designing of bio-toilets is to degrade organic solid matter efficiently, without contamination. It also includes promotion and enhancement of bio-toilets to achieve better future demand.

6. CONCLUSION

Bio-toilet is the most eco friendly sewerage system decomposes human waste material with the help of the microorganism. Bio-toilet systems using sawdust as a matrix was conducted attending the bio-degradability of organic matter contained in faces.

The consumption of water reduced by bio-toilet as compare to conventional toilet.

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