Lecture-15

Selection of construction materials

If the materials used in the plant construction such as cement, sand, aggregate etc. are not of good quality, the quality of the plant will be poor even if the design and workmanship are excellent. A brief description regarding the specifications for some of the construction materials is provided below to assist with selection of the best quality materials.

Cement

Cement should be high quality Portland cement from a brand with a good reputation. It must be fresh, free from lumps and stored in dry place. Bags of cement should not be stacked directly on the floor or against the walls. Wooden planks have to be placed on the floor to protect cement from dampness. Cement bags should be stalked at least 20 cm away from any walls.

Sand

Sand should be clean and not contain soil or other material; dirty sand will have a very early negative effect to the structure. Coarse and granular sand are suitable for concreting work, however fine sand should be used for plastering works. River/lake sand is well graded hence preferred. Avoid dusty sand.

Gravel/Ballast

The size of gravel should neither be very big nor very small and should be clean, hard and angular in shape. If dirty should be cleaned first before use and the maximum size of gravel should be ¾" or ¼ the slab thickness. Gravel should be clean, hard and of angular shape. If it is dirty, it has to be washed properly before use.

Water

Water is mainly required for making the cement mortar for masonry works, concreting works and plastering. It is also used to soak bricks before using. Besides, it is required for cleaning or washing construction materials if they are dirty. The water from ponds or cannel may be dirty so it is better not to use it. Dirty water will have an adverse effect on the strength of structure. Water from water tap or well or any other sources that supply clean water has to be used.

Bricks

Brick plays a very important role in construction of biodigesters. Bricks should be of high quality, usually the best quality available in the local market. The bricks should be well burnt, straight, regular in shape, sizes and should not have cracks or broken parts. High

quality bricks make a clear metallic sound when hitting them to each other. Such bricks should be able to bear a pressure of 120 kg per square centimeter. Before use, bricks must be soaked for few minutes in clean water. Wet brick will not absorb water from the mortar which is needed for setting properly.

Mild steel bars

MS bars are used to construct the covers of outlet tank and water drain chamber. It should meet the engineering standard generally adopted. For plants of 4, 6 and 8 cum, MS rods of 8 mm diameter and for plant of 10 cum capacity 10 mm diameter is recommended. MS bar should be free from heavy rust.

Mixing Device

This device is used to prepare good quality water-dung solution in the inlet tank when cattle dung is used as feeding material. Usually for household biogas digesters, vertical mixing devices are installed. The device should be of good quality, as per the design, and the mixing blades have to be well galvanized. The blade should be properly aligned for the effective mixing.

List of materials required for construction of KVIC biogas plants(40 days retention time)

Materials	**Plant size (m^3)**					
	2	**3**	**4**	**6**	**8**	**10**
Bricks- I Class (no)	2460	2770	3210	3730	4430	4650
Cement (50kg) bags (no)	13	17	19	23	26	28
Stone chip(12mm/20mm) (cu.m)	0.60	0.90	0.95	1.25	1.40	1.60
River sand(cu.m)	2.00	2.55	2.90	3.40	4.50	5.00
A.C.Pipe 100 mm dia (m)	3.9	4.6	6.3	6.5	7.7	8.0

List of materials required for construction of deenbandhu biogas plants (40 days retention time)

Materials	Plant size (m^3)				
	1	**2**	**3**	**4**	**6**
Bricks- I Class (no)	700	1000	1300	1600	2200
Cement (50kg) bags (no)	8	14	16	22	28
Stone chip (12mm/20mm) (cu.m)	0.85	1.14	1.43	1.70	2.40
River sand(cu.m)	0.85	111	1.43	1.70	2.40
GI pipe (cm)	17.78	17.78	17.78	17.78	17.78
A.C pipe 6" dia (m)	1.80	1.80	1.80	1.80	1.80
Iron rod 6 mm dia (kg)	6.00	7.00	10.00	12.00	15.00
Labours (man hours)					
Excavation	8	10	14	18	24
Masons	8	11	13	16	22
Construction labours	16	22	26	30	44

Plant layout

Construction works of biodigester starts with the process of layout works. This is the activity carried out to mark the dimensions of plant in the ground to start the digging work. For this purpose, first a small peg has to be stuck in the ground at the centre spot of the digester. Then the following steps should be followed:

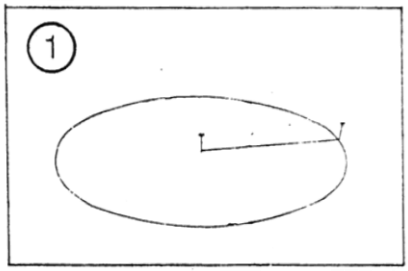
- Level the ground and determine the centre line of the digester, outlet tank and inlet pit
- Decide the reference level. It is better to assume the leveled ground level as the reference level. The top of the dome (outer) should exactly be in this level.
- Select the outer radius of the pit (digester diameter plus wall thickness plus space for a footing projection of at least 10 cm) and mark it in the rope or chord.
- Insert a stick or wooden peg in the leveled ground at the centre of the proposed digester pit. With the help of this pole and chord prepared earlier, make a circle, which indicates the area to dig.
- From the centre point where the central line meets with the perimeter line, draw a tangent and measure a length equal to half of the breadth of outlet plus wall thickness (for outlet chamber) and half of the size of manhole (30cm) plus wall thickness for manhole, on either side of this tangent. Mark the manhole ensuring that the inner size is 60 cm x 60 cm.

- Draw horizontal parallel lines from the points in either side in the tangent, which will meet the dome. From the centre point where the central line meets with the perimeter line, measure the length of outlet plus wall thickness to decide the outer dimension of outlet.
- Use coloured powder to mark the dimensions.
- Decide the location of slurry pits while laying out plant digester and outlet.

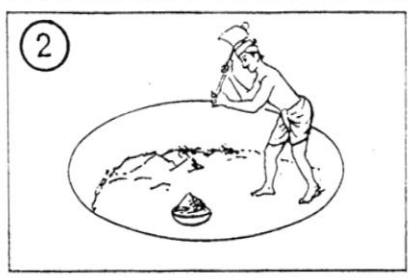
Digging of Pit

After completion of lay-out work, the work for digging of pit has to be started. Tools like, crow-bar, picks, spade, shovel and basket should be available at the site. The following points have to be followed to dig the pit.

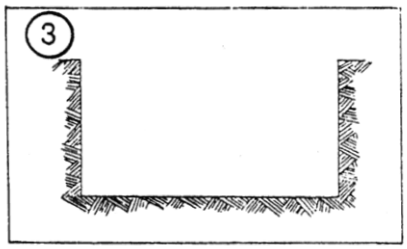
- Digging should be done as per the dimensions fixed during layout
- As far as practical the cutting in ground should be vertical
- If the water table is high and digging to the required depth is difficult, a deeper pit has to be constructed near the digester pit. Water accumulated in the digester pit has to be drain to this pit through underground pipes. Water should be pumped from this pit.
- Once the depth of digging is equal to the dimension, the work of leveling and ramming the base has to be done. The pit bottom must be leveled and the earth must be untouched
- Ensure that the excavated earth is deposited at least 2 m away from the pit in each side to ease the construction works.
- Be careful to avoid accident while digging near the sides as soil may collapse.
- Dig the foundation for the manhole (first step of outlet tank) along with the foundation for digester as per the dimensions in the drawing during the layout.



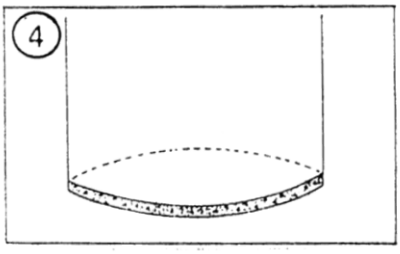
Marking the dimensions for digging



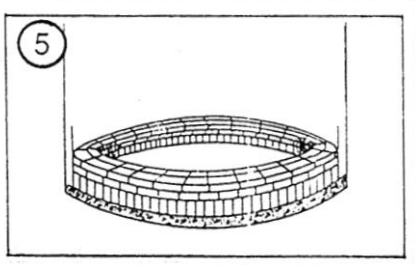
Digging



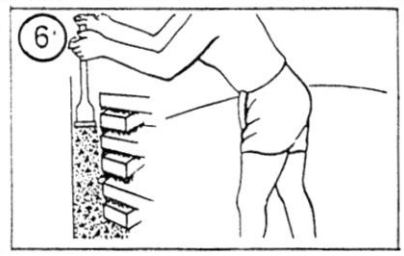
Completed pit



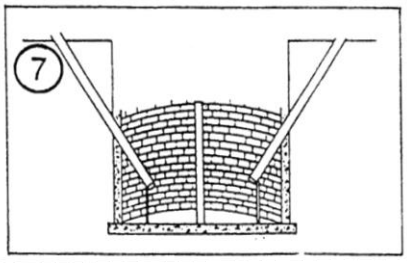
Laying the concrete foundation



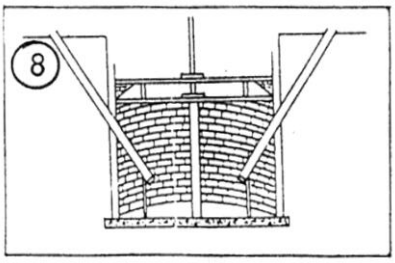
Constructing brick wall



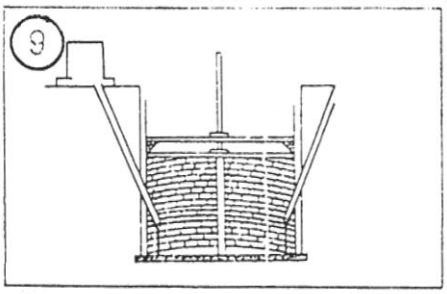
Filling the outer layer



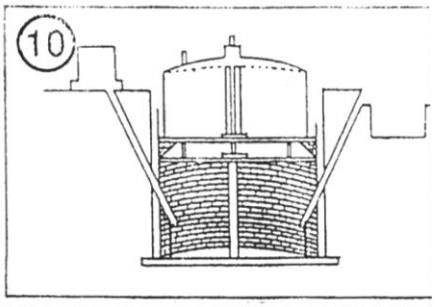
Placing inlet and outlet pipe



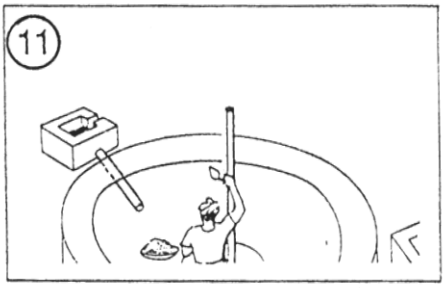
Fixing the guide frame

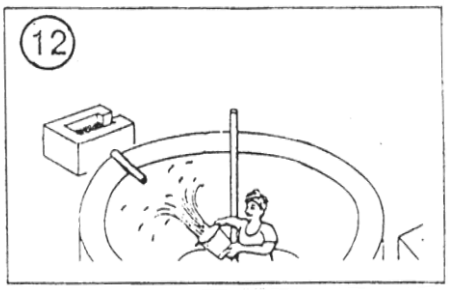


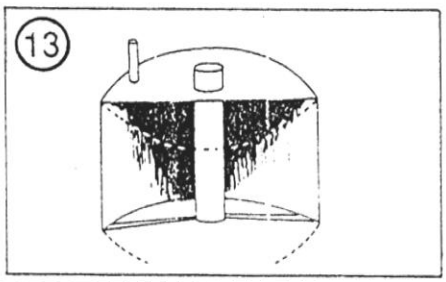
Constructing inlet tank



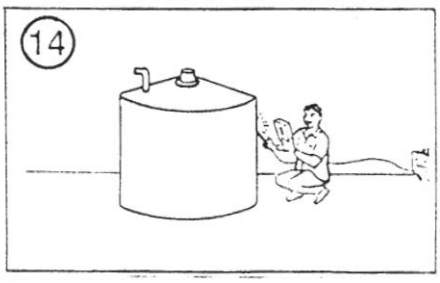
Constructing slurry outlet tank



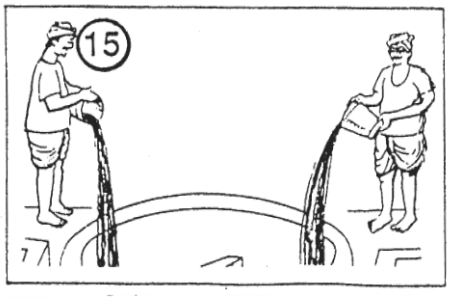




Gas holder

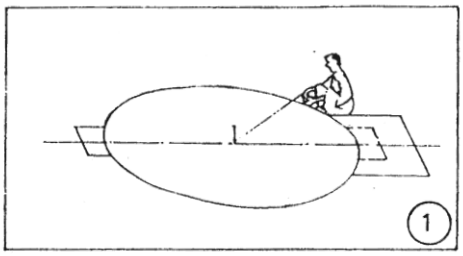


Welding the gas holder

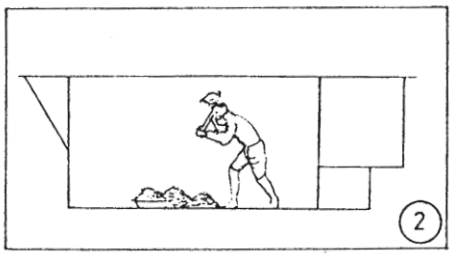


Feeding the plant with fresh slurry

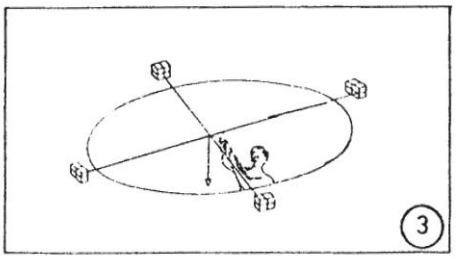
Fig. CONSTRUCTION OF KVIC BIOGAS PLANT



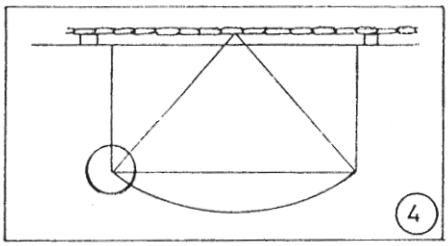
Marking



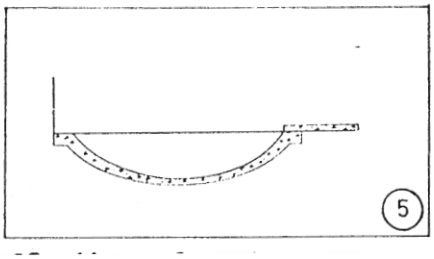
Digging



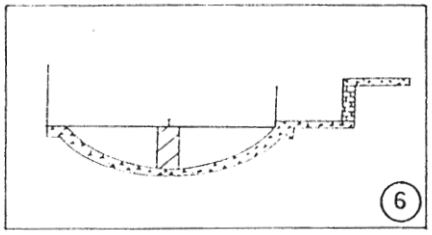
Finding the centre



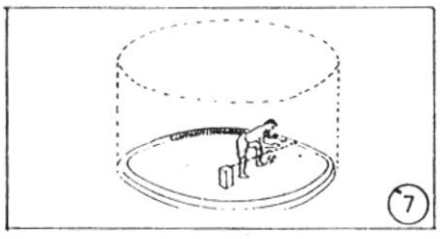
Digging for hemisphere layer



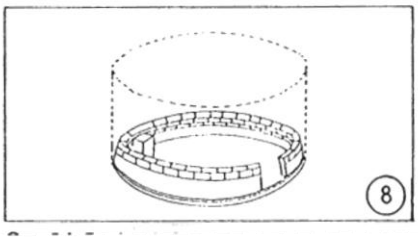
Laying of concrete layer



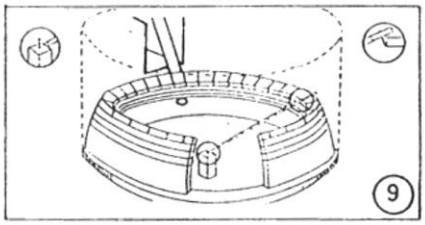
Finding the centre for constructing the dome



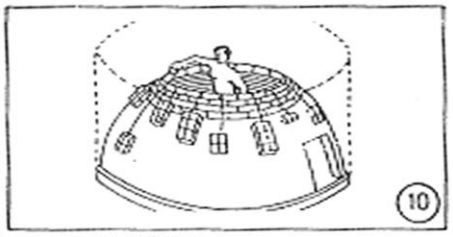
Laying of bricks



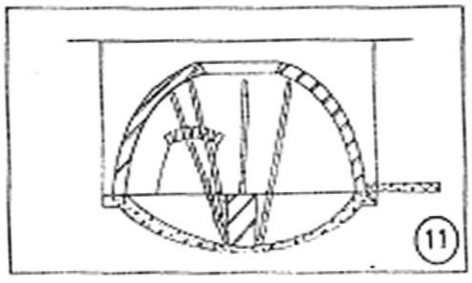
Leaving place for manhole construction

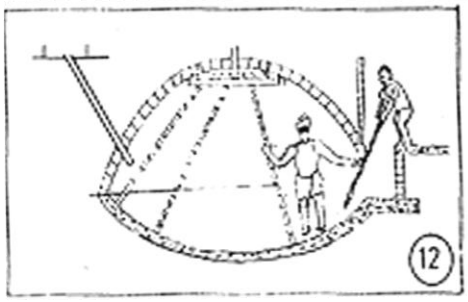


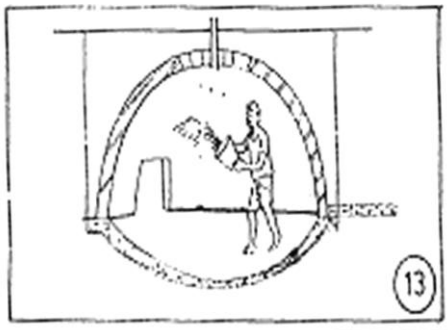
Laying inlet pipe



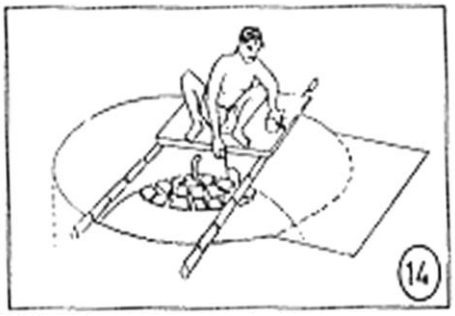
Construction of dome



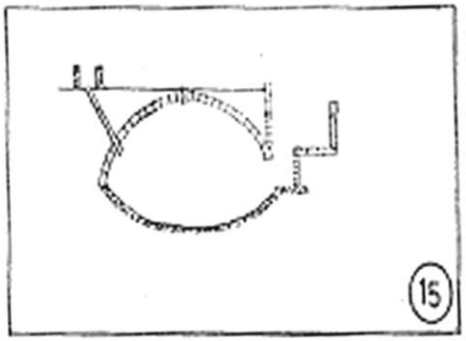




Watering



Closing of dome with bricks



Completed biogas plant

Fig. Construction of Deenbandhu biogas plant