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ISSN 2319-3077 Online/Electronic ISSN 0970-4973 Print

UGC Approved Journal No. 62923 MCI Validated Journal Index Copernicus International Value IC Value of Journal 82.43 Poland, Europe (2016) Journal Impact Factor: 4.275 Global Impact factor of Journal: 0.876 Scientific Journals Impact Factor: 3.285 InfoBase Impact Factor: 3.66

J. Biol. Chem. Research Volume 36 (1) 2019 Pages No. 342-344

Journal of Biological and Chemical Research

An International Peer Reviewed / Referred Journal of Life Sciences and Chemistry

Indexed, Abstracted and Cited in various International and National Scientific Databases

Published by Society for Advancement of Sciences®

J. Biol. Chem. Research. Vol. 36, No. 1, 342–344, 2019 (An International Peer Reviewed / Refereed Journal of Life Sciences and Chemistry) Ms 36/01/1945/2019 All rights reserved <u>ISSN 2319-3077 (Online/Electronic)</u> ISSN 0970-4973 (Print)





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Received: 15/05/2019

Revised: 11/06/2019

REVIEW ARTICLE Accepted: 11/06/2019

Bio-Toilet to Bio-Gas to Bio-CNG way to Sanitization Jitendra Pal Singh

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ABSTRACT

Bio-toilet is a mechanized digester to decompose human excretory waste in fermenting tank using specific high graded (aerobic/ anaerobic) bacteria. Even after invention of toilets from last 100 years, at present only 15% people in the world have such toilets. Only 13% people in India uses flush toilets. Indian railway till today assembled bio-toilets in it's 55,000 coaches under the clean Rail- clean India program of Govt. of India. The union Govt. has restricted the practice of manual scavenging since 2013, so emphasis required to be given to construct and use bio-toilets throughout the continent. Bacterial Involvement in fermentation process is an exothermic reaction, therefore these toilets can operate even at $(-)5^{\circ}C$ and at $60^{\circ}C$ temperature in deserts. The bio-gas (CH₄ & CO₂) Thus produced can be stored and attempt is underway to liquefy and filled in gas cylinders as Bio-CNG.

The demand for water in flush toilets ranges from 5-10 liters in one go, can be reduced by using such biological toilets. The water contents of substrate purified by the chlorination and can be used for irrigation. Bio-toilets originated as a solution to the problem of disposal of human waste for heavy deployment of armed force personals at high altitude and glaciers. Anaerobic digestion is a series of biological processes in which micro-organisms breakdown biodegrable material in the absence of O_2 Anaerobes can even degrade detergents and phenyl type liquids with minimum sludge generation.

Keywords: Human waste, aeration, inoculation, biological, inoculums, geo-climate, bio-gas, digester and ground water effluent.

INTRODUCTION

The bio digesters can be provided with household toilets where sewerage network does not exist within 30 mtrs. Bio-digester is a technology where human excreta are treated to make water reusable with production of CH_4 , CO_2 without production of much sludge. In traditional toilets, human excreta were released on rail tracks causing dirt in the environment. These vacuum based bio-toilets need just half litter water in one flush and provided respite to those who manually clean the shit at platforms. Anaerobic bacteria doubled in number just in 6-8 hrs and decompose the matter into liquid and gases (CH_4 and CO_2). Bacteria can be kept for 2-3 months at ambient temperature in bio-digester tank.

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According to DRDO information Lakshadweep 1600, Aizawal 850, leh city 750 have installed biotoilets, which falls under on site sanitation system and non-conventional in nature, where as conventional pattern has centralized sewer system. Septic tank need cleaning once in 2-3 yrs and if this process is not mechanized it will violate the manual scavenging Act. In conventional toilets the areas with high water table, effluent may pollute the ground water through soak pits. The tank has 2 or more chambers of treatment and an outlet for usable CH_4 gas.



EXPERIMENTAL PRACTICES AND RESULTS

CDTS operates on electrical and pneumatic pressure. The retention tank having effluent has two opening activated by double acting pneumatic cylinders and air pressure maintained by air brake system, upper opening operates every time when flush button is pushed, where as lower opening by predetermined speed of train under pressurized water to flush the waste , to drain out the effluent. The miniature Bio-toilets assembly depend upon the no. of users and qeoclimatic condition the six sets of Bio-toilets are designed according to the temp specially for -5° C, 10° C, 25° C, 35° C, 45° C having sub facial chambers numbering 05, 04, 03, 02 and 1 for each set. The inner lining painted with white, green, yellow, blue and in red colors. The P^H is maintained by applying buffering agent. Hydraulic retention time varied from 7, 14, 21, 28, 35, 42 days respectively.

The analysis of amount of bio-gas produced in each set of bio-toilet indicate that the effluent container with blue inner lining with 35° C temperature yield 75% bio-gas and lowest amount of CH₄ produced in first set of bio-toilet but fermentation process to take place at low rate because of exothermic nature of bacterial activities. Anaerobic microbial consortium developed by acclimatization, enrichment of microbes at low temperature (-5°C) and bio augmentation with specific group of Bactria. Bio-gas yield also depended upon the places of bio-toilets like gardens, play grounds, chowks, markets and transit nodes and highways locations

S. No.	Capacity in (Lit.)	Approx Price (INR)	No of Users	Location
1	15000	370,000	25-30	Rural Area
2	10,000	375000	15-20	Rural Area
3	8000	225000	10-15	Rural Area
4	5000	120000	8-10	Play ground
5	4000	75000	5-18	Urban
6	2000	40000	07	Urban
7	1000	20000	05	Urban
8	700	18000	04	Urban

Table 1. Specification of bio-toilets.



Material Size	PVC pipes with isi marking 1M X 1Mx0.7m	One Bio-toilet
Inlet pipe size shape	(6mm thick) 666 lit volume 110 mm	
No. of water flush	Rectangular 30 per day (8 lit cistern)	

FUTURE SCOPE

Attempt for thickly populated countries like India, China, for promoting bio-toilets to produce Biogas and it's liquefaction on large scale may solve energy problem as an alternate energy resource and bio-toilets may create new energy capsules in the form of bio-CNG.

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