



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 5, May 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118



9940 572 462



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Comparative Cost Analysis of Septic Tank and Bio-Digester for Individual House and Public Toilet

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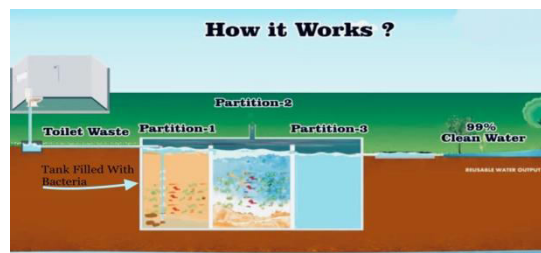
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ABSTRACT: Anaerobic Digestion is a most convincing alternative for the disposal of waste, due to high energy recovery. The main purpose of the research is to design, analysis and compare the cost of bio-digester tank and septic tank for Individual house and public toilet. Justify that, anaerobic digestion is the degradation and destruction of organic substances, with consequent reduction of the odorous emissions and pathogens. It mainly involves a large number of bacteria that operate in synergy, catalyzing different chemical reactions, hence the metabolic pathways that are involved in the anaerobic degradation are quite complex. Bio-digester is a technique in which biological degradation of human waste by inoculums digests the human waste converting it into water and gases in the process. Human waste disposal in high altitude and low temperature areas, moving railway coaches, buses, big cities, mines, remote areas, beaches, rural areas, long distance buses is a huge problem.

KEYWORDS: Bio-Digester, Septic Tank, Anaerobic digestion, Cost Analysis.

I. INTRODUCTION

Human waste disposal is a major growing problem leading to an aesthetic inconvenience. Population in the cities although have better access to the toilets, but later they arise the problems in maintaining the septic tanks. Untreated waste is responsible for several diseases like Diarrhea, Amoebiasis, Viral Hepatitis, Typhoid etc. taking the lives of huge number of people especially children's annually and leading ground water pollution and disturbance in air quality. A Bio-Digester is a mechanized Septic Tank that uses decomposition and sedimentation as its main mode of operation. This is a process where the human waste decomposes in a digestive tank using certain high graded bacteria. Bio-Digester work with a digestive process called an anaerobic digestion. The lack of air, as well as pre-residing bacteria, will begin to eat away the waste which is referred as Anaerobic Digestion. The design and build of a bio-digester toilet is a humanitarian project aimed at providing improved sanitation facilities, and reducing air pollution for the billions of people affected by this issue. For this project, a toilet is integrated with a Bio-digester-A Device that stores and digests organic material. Designing a Bio-digester to accommodate a toilet enables it to become an integrated waste management system, and provides a means of safe human waste disposal and on the other hand normal Septic tank differs in all the specifications.



II. LITERATURE REVIEW

This Study makes us understand that Anaerobic digestion is one of the best ways to properly handle and manage the waste. Anaerobic digestion is observed a strong option in safely reusing wastes which contributes to pollution control as it is present with the benefits that reduce biological oxygen demand and chemical oxygen demand of wastes. It destroys pathogenic microbes reducing the microbial load to a level which could be safely handled by humans with limited health risks and it destroys volatile fatty acids and reduces the emission of greenhouse gases. It also generates the biogas and high quality nutrient-rich fertilizer from animal manure thus upholds the concept of waste to wealth in order to the proper development.¹

The growth in the population has led to an increase in the amount of MSW (Municipal Solid Waste) generation. Since the developing countries or low-income countries do not have a sufficient government budget, non-sanitary and uncontrolled landfill is normally used as the MSW disposal method, which leads to negative effects on the environment and human health. One of the methods of MSW management is to reduce the amount of MSW by MSW separation. But the regulations for MSW separation in developing countries are not as strict as those in the developed countries. For the local community with less than 5 tons per day MSW, the MSW to be disposed accounts for approximately 2.5 tons per day after effective MSW.²

The research showed that, to solve location/allocation problems, the most used techniques are GIS-Multi criteria and GIS, and the most used aspects for solving this localization problem are the combination of economic, environmental and social aspects. Survey took place in various areas which is feasible for its economical-social aspects. This study is not without limitations hence the authors would like to highlight that this research is based on the Scopus Science Direct databases. Also in this paper It is said that future studies include new databases in order to make the report wide the research horizon. In conclusion in view of the results presented and this research can be used as a guide for future research aimed at developing models for the location of bio-digesters. The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.³

The Author concludes that Bio digester is considered as alternate source towards the generation of renewable energy Bio digester plays a main role in waste management in rural as well as urban regions. Hence this bio digester is helpful in ways that are organic waste, slurry management and generation of clean, economic form of renewable energy. The development is digester design is modernized with specific and legitimate calculations. It can also even more modernized by the government subsidy on development on biogas energy and creating awareness among the people to sustain energy for future generations too.⁴

Author has been found that an inexpensive medium for the cultivation of anaerobic bacteria which is simple and easy to prepare also supports the growth of every culture tested so far and which is more efficient in growth initiation from dilute inoculate than other media now generally used for anaerobic culture and which has some different value in the groups of anaerobes. It is used with good results for dilution counts of both vegetative and use of anaerobes and natural mixtures such as soil lake mud and silage. The species names used in this paper are those now prevalent in the American literature. The possible identity of cultures of this group bearing different names is not here considered.⁵

Here the experimental verification and result analysis is made to prove the improvement of its characteristics. The use of Bio reactor septic tank will decrease the demand of water. The water from filter media can be used for domestic purpose. The sewage water is treated and re-used by people. This type of septic tank can be constructed in an individual house in order to fulfill their requirements. Since the construction of this Bio-reactor septic tank is ease and economic which can be implemented and used in developing countries. The project will reduce the pollution of sewage and fulfils the needs of future generation.⁶

From this study, it was possible to conclude that: Projects must be integrated and multidisciplinary in order to develop bio-digester profiles that can meet the specific needs of the urban environment where they will be installed Considering local limitations and constraints it is important to invest in social technologies (low-cost products, techniques, and equipment that can be replicated anywhere in the country). In order for the project to be feasible, it will require the co-participation of the community and government, proper areas for installation. Future studies will be necessary to evaluate how many residences can benefit from a large-scale bio-digester and whether it will be economically viable.⁷

III. OBJECTIVE

- Comparative analysis of Bio-digester Tank and septic tank for an individual house and public toilet.
- Cost analysis for the same.
- Comparative cost analysis of Bio-digester with respect to Septic tank.

IV. METHODOLOGY

To achieve the research objective and answer the research question, the following process is carried out to show the methodological structure of the research.

- **Data Collection:**

The process of finding the required data for the design of Septic Tank and Bio-digester is carried out, at first the proposed assumed location for the project is assumed in two different types, i.e. for public toilet and for individual house.

For public toilet the assumption will be, the tank design for the toilet of 1321 people and for the individual house the tank design for toilet of 5 people.

- **Design of Septic Tank:**

The design of the septic tank is done in mathematical form for an individual house and a public toilet with respective requirements and dimensions according to the location.

Technical Design parameters are as follows:

- The desired size of the tank.
- Cleaning period of the tank.
- Number of users.
- Daily rate of water supply.
- Space required for retention of sewage flow.
- Rate of deposition of sludge.
- Volume of sludge per capita in 1 year.
- Area of septic tank.
- Design of soak pit.
- Diameter of soak pit

- **Volume of Bio-digester:**

The volume of Bio-digester tank for individual house and public toilet is calculated according to the standard norms given by Defence Research And Development Organisation (DRDO) for Bio-digester tank.

Technical Design parameters will be as follows:

- Number of users
- The desired size of the Tank..
- Space required.
- Daily rate of water supply.
- Recharging Anaerobic bacteria
- Rate of deposition of sludge.
- Area of Bio-digester tank.



The estimated cost of the septic tank is carried out using State Schedule of rate 2021-22 (S.S.R. 2021-22).

- **Cost Analysis:**

Calculation of individual cost required for the construction of both Septic tank and Bio-digester respectively and carrying out the comparative cost analysis for the same i.e. individual house and public toilet.

V. RESULTS

Cost of septic tank for individual house = ₹62,080.00

Cost of septic tank for public = ₹195.48 Per Person.

Cost of bio-digester tank for individual house = ₹ 25,000.00

Cost of bio-digester for public use = ₹ 1500.00 per person .

VI. CONCLUSION

After comparative analysis of septic tank and bio-digester tank for individual house, we came to a conclusion that, the cost for septic tank is more than that of bio-digester tank, so it is not economically feasible to construct the septic tank for a individual house. Hence, bio digester tank is highly recommended for a individual house. And on the other side after comparative analysis of septic tank and bio digester tank for public use, the cost for septic tank is less than that of bio-digester tank, but on the other hand the maintenance cost of septic tank is higher than that of bio-digester tank neglecting the initial cost of construction of the septic tank, bio-digester tank is more advantageous over septic tank in other ways like lesser space for installation, zero maintainance after recharging it with Anaerobic bacteria, Minimizes water consumption and cheaper in long run.

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Impact Factor: 8.118



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