भारतीय मानक

Indian Standard

IS 18150 : 2023

सीवर रहित ऑन साइट स्वच्छता प्रणाली — मानव मल के अपघटन के लिए बायो-डाइजेस्टर की डिज़ाइन, विरचना और संस्थापन — रीति संहिता

Non-Sewered On-Site Sanitation System — Design, Fabrication and Installation of Biodigesters for Human Waste Decomposition — Code of Practice

ICS 93.030

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October 2023 **Price Group 7**

Public Health Engineering Sectional Committee, CED 24

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Public Health Engineering Sectional Committee has been approved by the Civil Engineering Divisional Council.

This standard lays down recommendations for the design, layout, fabrication, installation and maintenance of biodigester for the purpose of human waste (night soil) decomposition in houses, flats, residential housing colonies, hostels, boarding schools, community toilets, etc.

Each biodigester primarily consists of two components: a specially designed treatment system (biodigester tank) and bacterial consortium [anaerobic microbial inoculum (AMI)]. A biodigester unit can be fitted with reed bed, which can further ameliorate the effluent from digester tank and is safe to release into the environment or can be reused at specific areas.

Sewage is retained in biodigester where it undergoes anaerobic digestion mediated by AMI. The digestion results in appreciable reduction in the volume of organic matter and therefore sludge generation, as well as reduction of transmission of pathogens of faecal origin. The effluent of biodigester can easily be introduced into the centrally managed sewer systems, where it can greatly reduce the organic load of sewage treatment plants (STPs) and increase their efficiencies.

Flawed design, fabrication and maintenance of biodigester undermine the potential of this technology and pose a significant health hazard. It is therefore, considered essential to lay down minimum standards with respect to biodigester technology for guidance of the fabricators, users and concerned authorities. This standard has, therefore, been formulated to fulfil this need. It is expected that this standard which has been prepared for providing guidance on proper design, fabrication and maintenance of biodigester, will be followed by local bodies, public works departments and other agencies entrusted with issues related to sanitation.

The provisions contained in this standard are good practices applicable for non-sewer on-site human waste (night soil) treatment system using biodigester technology, in the country. This standard is based on the biodigester technology developed by Defence Research and Development Organisation (DRDO), Ministry of Defence, for effective on-site treatment of sewage.

The composition of the Committee responsible for the formulation of this standard is given in Annex B.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

NON-SEWERED ON-SITE SANITATION SYSTEM — DESIGN, FABRICATION AND INSTALLATION OF BIODIGESTERS FOR HUMAN WASTE DECOMPOSITION — CODE OF PRACTICE

1 SCOPE

This standard covers the design, layout, fabrication, installation, and maintenance of biodigester and reed bed for the purpose of human waste (night soil) decomposition as an on-site (decentralized), non-sewer, sanitation system. It is applicable to houses, flats, residential housing colonies, hostels, community toilets and other such locations that lack sewerage system for treatment of human waste.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply:

3.1 Acetogenesis — The third step of anaerobic digestion, in which products from fermentation (organic acids and alcohols) are converted into hydrogen (H_2), carbondioxide (CO_2) and acetic acid (CH_3COOH).

3.2 Adsorption — The process by which bacteria are attached/adhered/immobilized ona solid surface. The bacteria are attached to the surface but do not enter the solid's minute spaces as in absorption.

3.3 Anaerobic — Means completely oxygen deficient and describes environment where there is no molecular gaseous oxygen (O_2), neither any other form of oxygen available for metabolic activity.

3.4 Anaerobic Digestion — The degradation of organic material by microbial activity in the absence of air (O_2) transforming it into simple organic biomass, effluent water and biogas.

3.5 Anaerobic Microbial Inoculum (AMI) — A consortium of active bacteria that helps in biodegradation of organic matter of biological waste materials (faeces) more efficiently.

3.6 Biodigester — A treatment system that works in anaerobic condition and transforms organic waste through anaerobic digestion process into simpler organic molecule, water and biogas.

3.7 Biogas — The gas generated from anaerobic digestion of organic matters, typically composed of methane (CH_4) (50 percent to 75 percent), carbon dioxide (CO_2) (25 percent to 50 percent) and varying quantities (traces) of nitrogen, hydrogen sulphide (H_2S) and other components.

3.8 Chemical Oxygen Demand (COD) — The oxygen required for a chemical oxidizing agent (for example, potassium dichromate) to break down organic waste in water. COD is generally higher than BOD because more compounds can be chemically oxidized when compared to biological oxidation by bacteria.

3.9 Chlorination — The process generally refers to the addition of chlorine to water or sewage for disinfection and killing of pathogens.

3.10 Coliform Bacteria — The rod-shaped, gram-negative organisms, which ferment lactose and produce acids and aldehydes. The coliforms include *Escherichia*, *Kliebsiella*, *Enterobacter*, *Citrobacter*, *Serratia* and *Edwardsiella*.

3.11 Colony Forming Unit (CFU) — The measure indicating the number of micro-organisms in a sample capable of multiplying and forming a colony on standard cultivation plates (petri-plates).

3.12 Effluent — A resultant liquid that is formed after biodigestion process and flows out of the biodigester tank.

3.13 Fecal Coliforms — A group of bacteria (for example, *Escherichia coli*) present in excreta (faeces). They are common gut bacteria relatively easy to detect in samples indicating faecal contamination.

3.14 Fermentation/Acidogenesis — The second step of anaerobic digestion, in which fermentative bacteria transform sugars and other monomeric organic products from hydrolysis into organic acids, alcohols, carbon dioxide (CO_2), hydrogen (H_2) and ammonia (NH_3).

3.15 Hydraulic Retention Time (HRT) — A measure of the average length of time that a soluble compound remains in a reactor. It is calculated by dividing the volume of a reactor, in m^3, by the influent flow rate, in m^3/day). HRT influences substantially the quality of wastewater treatment process (variations in terms of organic and microbial load) and is an important parameter with respect to the desired degradation rate.

3.16 Hydrolysis — The breaking of a chemical compound by reacting with water, wherein a hydrogen atom (H) is added to one part of the split chain, while the remaining hydroxyl (OH) group of water is added to the other. It is the first step of anaerobic digestion in which complex macro-molecules such as carbohydrates, proteins and fats are broken down to short sugars, fatty acids and amino acids.

3.17 Indicator Organisms — The microorganisms or plants that serve as a measure of the environmental conditions that exist in a given location. Typical indicator organisms in effluents are faecal contamination indicators such as *E. coli* or coliforms.

3.18 Methanogenesis — The final and rate limiting step of anaerobic digestion, performed by methanogens (archaea), which are strictly anaerobic, transform the acetic acid (acetate), carbon dioxide and hydrogen into single carbon molecule (methane).

3.19 Most Probable Number (MPN) — A method to estimate the amount of bacteria in a sample.

3.20Pathogen — The microorganisms (for example, bacteria, viruses, protozoa, fungi and helminths) that can cause disease or illness.

3.21 *p*H — The quantitative measure of the strength of the acidity or alkalinity of a solution. It is defined as the negative common logarithm of the concentration of hydrogen ions [H^+] in moles/l.

$$pH = - \log [H^+]$$

3.22 Total Dissolved Solids — The content of all inorganic and organic substances present in a liquid in molecular, ionized or micro-granular (colloidal) suspended form, expressed in mg/l. Dissolved solids shall be small enough to survive filtration through a sieve of two micrometers.

3.23 Total Solids (TS) — The residue remaining after a wastewater sample has been evaporated and dried at a specific temperature (103 °C to 105 °C). It is generally measured in mg/l. TS is the sum of total dissolved solids (TDS) and total suspended solids (TSS).

3.24 Volatile Fatty Acids — The fatty acids with a carbon chain of six carbons or fewer, formed during fermentation.

3.25 Volatile Solid — The content of all solids lost on ignition at 550 °C.

4 DESIGN CONSIDERATIONS

4.1 Biodigester

Biodigester is a specially designed multi-chambered anaerobic tank for accelerated biodegradation of organic waste. It has a provision of inlet for human waste and outlets for treated effluent and biogas. The multiple number of chambers in tank are provided for increasing the path length of the organic waste, thereby improving contact time, sedimentation and degradation. The dimensions and internal designs may vary according to number of users, water availability and prevailing geo-climatic conditions. Human waste degradation occurs through bacterial activities which converts it primarily into water and biogas. The process results into effluent which is free from undigested particle matter and is environment-friendly. The biodigester tank design should have following essential design specifications (*see* Fig. 1 to 3):

a) Biodigester tank should contain minimum two partition (baffle) walls resulting in three chambers of approximately 4 : 3 : 3 ratio.
b) The volume of chamber containing inlet pipe should be approximately 40 percent of total volume.
c) PVC immobilization matrix should be provided on both sides of partition walls of the chambers, as well as hanging matrix.

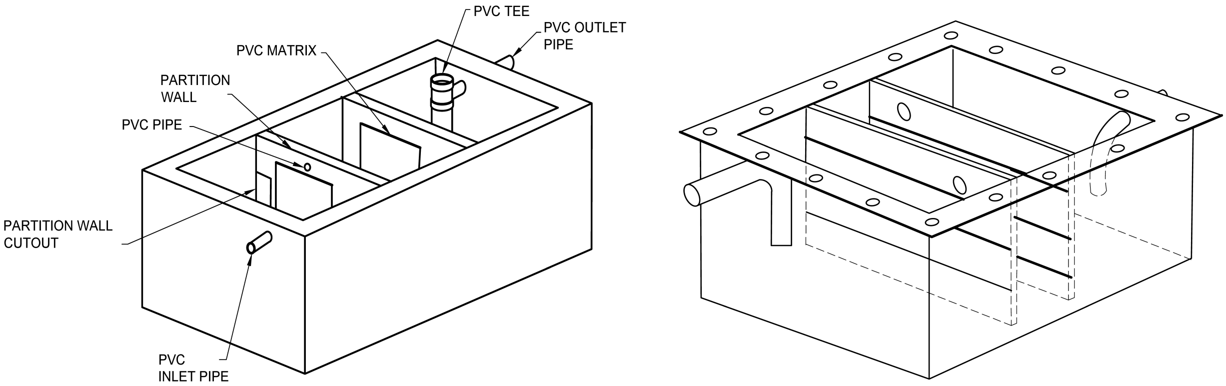

FIG. 1 TYPICAL DESIGN OF THE BIODIGESTER TANK

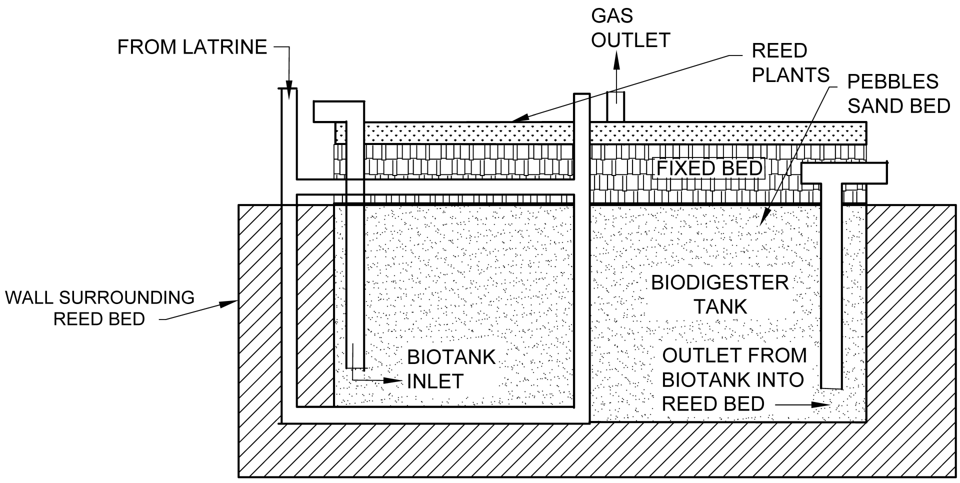

FIG. 2 TYPICAL DESIGN OF BIODIGESTER CUM REED BED SYSTEM

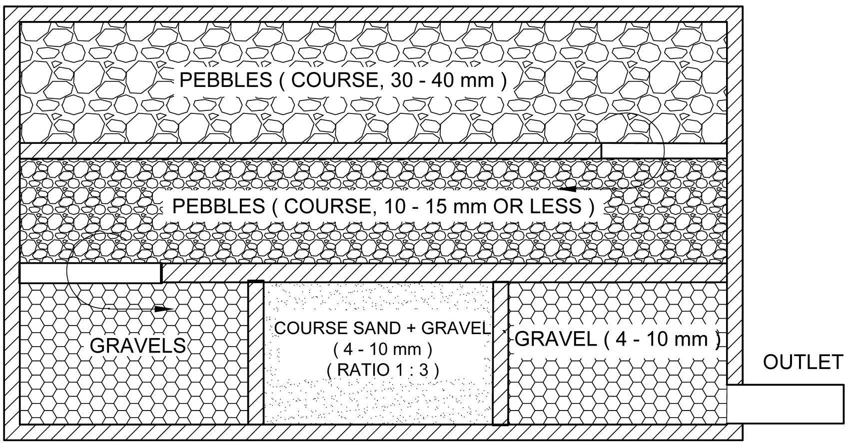

FIG. 3 TOP VIEW OF REED BED

4.2 Fabrication Material for Biodigester Tank

Biodigester tank may be fabricated using fibre reinforced plastic (FRP) or stainless steel (SS) or may be constructed onsite by plain cement concrete (PCC)/reinforced cement concrete (RCC). Biodigesters can be of varied volume as per the requirement of users. However, for larger volume of digesters for use at community level, it is always convenient to do onsite construction to reduce the transportation and installation issues if it is fabricated at factory. However, custom designed modular tanks having scope for onsite integration and installation for FRP/SS material is also possible, which will reduce the hassle of transportation and installation of large tanks.

4.2.1 *FRP Biodigester Tank*

4.2.1.1 In case of FRP is used for biodigester fabrication, the FRP shall consist of resin, fibre reinforcement and additives, processed uniformly. The resin shall be isophthalic with properties as given below:

a) Colour — The colour of the resin shall be cream or white. It should be opaque liquid of uniform consistency.

b) Viscosity — Viscosity of resin when tested with Brookfield viscometer shall be between 800 cps to 1 200 cps when tested at 25 °C as per Annex A of IS 6746, and shall be such that it is easy to apply.

c) Acid value — The acid value of resin when expressed as mg KOH/g shall be 15 (*Max*), when tested as per Annex B of IS 6746.

d) Volatile content — The volatile content shall be 33 percent ± 3 percent when tested as per Annex C of IS 6746.

e) Gel time — The gel time of the resin system shall be 20 min ± 5 min at 25 °C, when tested as per Annex D of IS 6746.

f) Relative density — The relative density of the resin shall be between 1.15 to 1.25 at 27 °C, when tested as per Annex F of IS 6746.

g) Styrene content — Maximum styrene content of the resin shall be 27 percent of total mass, when tested as per Annex M of IS 6746.

4.2.1.2 *Properties of cured cast resin*

A clear cast resin sample (without reinforcement) of thickness 3 mm ± 0.15 mm shall be made from resin followed by 24 h curing at room temperature and 4 h post curing at 70 °C. The cured cast resin shall possess the following properties:

a) Physical state — Hard and tough;

b) Barcol hardness — 42 to 45, when tested as per Annex J of IS 6746;

c) Percentage water absorption — 0.5 percent, *Max*, when tested as per Annex K of IS 6746;

d) Tensile strength — 400 kg/cm^2, *Min*, when tested as per IS 1998;

e) Cross-Breaking strength — 350 kg/cm^2, Min, when tested as per IS 1998;

f) Impact resistance — not be less than 120 J/m, when tested as per IS 1998;

g) Density of fibre glass chopped strand mat — 450 g/m^2, *Min*, when tested as per IS 11551 with polyester resin system (three layers); and

h) Stiffeners (after phosphate) can be sandwiched during hand laying or FRP extra ribs may be used for improving the strength, where required.

4.2.2 *Stainless Steel Biodigester Tank*

The stainless steel used for manufacturing of biodigester tank shall conform to grade 304S1 as per IS 6911.

4.2.3 The PUF panel of minimum thickness 50 mm shall be used for temperature controlled biodigesters, to be used in high altitude low temperature regions. PUF thickness may vary (more insulation may require) as per the requirement of cold condition. It shall be made by reaction of 2 liquids polyol and methyl diphenyl di-isocyanate (MDI). The PUF shall be sandwiched between 0.5 mm to 0.75 mm outer skin.

4.2.4 *Pipes*

Polyethylene pipes conforming to IS 14333 shall be used. For practical considerations, a minimum nominal diameter of 110 mm is recommended.

5 WORKMANSHIP AND FINISH

5.1 The biodigester shall be free from gel crack, blister, porosity, air bubbles and other surface defects.

5.2 Outer surface of the chamber should be smooth finish side. Colour may be as per the choice of the user/purchaser.

6 TESTS

6.1 The biodigester tank should not leak from any side, when filled with water up to the top edge and the static pressure maintained for one hour.

7 FABRICATION AND CONNECTION OF BIODIGESTER

7.1 Fabrication

Various components of the bio-digester (biodigester-SF-S-FRP; biodigester-SF-T-FRP; biodigester-20-FRP; biodigester-50-FRP; biodigester-SF-TC-FRP) shall be fabricated as per drawings and specifications No. DRDE/BT/SF-S/2013/01; DRDE/BT/SF-T/2013/02; DRDE/BT/BD50/2013/03; DRDE/BT/BD20/2013/04; DRDE/BT/BD-TC-SF-FRP/2013/05 and their associated drawings. Onsite construction shall be carried out as per **12**.

7.2 Transportation

The biodigester tank components should be stacked and transported.

7.3 Connection with Toilet

Biodigesters shall be assembled on site with the toilet as per drawings as given in **7.1**.

7.4 Sizes of Biodigester Tank

The biodigesters shall be of the sizes as given in Table 1 depending upon the number of users.

8 ANAEROBIC MICROBIAL INOCULUM (AMI)

8.1 Microbial consortium used is a mixture of different types of bacteria (hydrolytic, acidogenic, acetogenic and methanogenic groups) responsible for breakdown of complex polymers into simple sugars which are further broken down into low chain fatty acids and finally into biogas.

NOTE — The microbial consortium was developed by DRDO by enriching desired group of bacteria from mixture of microbes by natural selection. The efficiency of the consortium was improved by fortification of several critical species of bacteria (proteolytic bacteria) isolated from different areas. The consortium has been also augmented with volatile fatty acids (VFA) degraders. The microbial consortium has been gradually adapted to grow even at 5 °C so that it can work efficiently at mesophilic as well as psychrophilic temperature. Microbial consortium efficiently degrades human waste at temperature as low as 5 °C and as high as 50 °C. Currently, AMI is being propagated at Defence Research Development Establishment (DRDE), Gwalior and Defence Research Laboratory (DRL), Tezpur. In addition, technical know-how of AMI production at industrial scale has been shared with more than a dozen industries through licensing agreement for Transfer of Technology with cumulative capacity of around 90 lakh litres per year.

8.2 AMI Quality Requirements

The AMI shall be procured from DRDO or their licensee. The AMI so obtained shall be supplied with a test certificate showing that the same conform to the requirements as given in Table 2. After connection of the biodigester tank with the toilet, the manufactures/supplier shall change the tank with AMI of volume 30 percent of the tank volume. The manufacturer/supplier shall demonstrate to the user of the site of installation/commission, the gas pressure at the time of changing the tank with inoculum. The requirement of gas pressure shall be as specified by DRDO in the test certificate provided with AMI. AMI shall conform to the requirements given in Table 2.

Table 1 Sizes of Bio-Digester

(*Clauses* 7.4 *and* 9.2)

Sl No.	No. of Users	Volume of Biodigester m^3
(1)	(2)	(3)
i)	5	1.0
ii)	10	1.2
iii)	15	1.8
iv)	20	2.5
v)	50	5
vi)	100	9
vii)	150	14
viii)	200	17
ix)	300	25

Table 2 Requirements of Anaerobic Microbial Inoculum

(*Clause* 8.2)

Sl No. (1)	Characteristic (2)	Requirement (3)
i)	*p*H	6.5 to 7.5
ii)	Biogas inflammability	Inflammable
iii)	Methane content of biogas	45 percent to 70 percent
iv)	Total solid content	3 percent to 4 percent
v)	Methanogens count, CFU/ml, *Min*	10^3

9 REED BED

Reed bed is an appropriately designed constructed wetland that helps in the quality improvement of the effluent water coming out of the digester tank. It comprises different size of pebbles and sand and reed plants which improve the effluent quality by reducing water contaminants.

9.1 Reed bed helps in the following:

a) Mechanical filtration of large particulate matter, if any;
b) Degradation of organic molecules by microorganisms present in the filtration bed and in the root zone of reed plants; and
c) Utilization of micro-molecules and hence naturally reducing the eutrophication factors.

9.2 Size of the Reed bed

The size may vary, however, optimally 20 percent of the digester's volume (as mentioned in Table 1) is required for making effective subsurface horizontal flow treatment system for the effluent coming out of the digester tank. Achieving the 20 percent volume of the tank is done by multiplying the length (X m), breadth (Y m) and height of 0.2 m [where X, Y are any numerical value of the tank size, assuming the depth (or height) of the digester tank is 1 m, which is optimal].

9.3 Placement

Reed bed can be placed on the top of the digester tank, or it may be fabricated/constructed separately. A pipe from the digester (outlet) tank enters to the one corner of the reed bed, while outlet from reed bed situated at another end. The water from the outlet can be released into open drain/soak pit or can be used for specific purposes.

9.4 Basic Structure

Reed bed is an open chamber having at least two incomplete partition (80 percent length wise; opening at opposite ends) walls, creating a spiral movement of the water. Final outlet (at the other end) from the reed bed should be 0.2 m above the base (floor) of the reed bed. The outer walls of the reed bed are either fabricated (in case FRP/SS of biodigester) or constructed (PCC/RCC, as per the digester tank construction) having wall height of four sides of at least 0.25 m, which can be raised on the top of the digester tank or can be put separately. If it is placed on the top of the digester tank, the top (roof) cover (FRP/SS) or slab (RCC) becomes the base of the reed bed. Otherwise, a separate base is required to make it a leak proof open chamber (having no cover).

9.5 Design

Proper design of the reed bed is important to get its benefit. Effluent water is getting treated inside the reed bed as it remains in flooded condition. Each reed bed shall have at least two incomplete partition/baffle walls (80 percent length wise; opening at opposite ends), to create a spiral movement of the water that enters from the digester tank. Final outlet (at the other end) from the reed bed should be 0.2 m above from the base (floor) of the reed bed. Pebbles of different sizes are used in the bed. Coarse pebbles, 30 mm to 40 mm size should be are placed at the initial lane of the reed bed (where inlet from digester tank is placed). Pebbles of reduced size 10 mm to 15 mm should be placed at middle lane and smaller pebbles of size 4 mm to 10 mm should be placed at the third lane of reed bed from where water is discharged finally. Intermittent use of sand is effective. Water from inlet (first lane) moves spirally to come to the outlet (third lane) and getting discharged after treatment. Greater quantity of pebbles at 0.21 m to 0.23 m from the base of the tank shall be placed so that water flow (displacement) occurs below the surface layer of the pebbles and sand. Reed plants, for example, *Phragmites australis, Typha orientalis, Arundo donax, Phalaris arundinacea* can grow within the reed bed. The bed may also be explored for landscaping.

9.6 Fabrication/Construction Material

Fabrication/construction material of the reed bed shall be as that of the digester tank as given in the para **4.2.1** for FRP fabrication; or **4.2.2** for stainless steel (SS) fabrication. Inlet and outlet pipes' specification shall be as given in **4.2.4**. The reed bed can be constructed with common PCC/RCC materials as given in **12**, for onsite construction of digester tank).

10 LOCATIONS OF BIODIGESTER TANK AND REED BED

Biodigester tank should be preferably located underground in proximity of toilet superstructure. However, reed bed should be placed overground separately, or, on the top of the tank (*see* Fig. 4). However, placement of both tank and reed bed may be calculated site wise as per the plinth height of the toilet and ground level to ensure regular and easy release of treated water.

11 LAYOUT AND INSTALLATION OF FRP OR SS BIODIGESTER

11.1 The layout should be as simple and direct as practicable to facilitate movement of waste from toilet to biodigester tank without any interruption.

11.2 The piping arrangement should be such that it does not cause any hindrance/choking.

11.3 Wherever bend in pipe is provided for practical reasons, provision for cleaning eye should be made.

11.4 The following considerations shall be taken care of in the installation of biodigesters:

a) Selection of a suitable location for the bio-digester;
b) Determination of the size of the biodigester according to user numbers;
c) The pit size should be according to dimension of biodigester;
d) The sides and the floor of the pit should be smooth with no protruding stones or roots that could damage biodigester;
e) The soil that is excavated should be completely removed from the edges of the pit to prevent it falling back into the pit;
f) Proper digging and leveling of soil is to be carried for installation of biodigester;
g) Leveling should be carried out carefully with the water gauge;
h) Floor/base of pit should be made of one layer of plain cement concrete (PCC);
j) A layer of concrete blocks may be placed at bottom of pit;
k) Connection of biodigester is to be carried out outside the installation pit;
m) All pipes, partition walls and the cover plate with gasket should be properly sealed with main tank body. For sealing of pipes and partition walls to make the leak proof proper, general purpose/suitable resin and fiber mat should be used;
n) Completely, assembled biodigester should be carefully placed inside the pit;
p) Locate the area where the gas outlet should be placed. This should be at the top of the bio-digester. Fit the gas release valve with gas outlet;
q) Proper sealant should be used where necessary to prevent gas leaks;
r) Place the biodigester in to pit and connect to super structure/toilet;
s) A soak pit should be constructed to collect effluent from the outlet of the biodigester; and
t) Anaerobic microbial inoculum (30 percent of biodigester volume) should be provided in the biodigester tank in the first chamber either before cover plate assembly or it can also be poured from the toilet pot.

12 ONSITE CONSTRUCTION OF PCC-RCC DIGESTER TANK

a) Select a suitable location for the biodigester;
b) Determine the size of the biodigester according to user numbers;
c) The pit size should be according to dimension of biodigester;
d) Biotank should be brickwalled PCC or RCC structure and should be rectangular in shape;
e) Materials for construction — bricks, sand, cement, stone chips (variable size), reinforcement (for RCC), aluminium/PVC pipes, inlet/outlet pipes, attachment matrix for bacteria;
f) After digging the pit of required size, shoaling shall be done at the bottom by RCC for making leak-proof bottoms of the tank. Materials required are sand, cement, stone-chips;

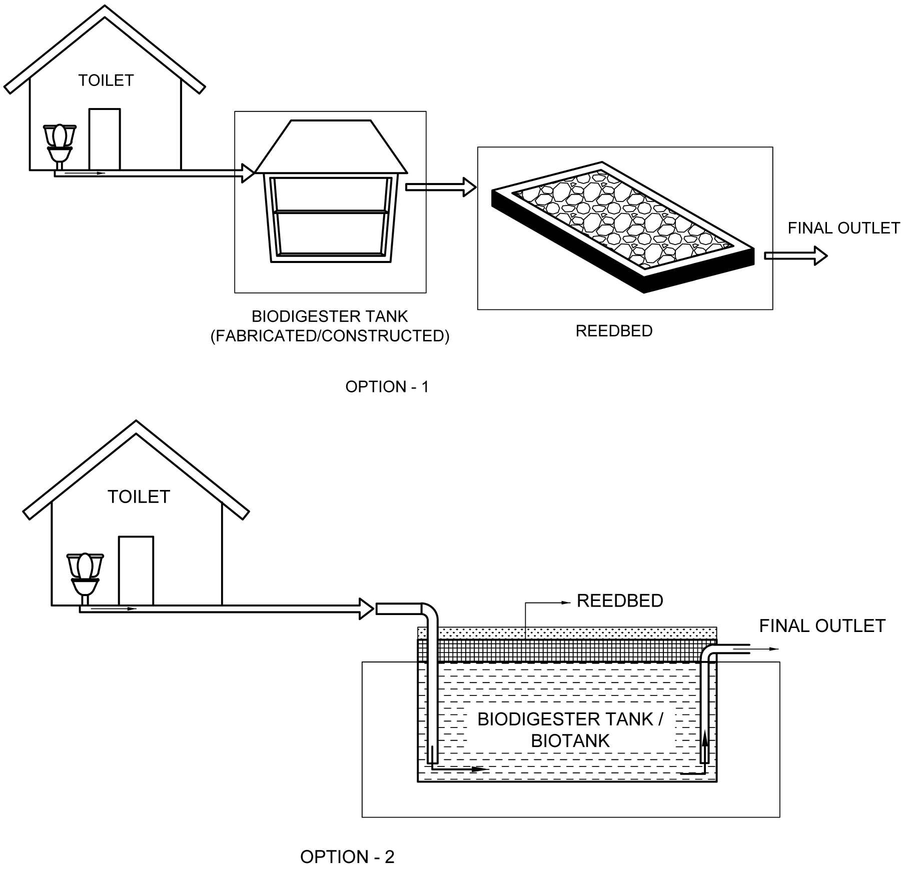

FIG. 4 TYPICAL LAYOUT OF BIODIGESTER WITH REED BED

g) Side/outer walls of the tank — 250 mm brick wall. Both sides shall be plastered to make it leak-proof.

h) Tanks shall have at least two partial partition walls lengthwise (dividing the tank internally into three chambers of volumetric ratio 4 : 3 : 3, from bottom to the top of the tank). The length of each wall should be 80 percent of the length of the tank starting from one side of the tank towards the other end (for example, if tank is 1 000 mm long and 1 000 mm high, then each partition wall should be 800 mm long and 1 000 mm high, placed at opposite direction).

j) Inlet pipe from the toilet — 150 mm diameter or more (PVC with door bend), should travel inside the tank 70 percent downward from the top (that is, for the tank of 1 000 mm in height, the inlet pipe should be of 700 mm from the top slab).

k) Outlet pipe from the tank to the reed bed — may be constructed on the top of the tank above the slab. The structure and configuration should be same as the inlet, however, 100 mm diameter pipe to be used.

m) Breadth wise rods made from anti-rusting material (like PVC), to be placed at equidistant spacing of 150 mm.

n) Plastic wires hanging downwards from each rod, with each wire containing at least 4 PVC bacterial immobilization/attachment matrix (at equidistant, spacing of 200 mm, for example, if the height of the tank is 1 000 mm, place the attachment matrix at 800^{th}, 600^{th} 400^{th}, and 200^{th} mm). This material should be hung at both sides of the partition wall. The water coming out of the biodigester tank, enters the reed bed (*see* **9.1** to **9.6**).

p) The water can be released directly to the environment or may be reused for specific requirements (for example, watering plants, etc).

q) Anaerobic microbial inoculum (30 percent of biodigester volume) should be provided in the biodigester tank.

13 START-UP OF BIODIGESTERS

Once the biodigester is fully fabricated or constructed, AMI is poured into the tank from the inlet (or flushing from the squat pan of the toilet itself). As far as possible, precaution should be taken that during addition of inoculum it is exposed to minimum oxygen. The facility can be started for using thereon. Colourless odourless water from the final outlet (after reed bed treatment) and clean odourless ambience indicates the proper functioning of the system.

14 USE OF DETERGENTS AND DISINFECTANTS

The instructions for use and maintenance of biodigesters shall be provided by the manufacturer to the purchaser. Detergents and disinfectants should not be used at the dose more than the recommended because an excess dose adversely affects the bacterial population and therefore anaerobic biodegradation process.

15 EFFLUENT REQUIREMENTS

The biodigester shall comply with the effluent parameters as given in Table 3. The manufacturer shall demonstrate the same to the user. The manufacturer/supplier shall obtain sample after one month or discharge of effluent, whichever is later of installation of the biodigester and provide the test results after getting the sample tested.

NOTE — It is recommended to get the effluent tested at DRDO approved laboratories, the list of which may be obtained from them.

Table 3 Effluent Requirements of Discharge from Biodigester

(*Clause* 15)

Sl No.	**Parameter**	**Value**	**Value with Reed Bed**	**Method of Test, Refer to**
(1)	(2)	(3)	(4)	(5)
i)	*p*H	6.0 to 9.0	6.8 to 7.5	IS 3025 (Part 11)
ii)	TSS mg/l	< 75	< 15	IS 3025 (Part 17)
iii)	BOD mg/l[1)]	< 100	< 20	IS 3025 (Part 44)
iv)	COD mg/l	< 300	< 50	IS 3025 (Part 58)
v)	Faecal coliform count (MPN/100 ml at 44 °C)	< 10 000	< 1 000	IS 1622

[1)] 3 days at 27 °C.

ANNEX A

(*Clause* 2)

LIST OF REFERRED STANDARDS

IS No.	*Title*
IS 1622 : 1981	Methods of sampling and microbiological examination of water (*first revision*)
IS 1998 : 1962	Methods of test for thermosetting synthetic resin bonded laminated sheets
IS 3025	Methods of sampling and test (physical and chemical) for water and wastewater:
(Part 11) : 2022	*p*H value (*second revision*)
(Part 17) : 2022	Non-filterable residue (total suspended solids at 103 °C – 105 °C) (*second revision*)
(Part 44) : 1993	Biological oxygen demand (BOD) (*first revision*)
(Part 58) : 2006	Chemical oxygen demand (COD) (*first revision*)
IS 6746 : 1994	Unsaturated polyester resin systems — Specification (*first revision*)
IS 6911 : 2017	Stainless steel plate, sheet and strip — Specification (*second revision*)
IS 11551 : 1996	Glass fibre chopped strand mat for the reinforcement of epoxy, phenolic and polyster resin systems — Specification (*first revision*)
IS 14333 : 2022	Polyethylene pipes for sewerage and industrial chemicals and effluent — Specification (*first revision*)

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Public Health Engineering Sectional Committee, CED 24

Organization	*Representative(s)*
In Personal Capacity (*840, Sector-17, Faridabad - 121002*)	SHRI A. K. SARIN (***Chairperson***)
Bangalore Water Supply & Sewerage Board, Bengaluru	SHRI B. R. NAGENDRA SHRI GURUPRASSAD BAILY (*Alternate*)
Brihan Mumbai Licensed Plumbers Association, Mumbai	SHRI KISHOR MERCHANT SHRI BIJAL M. SHAH (*Alternate*)
Bureau of Design (BODHI), Water Resources Department Government of Madhya Pradesh, Bhopal	REPRESENTATIVE
Central Pollution Control Board, New Delhi	SHRI P. K. MISHRA
Central Public Health & Environment Engineering Organization, New Delhi	SHRI V. K. CHAURASIA SHRIMATI K. SRAVANTHI JEEVAN (*Alternate*)
Central Public Works Department, New Delhi	SHRI M. K. MALLICK SHRI DIVAKAR AGRAWAL (*Alternate*)
CSIR - Central Building Research Institute, Roorkee	DR NEERAJ JAIN DR SOUMITRA MAITY (*Alternate*)
CSIR - National Environmental Engg Research Institute, Nagpur	DR S. K. GOYAL DR SUNITA SHASTRY (*Alternate*)
Delhi Development Authority, New Delhi	MS HARLEEN BEHL SHRI RAVINDER KUMAR (*Alternate*)
Delhi Jal Board, New Delhi	SHRI VIKRAM SINGH SHRI S. L. MEENA (*Alternate*)
Defence Research and Development Organization, New Delhi	SHRI DEVAKANTA PAHAD SINGH DR K. P. MISHRA (*Alternate* I) DR ANURAG PANDEY (*Alternate* II)
Delhi Technology University, New Delhi	DR VIJAY K. MINOCHA
Engineers India Ltd, New Delhi	SHRI D. C. BRAHMA SHRI ATULYA RANJAN (*Alternate* I) SHRIMATI RASHMI CHATURVEDI (*Alternate* II)
Gujarat Water Supply & Sewerage Board, Ahmedabad	SHRI P. G. GADANI SHRI R. B. SHETH (*Alternate*)
Indian Institute of Technology (BHU) Varanasi, Varanasi	DR GOUTAM BANERJEE DR D. MOHAN (*Alternate*)
Indian Institute of Technology Delhi, New Delhi	DR B. J. ALAPPAT DR K. N. JHA (*Alternate*)

Organization	*Representative(s)*
Indian Institute of Technology Roorkee, Roorkee	DR C. S. P. OJHA DR A. A. KAZMI (*Alternate*)
Indian Institute of Science Bengaluru, Bengaluru	REPRESENTATIVE
Indian Plumbing Association, New Delhi	SHRI H. R. RANGANATH
Indian Plumbing Skill Council, New Delhi	SHRI VINAY GUPTA SHRI ROHIT KUMAR SAHA (*Alternate*)
Indian Water Works Association, New Delhi	SHRI PRAMOD KUMAR SINHA SHRI ANIL KUMAR GUPTA (*Alternate*)
Institution of Public Health Engineers, Kolkata	SHRI ASIT NEMA SHRI YOGESH SHARMA (*Alternate*)
Jal Jeevan Mission, Ministry of Jal Shakti, New Delhi	REPRESENTATIVE
Jindal Saw Ltd, New Delhi	SHRI MANEESH KUMAR SHRI RAJEEV RANJAN (*Alternate*)
Military Engineer Services, Engineer-in-Chief's Branch, Integrated HQ of MoD (Army), New Delhi	SHRI RAJIV KHARE SHRI SUMEET SINGH MAKKAR (*Alternate*)
MKG Consultants, New Delhi	SHRI M. K. GUPTA SHRI NISHANT GUPTA (*Alternate*) SHRI SHASHANK MOHAN TRIVEDI (*Alternate* II)
Municipal Corporation of Brihanmumbai, Mumbai	SHRI ASHOK S. TAVADIA SHRI S. D. WANI (*Alternate*)
National Institute of Technology, Patna	DR NITYANAND SINGH MAURYA
Proion Consultants Pvt Ltd, New Delhi	SHRI SANDEEP GOEL SHRI MANVEER SINGH (*Alternate*)
Public Health Engineering, Department of Haryana, Panchkula	REPRESENTATIVE
Saviram Engineering Consultants Pvt Ltd, Noida	SHRI GIRISH CHANDRA MISHRA
Shreshtha Consultants, Jaipur	SHRI SUDHIR MATHUR
Tata Consulting Engineers Ltd, Mumbai	SHRI N. P. RAO SHRI DHEERAJ KAUSHIK (*Alternate*)
The Institution of Engineers, Kolkata	SHRI DINESH KUMAR MS NIKITA (*Alternate*)
Water and Power Consultancy Services India (WAPCOS), New Delhi	SHRI SANJAY VERMA
In Personal Capacity (*Flat No. 12, Sanket Bhawani, Shankar Road, Mumbai - 400028*)	SHRI A. S. GUPTE

Organization	*Representative(s)*
In Personal Capacity (*Flat 112, United Apartments, Plot 34, Sector – 4, Dwarka, New Delhi - 110075*)	SHRI VINAYAK KOUNDANYA
In Personal Capacity (*34, PG enclave, City Centre, Gwalior - 474011*)	DR LOKENDRA SINGH
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