No W.11044/1/2012-CRSP (Vol. II)
Government of India
Ministry of Drinking Water and Sanitation
NBA Division

12th Floor, Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi – 110003
Date: 12.8.2014

To,
The Principal Secretary / Secretary,
In charge Rural Sanitation, All States/UTs
Subject: Regarding implementation of DRDO Bio-digester toilets

Sir/Madam,

I am directed to intimate that an MOU (Memorandum of Understanding) between Ministry of Drinking Water and Sanitation (MODW&S) and Defence Research & Development Organization (DRDO) for "Implementation of Bio-digesters/Bio-tank Toilets" was signed on 26.7.2012, for promoting the use of this technology in providing sanitation services in rural areas. Following decisions taken in this regarded are brought to the notice of all States/UTs:

i. States may be given the option for adopting the DRDO model of a complete toilet unit including the bio-digester tank and the super-structure, or only the bio-digester tank with a brick-mortar super-structure.

ii. Nirmal Bharat Abhiyan (NBA) guidelines shall form the basis for the projects including the financial incentive that would be the same for the bio-digester toilets as provided for in the NBA guidelines. Additional cost over and above that fixed under NBA guidelines plus that allowed under MNREGS would be met by the State Governments.

The following are enclosed:

(a) Note on Bio-digester Technology
(b) Note on comparison between Bio-digester and conventional septic tank
(c) List of TOT holders

Yours faithfully,

Encl; As above

(Christina Kujur)
Under Secretary (NBA)

Copy to :

i. State Coordinator, NBA, All States/UTs
ii. Shri Lokendra Singh, Director (Technical) DRDO, DRDO Bhavan, New Delhi Phone; 011-23017752
iii. Technical Director, NIC, MODW&S for placing in Ministry's web-site

BIODIGESTER (GREEN TOILET) TECHNOLOGY FOR ECO-FRIENDLY DISPOSAL OF HUMAN WASTE UNDER DIFFERENT SITUATIONS

The major proportion of ill health in India can be attributed to lack of safe drinking water, poor sanitation and hygiene practices. Water pollution, the root cause of most of the water borne diseases, is caused by human waste. A number of diseases with high morbidity and mortality are wide spread in the communities specially living in unsuitable environmental conditions in urban slums and vast rural areas. The major diseases are diarrhoea, cholera, shigellosis, *E coli* diarrhoea, poliomyelitis, typhoid, viral hepatitis and dysentery. Of these, diarrhoeal diseases alone cause more than 6,00,000 deaths annually. Diseases caused by faeco-orally transmitted enteric pathogens account for 10% of total burden of disease in India. Statistics indicate that intestinal group of diseases claims about 5 million lives and about 50 million people suffer from these diseases every year. The situation is not different in most of the other developing countries.

The situation with respect to availability of toilets and waste treatment is very serious in the country. None of the cities,including metros, have complete sewage treatment system and waste is directly being discharged into the rivers. Most of the houses, which have toilets, discharge the liquid waste into open drains or into soak pits which contaminate the surface or underground drinking water sources. In the absence of central sewage system, septic tanks provide the partial solution to the problem but the application of technology on wider scale is restricted due to assorted reasons like unaffordable cost by poor people, space requirement and periodic evacuation. Current census data (2011) of the country revealed the shocking figures on sanitation in spite of developments in the areas of economy, education, communication, power, connectivity, housing and living standard. Only 46.9 % of the total 246.6 million households have toilet facilities. Of the rest, 3.2% use public toilets and 49.8% ease themselves in the open. Although, the role of culture and traditions cannot be denied for this grim situation, lack of education, awareness, money constraints and poor planning are the major contributing factors.

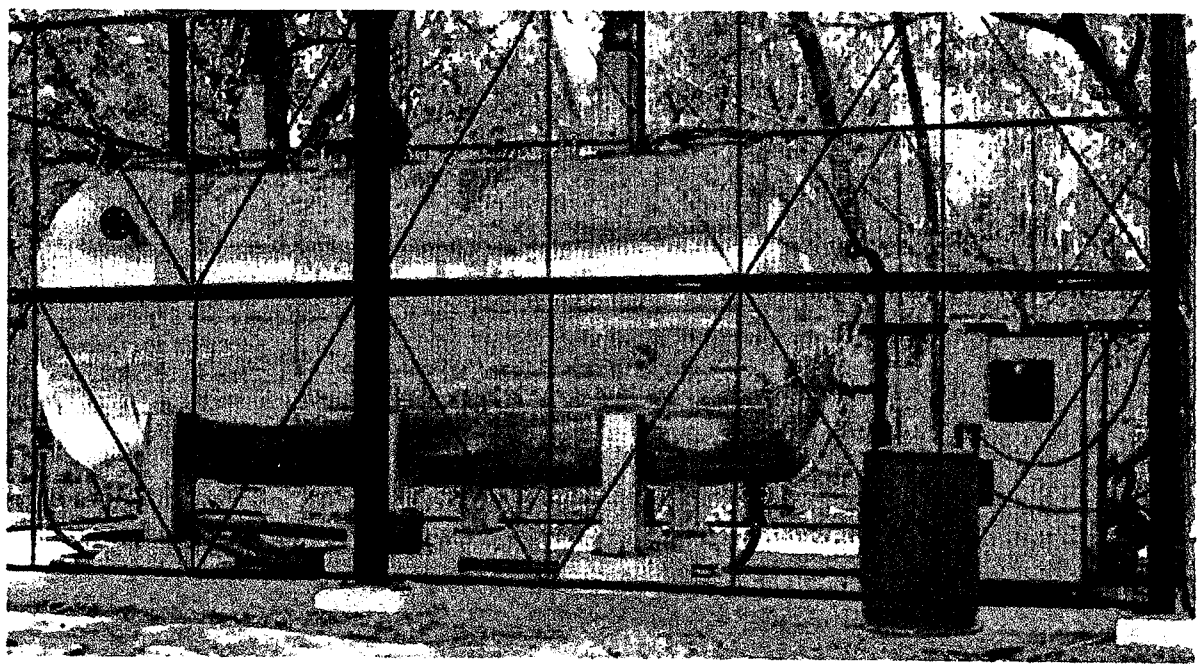
Why and how DRDO developed human waste disposal technologies

First and prime goal/ responsibility of DRDO is to develop the technologies for meeting the requirement of Armed Forces. However spin- off benefits are transferred to civil sector also. During 1984, when Indian Army positioned itself at Siachen Glacier, the problem of human waste disposal became a serious issue due to prevailing subzero ambient temperature (-30 to -50^{0}c). Such a low temperature does not allow natural microbial decompositon of waste which continues accumulating throughout the ice layers and risks the soldier's health as ice being the single drinking water source for him beside aesthetic nuisance. Various options were experimented by Indian Army based on suggestions by institutions/ agencies like chemical

treatment and incineration but being practically unsuccessful, the task of biodegradation was assigned to DRDE Gwalior. In the absence of any prevalent (national /international) technology DRDO developed BIODIGESTER TECHNOLOGY for application in low temperature high altitude areas that was subsequently modified and expanded to plains and mobile systems.

Anaerobic microbial consortium

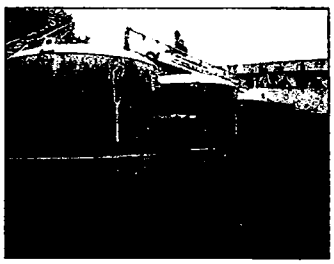
Anaerobic microbial consortium has been developed by acclimatization of slurry of biogas plants operating at low temperature areas and further modified by incorporating the bacteria isolated from Antarctica, Siachen and other emote high altitude locations. The microbial consortium (inoculums) works in a wide temperature range (5-50 ⍰C), resist temperature fluctuation, freezing-thawing and also tolerate the limited quantity of antiseptics. The mother culture is being maintained at DRDE Gwalior by operating two reactors, one of size 14 m^3 and another of 75 m^3.

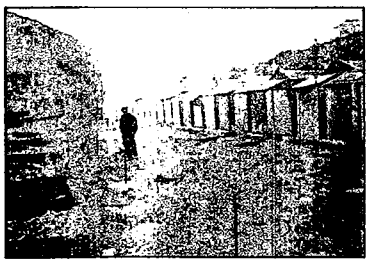


Biodigesters for soil bound high altitude regions

Metal/FRP digesters have been made for snow bound areas like Leh, kargil and Drasswhich bear the temperature in the range of 0 to -50 ⍰C. These areas are not permanently covered by ice and experience snow during the winter only. These biodigesters are of cylindrical shape, incorporate immobilization matrix and does not require any heating device. The biodigesters are installed underground and charges only initially with the bacterial consortium. The main

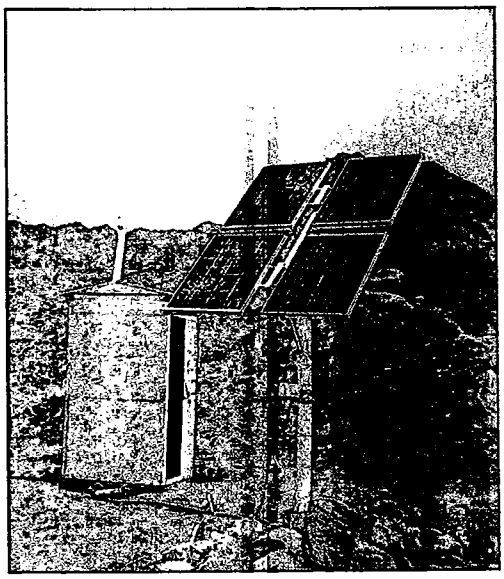
tank is connected to existing toilets. The one m^3 digesters can treat the waste of 20-25 personnel whereas, 2 m^3 size biodigester is suitable for use of 50-60 personnel. Alternative models with pre-fabricated shelters containing toilets (4 Nos.) on the top of main tank overcome the problems of freezing of inlet pipe during the winter. A large number of biodigesters have been installed in Leh, Kargil, Drass, Sikkim, Arunachal Pradesh, etc.





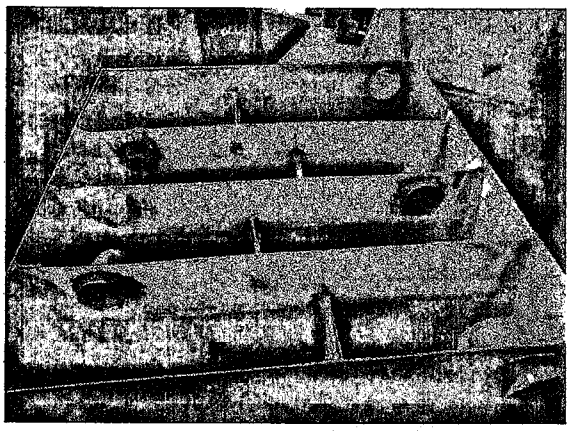
Biodigesters for Glaciers

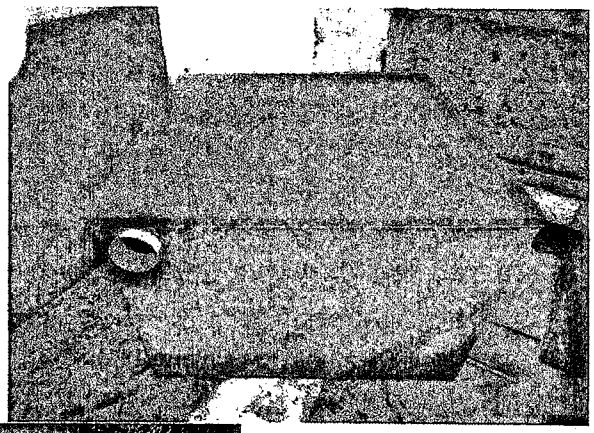
These areas have thick layer of ice throughout the years and the temperature varies from -30 to -50 ⍰C. The biodigesters have been made of stainless steel (SS) and insulated with thick layer of PUF to retain the desired heat. The heating is provided by using 4 nos of solar panels (75 W each), oil immersed heaters and a thermostat. These systems have inbuilt toilet seat (one no) and the shelter. The technology has been proven in North and Southern Glacier as well as in other parts of Jammu and Kashmir.



Biodigesters for plain areas

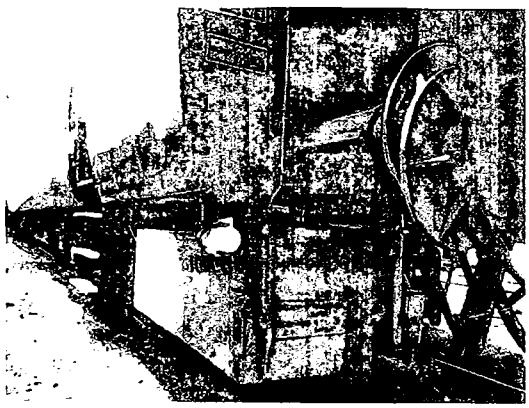
Metal and FRP based digesters have been made of assorted sizes (0.5-2.0m^3) and are of rectangular and cylindrical shapes. The design involves longer path by providing partitions, immobilization matrix and chemical treatment, if required. Such systems have been installed at Lakshadweep, Gwalior, Gurgaon, Delhi, Sagar and other places.

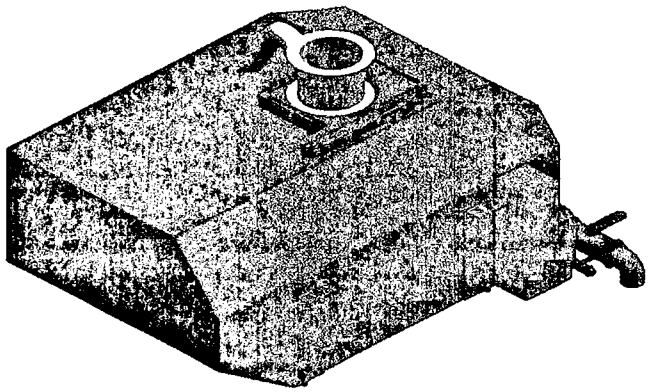




Biodigesters for Indian Railways

At the request of RDSO, Lucknow the task was undertaken during 2006 as a spin-off of high altitude technology using the above mentioned microbial consortium. The technology was modified to cope up the limited space available beneath the coaches. Thus, SS made biodigesters involve more number of compartments, higher volume of immobilization matrix, sludge settling device and chlorine treatment. Consequent upon MOU signed with railway ministry, different versions have been made to take care of public nuisance of throwing bottles and other non-biodegradable materials in the digester. Such biodigesters have been extensively subjected to field trials in different trains and different types of coaches. Finally, Indian railway has installed 100s of biodigesters and has planned for thousands for next financial year.





Bio-Tank System

The present biodigesters involve fabrication of main tank either of mild steel or FRP from industry and its transportation to the place of installation. As an alternative to overcome the cost of industry and transportation and to have longer life, a modified septic tank technology (**Bio-Tank**) has been developed. Bio-Tank construction is done at the site of its use by any local mason. It is *initially charged with anaerobic microbial consortium* (only once) and put up for use like any other septic tank. The Bio tank is also having the special designs for the microbial attachments. Number of benefits of this technology over conventional septic tank system can be enumerated as follows:

- Design wise, it is a simple rectangular tank having 1 to 4 partitions (lengthwise or breadth wise) keeping in mind of the treatments of various uses i.e., human waste &/or bathroom water &/or kitchen water. Construction is also very simple.
- The size of the Bio-Tank is approximately $1/3^{rd}$ of conventional septic tank and hence, material cost and space requirement for building the Biotank will be lower as compared to septic tank.
- Bio-Tank can be customized for use, either for single house or multistoried complexes.
- The technology works at wide range of temperature
- No need to evacuate the tank, which is required for conventional septic tank at periodic intervals.
- Comparatively, very little quantity of H_2S is produced as compared to septic tank.
- Toilet cleaning by routine cleansing agent in nominal quantity is permitted.
- If large number of toilets are connected, sufficient biogas can be generated, which can be used as an alternate energy source.
- Finally, the Bio-Tanks are maintenance free installations.

The alternative system also includes natural reed bed system to perform secondary treatment of the wastewater that is coming out of the biotank. The reed bed system comprises of bed of sand and pebbles along with reed plants capable of natural amelioration of the wastewater that

is coming out of the digester tank by *totally reducing smell, suspended particulates, pathogenic microorganisms (more than 99% of pathogens (disease causing bacteria)) and agents causing sudden nutrient enrichment &/or pollution* to the water bodies (eutrophication). BioTank cum Reed bed system is also used to treat the wastewater of kitchen and bathroom.

Natural reed plants-microbial consortium work efficiently at *wide range of temperature and effluent is very safe to discharge into environment* and may be used for irrigation purposes.

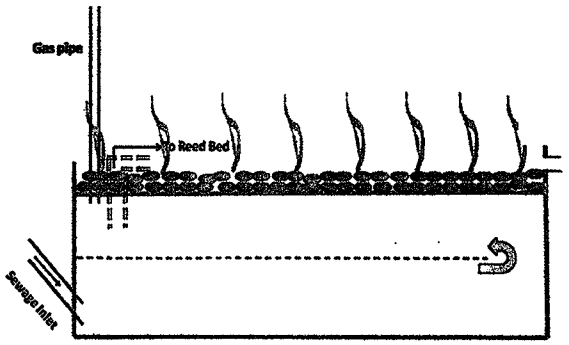
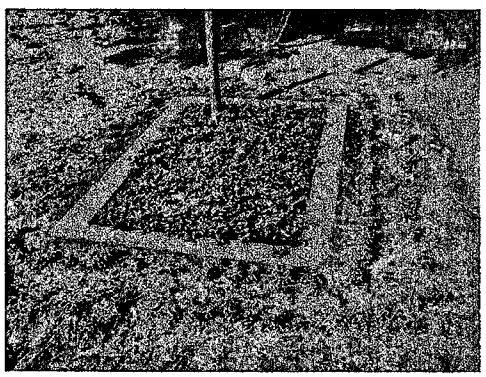


Fig: BioTank cum Reed Bed system: in this fig., biotank is horizontally separated by an incomplete partition wall. The water from the biotank, (after travelling the long path) is released into reed bed. The water from the reed bed may be stored to a tank for further use or may be released directly to the agro fields for irrigation.



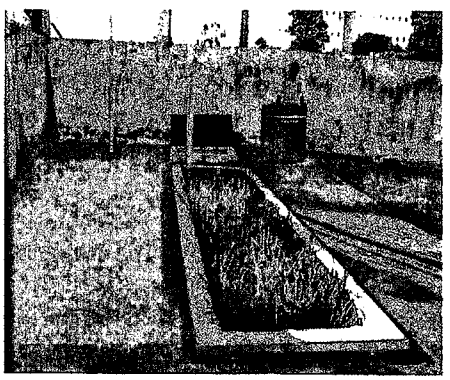


Fig.BioTank cum Reed Bed systems functioning at Defence Research Laboratory, DRDO, Tezpur, Assam