

# National Vocational Certificate Level 2 in Biogas Technology



## Competency Standards



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**Date of approval by NCRC:**

29th -30th October 2014

**Date of Notification:**

10th December 2014, vide notification no F.2-1/2013-DD(VT)

This curriculum has been produced by the National Vocational & Technical Training Commission (NAVTTCC) with the technical assistance of TVET Reform Support Programme, which is funded by the European Union, the Embassy of the Kingdom of the Netherlands, Federal Republic of Germany and the Royal Norwegian Embassy. The Programme has been commissioned by the German Federal Ministry for Economic Cooperation and Development and is being implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

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## Competency Standards: Biogas Technicians (Floating Drum Biodigesters)

### Standard-1: Recall basic concepts of biogas production and benefits of biodigester technology.

Overview: These competency standards will ensure that the trainees will be able to explain process of biogas production, types of biodigesters and importance of biogas technology in Pakistan

Competency Unit	Performance Criteria	Knowledge and Understanding
C1.1: Explain prerequisites for biogas generation	<p>P1: Explain methods of biogas production</p> <p>P2: Explain different types of inputs (feeding materials) for biodigesters</p> <p>P3: Explain merits and demerits of different feeding materials</p> <p>P4: Describe why cattle dung is the best feeding material for Pakistan context</p> <p>P5: Explain ideal conditions for biogas generation</p> <p>P6: Describe effects of temperature on biogas generation</p>	<p>The participants will gain knowledge and enhance understanding on:</p> <p>K1: Basic bacterial activities to produce biogas</p> <p>K2: Different types of inputs to operate a biodigester</p> <p>K3: Merits and demerits of different feeding materials</p> <p>K4: Reasons for the use of cattle dung as the main feeding materials for biodigesters</p> <p>K5: Methods and practices to ensure effective biogas production</p> <p>K6: Suitability of biodigester in different climatic conditions</p>
C1.2: Describe types and functioning/ working of biodigesters	<p>P1: Describe different types of biodigesters and their strengths and weaknesses</p> <p>P2: Explain components of a floating drum biodigester and function(s) of each component</p> <p>P3: Explain inter-relations of different components of a floating drum biodigester</p> <p>P4: Describe criteria to select a particular design of a floating drum biodigesters</p>	<p>K1: Different types of biodigesters and their comparative advantages</p> <p>K2: Components and functions of a floating drum biodigesters</p> <p>K3: Working principle of a floating drum biodigester</p> <p>K4: Merits and demerits of different designs (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum) of floating drum biodigesters in</p>

	P5: Explain suitability of floating drum designs for electricity generation	particular context K5: Strengths and weaknesses of floating drum design for electricity generation
C1.3: Describe benefits of floating drum biodigesters and importance of the technology in Pakistan	<p>P1: Explain the products of a biodigester</p> <p>P2: Recall various end use applications of biogas</p> <p>P3: Recall advantages of bioslurry over FYM</p> <p>P4: Explain benefits of biogas at household and community level</p> <p>P5: Explain why biodigester technology is important for Pakistan</p>	<p>K1: Products of biodigesters – biogas and bioslurry</p> <p>K2: Diversified use of biogas – cooking, lighting, running an engine</p> <p>K3: Comparative advantage and disadvantages of FYM and bioslurry</p> <p>K4: Benefits of biogas over conventional fuel sources</p> <p>K5: General energy scenario in Pakistan</p>



## Standard 2: Read and interpret drawings of floating drum biodigesters

Overview: This competency standard ensures that the participants are familiar with different types of drawings and they are able to read and interpret drawings of floating drum biodigesters.

Competency Unit	Performance Criteria	Knowledge and Understanding
C2.1: Describe the basic concepts of a drawing of an object	P1: Tell why drawing is needed P2: Describe the concept of plan, elevation and sections while preparing drawings	K1: The need and importance of drawing K2: Notion of plan, elevation and sections of a drawing
C2.2: Demonstrate ability to read basic drawings	P1: Explain the concept of foot-inch and meter-centimeter system of measurement P2: Demonstrate ability to distinguish different types of drawings	K1: Different systems of measurement and use of measuring tape K2: Different types of drawings – isometric view, sectional elevations, plan, elevation etc.
C2.3: Demonstrate ability of interpret drawing of floating drum biodigesters	P1: Describe the dimensions of various components of a floating-drum biodigesters P2: Define plan, section, isometric view, and half sectional elevation of biodigesters P3: Describe inter-relationship of various components of a floating-drum biodigester	K1: Working of floating-drum biodigester, its components and dimension of various parts. K2: Methods of reading drawings of different components of a floating-drum biodigester K3: Inter-relationship of various floating-drum biodigester components
C2.4: Read and interpret drawings of templates, appliances, pipes and fittings and filter systems	P1: Read drawings of various sizes of templates P2: Read drawing of mixing devices P4: Read drawing of biogas stoves and lamps P5: Read drawings of pipes and fittings P6: Read drawings of filter systems	K1: Templates and their uses K2: Mixing device and its use K3: Biogas stoves and lamps K4: Pipes and fittings such as tee, elbow, nipple, valves, socket K5: H <sub>2</sub> S filter, moisture filter, CO <sub>2</sub> filter

### Standard 3: Select suitable type and appropriate size of floating-drum biodigester and carry out basic calculations

Overview: This competency standard ensures that the participants are familiar with different criteria to be considered while selecting best suitable type and size of a biodigester and be able to carry out simple calculations.

Competency Unit	Performance Criteria	Knowledge and Understanding
C3.1: Select suitable type of biodigester	<p>P1: Explain pre-requisite for the selection of biodigester type such as consideration on durability, reliability, affordability, user-friendliness for construction and operation</p> <p>P2: Describe suitability of different designs in specific site conditions</p>	<p>K1: Criteria to select suitable type of biodigester</p> <p>K2: Different designs of floating drum biodigester (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum) and their suitability in different context</p>
C3.2: Select suitable size of biodigester	<p>P1: Explain pre-requisite for the selection of biodigester size</p> <p>P2: Estimate the quantity of feeding materials (cattle dung) available and gas production</p> <p>P3: Estimate the quantity of gas required based upon end-use applications</p> <p>P4: Select suitable size of biodigester based upon main selection criteria</p>	<p>K1: Criteria to select suitable size of biodigester</p> <p>K2: Calculation of quantity of feeding materials and gas production</p> <p>K3: Various end-use application and gas requirements</p> <p>K4: Different sizes of biodigesters and gas production</p>
C3.3: Carry out basic calculations	<p>P1: Practice addition, subtraction and multiplication of measurement units</p> <p>P2: Calculate material needed and related cost</p> <p>P3: Describe the quantity of various construction materials needed for different sizes of biodigesters</p>	<p>K1: Basic addition, subtraction and multiplication</p> <p>K2: Use of calculators</p> <p>K3: Types and quantity of construction materials needed for construction</p>

<p>C3.4: Interpret the relation between HRT, quantity of feeding materials and required size of biodigester</p>	<p>P1: Describe the effect of HRT on size selection</p> <p>P2: Explain relation between quantity of feeding and HRT</p> <p>P3: Select size of biodigester based upon feeding materials and estimated HRT</p>	<p>K1: Concept of HRT and its effect on size selection</p> <p>K2: Types of feeding materials and estimated HRT</p> <p>K3: Different sizes of floating-drum biodigesters and quantity of feeding materials needed.</p>
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#### Standard 4: Select construction materials and construction site

Overview: This competency standard ensures that the participants are able to name the construction materials required for the construction of a floating-drum biodigester and select construction materials to comply with the set quality standards.

Competency Unit	Performance Criteria	Knowledge and Understanding
C4.1: Name different types of construction materials needed for constructing a floating-drum biodigester	P1: State the type of construction materials needed for construction	K1: Different construction materials needed for floating-drum biodigesters (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)
C4.2: Appraise quality standards of construction materials	P1: Describe quality standards of bricks and stones P2: Describe quality standards of cement P3: Describe quality standards of sand P4: Describe quality standards of aggregate/gravel P5: Describe quality standards of MS rod P6: Describe quality standards of steel floating drum P7: Describe quality standards of other types of floating drum (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)	K1: Types and quality of bricks and stones and their uses, hitting and abrasion tests K2: Cement grade and OPC, storing and handling of cement K3: Bottle test for assessing quality of sand, calculations of % of impurity in sand K4: Different sizes of aggregate and their uses K5: Types of MS rod and their uses K6: Thickness of iron sheet, priming and coating (oil paints, synthetic paints and bitumen paints), welding and gas tightness K7: Thickness of drum, uniformity, smoothness, gas-tightness, slope of roof, welding and jointing
C4.3: Explain criteria for selection of construction site	P1: Explain why biodigester should be constructed near cattle shed P2: Explain why biodigester should be located in sunny place	K1: The fact that feeding will be difficult and tiresome if biodigester is far from cattle shed K2: Effect of outside temperature on biodigester

	<p>P3: Explain why the distance between biodigester and point of use should be as minimum as possible</p> <p>P4: Explain why biodigester should not be constructed too close to foundation of structures, growing trees, main trail and machines producing vibrations</p> <p>P5: Explain why biodigesters should not be constructed in water logging areas and slide-prone areas</p> <p>P6: Explain the characteristics of best site for constructing biodigesters</p>	<p>K3: Effect of longer conveyance system on installation cost and operation and maintenance</p> <p>K4: Safety in construction, potential damage to biodigester because of roots of a tree and vibrating machines.</p> <p>K5: Potential danger of flooding and cracking of digesters because of water logging and ground movements</p> <p>K6: Characteristics of best site for construction of a biodigester</p>
<p>C4.4: Explain steps (sequences) of construction of a floating drum biodigester</p>	<p>P1: Describe methods of construction of different components of a floating drum biodigester</p> <p>P2: Describe relative positioning of different components of a floating drum biodigesters</p> <p>P3: Explain the importance of reference line</p>	<p>K1: Sequence of construction activities</p> <p>K2: Functioning of different components of a floating drum biodigesters</p> <p>K3: Reference line and its use during construction</p>

## Standard 5: Construct structural component of a floating-drum biodigester

Overview: This competency standard ensures that the participants are able to construct civil structures of a floating-drum biodigester complying with set quality standards.

Competency Unit	Performance Criteria	Knowledge and Understanding
C5.1: Construct digester	<p>P1: Demonstrate methods for lay out (demarcation) of biodigester</p> <p>P2: Supervise the excavation of pit</p> <p>P3: Prepare mortar</p> <p>P4: Prepare base of the digester and construct foundation</p> <p>P5: Construct digester walls</p> <p>P6: Fix inlet and outlet pipes</p> <p>P7: Construct baffle walls</p> <p>P7: Plaster digester walls</p> <p>P8: Maintain plumb of digester wall</p>	<p>K1: Drawing, measurement and marking methods</p> <p>K2: Pit diameter and depth, excavation tools and uses</p> <p>K3: Mixing ratio and methods of preparing mortar of different ratio</p> <p>K4: Methods of leveling, compacting and ramming</p> <p>K5: Use of different construction tools and equipment, masonry skills</p> <p>K6: Proper location of inlet and outlet pipes</p> <p>K7: Importance of baffle wall</p> <p>K7: Plastering skill, knowledge of ratio of mortar</p> <p>K8: Proper use of plumb-bob</p>
C5.2: Install floating drum (gas holder) – (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)	<p>P1: Prepare scaffolding and formworks for erecting floating drum</p> <p>P2: Install central guide frame</p> <p>P3: Install internal/external guide frame and support ledge</p> <p>P4: Install floating drum (normal or water-jacket)</p>	<p>K1: Fitting of scaffolding and formworks for casting gas holder</p> <p>K2: Positioning of central guide frame, maintaining verticality.</p> <p>K3: Positioning of guide-frame and support ledge</p> <p>K4: Installing water jacket-floating drum and normal floating drum, knowledge of different types of floating drum (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)</p>

	P5: Remove scaffolding and frameworks	K5: Safety precautions while removing scaffoldings/frameworks
C5.3: Construct outlet/ hydraulic chamber	P1: Fix outlet pipe P2: Construct outlet walls  P3: Plaster outlet walls  P4: Maintain plumb of outlet wall P5: Cast concrete cover slab for outlet and fit in place	K1: Methods of fixing outlet pipe K2: Methods of use of different construction tools and equipment, masonry skills K3: Plastering skill, knowledge of ratio of mortar K4: Correct use of plumb-bob K5: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete
C5.4: Construct inlet and mixing tank	P1: Construct platform for inlet tank  P2: Construct walls of inlet tank P3: Plaster inlet tank  P4: Fix mixing device	K1: Use of different construction tools and equipment, masonry skills K2: Types of masonry works K3: Plastering skill, knowledge of ratio of mortar K4: Vertical and horizontal mixture machines
C5.5: Construct slurry collection and composting pit	P1: Select location of slurry collection and composing pit P2: Decide the size of collection and composing pits P3: Supervise excavation of pits  P3: Construct walls and roof of the pits	K1: Proper handling and application of bioslurry K2: General thumb rule to decide the size of slurry pit K3: Pit dimensions, excavation tools and their uses K3: Use of different construction tools and equipment, masonry skills

## Standard 6: Install pipeline and electro-mechanical components

Overview: This competency standard ensures that the participants are able to install biogas conveyance system, biogas filtration system and biogas utilization system as per set quality standards.

Competency Unit	Performance Criteria	Knowledge and Understanding
C6.1: Install pipeline	<p>P1: Describe quality standard of pipes and fittings</p> <p>P2: Select correct size of pipes and fitting</p> <p>P3: Select best alignment for pipe laying</p> <p>P4: Join pipes using correct fitting and sealing agent</p> <p>P5: Protect pipeline against possible damage</p>	<p>K1: Quality standards of pipes and fittings</p> <p>K2: Flow of gas and distance vs. pipe size</p> <p>K3: Effect of longer pipe on cost as well as risk of biogas leakage</p> <p>K4: Plumbing skill and knowledge on fittings and sealing agents such as Teflon tape</p> <p>K5: Methods to protect pipeline against possible damage</p>
C6.2: Install appliances/accessories	<p>P1: Name different types of biogas appliances and end use applications</p> <p>P2: Describe quality standards of appliances</p> <p>P3: Fix biogas stoves, lamps and other appliances as per users' need</p> <p>P4: Install pressure gauge, gas-flow meter and temperature gauge</p>	<p>K1: Types of biogas appliances such as stoves, lamps, water heaters, rice-cookers, generators</p> <p>K2: Quality standards of biogas appliances</p> <p>K3: Methods of fitting appliances, plumbing skills</p> <p>K4: Plumbing skill, functioning of pressure gauge, gas-flow meter and temperature gauge</p>
C6.3: Install gas filtration/purification system	<p>P1: Describe quality standards of filter system</p> <p>P2: Install CO<sub>2</sub> scrubber (for larger biodigesters, more than 100 cum)</p> <p>P3: Install H<sub>2</sub>S remover</p> <p>P4: Install moisture removal</p>	<p>K1: Quality standards of biogas purification system</p> <p>K2: Plumbing skill, understanding of functioning of CO<sub>2</sub> scrubber and safe disposal of carbonated water</p> <p>K3: Plumbing skill, understanding of functioning of H<sub>2</sub>S remover</p> <p>K4: Plumbing skill, understanding of functioning of moisture removal</p>

<p>C6.4: Install pump and/or generator</p>	<p>P1: Describe quality standards of pump/generator  P2: Calculate gas demand and select suitable pump/generator size  P3: Explain modifications of conventional machines to operate with biogas  P4: Install pumping arrangements, generators and control systems and blower or compressor</p>	<p>K1: Quality standards of pump/generators  K2: Knowledge of calculating gas demand and suitable size of pump/generators  K3: Working principle of biogas operated engines  K4: Plumbing skill, knowledge of working of biogas operated engines</p>
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## Standard 7: Perform routine operation and minor maintenance tasks

Overview: This competency standard ensures that the participants are familiar with the routine operational activities as well as minor repair works and they are capable of imparting effective operation and maintenance training to biogas users.

Competency Unit	Performance Criteria	Knowledge and Understanding
C7.1: Describe routine operation activities for trouble-free functioning of biodigester	<p>P1: Prescribe correct quantity of feeding</p> <p>P2: Describe the effect of under-feeding and over-feeding</p> <p>P3: Demonstrate efficient use of different appliances such as water drain, main valve, gas taps</p> <p>P4: Perform leakage testing</p> <p>P5: Explain dos and don'ts dos for effective functioning of biodigesters</p>	<p>K1: Quantity of feeding/biodigester loading rate</p> <p>K2: Effects of underfeeding and overfeeding, change in HRT</p> <p>K3: Operation of different appliances, working principle of appliances</p> <p>K4: Leakage testing methods and protocols, use of soap-water solution, colour smoke etc.</p> <p>K5: dos and don'ts dos for effective functioning of biodigesters</p>
C7.2: Conduct minor repair and maintenance works	<p>P1: Demonstrate painting of floating-drum</p> <p>P2: Perform greasing/oiling of movable parts</p> <p>P3: Perform minor repair of appliances</p> <p>P4: Perform repair of leaked pipeline</p> <p>P5: Maintain central and side guide frames</p>	<p>K1: Methods to protect drum against corrosion, suitable coating products such as, oil paints, synthetic paints and bitumen paints.</p> <p>K2: Greasing techniques, use of repair and maintenance tools</p> <p>K3: Working of appliances, se of repair and maintenance tools</p> <p>K4: Use of plumbing tools, sealing agents, pressure testing and application of soap water solution</p> <p>K5: Need for the verticality of guide-frames, reasons for tilting of drum</p>
C7.3: Identify potential problems and likely solutions	<p>P1: Demonstrate the use of pH meter, pressure meter, foot pump, gas flow meter to identify potential problems</p> <p>P2: Carry out pressure testing to detect biogas</p>	<p>K1: Functioning and use of testing tools and equipment</p>



	<p>leakages</p> <p>P3: Inspect the colour of bioslurry, water dung ratio, flow pattern and odour of bioslurry to assess potential problems</p>	<p>K2: Pressure testing methods and protocols</p> <p>K3: Changes in slurry during the process of biogas formation.</p>
<p>C7.4: Explain methods for optimum utilization of biogas and bioslurry</p>	<p>P1: Describe different uses of biogas and biogas appliances</p> <p>P2: Identify potentials for diversification of biogas end use applications</p> <p>P3: Tell the effect of under-utilisation of biogas</p> <p>P4: Describe characteristics and benefits of bioslurry</p> <p>P5: Apply suitable methods for optimal utilisation of bioslurry</p> <p>P6: Describe the benefits of composting of bioslurry</p>	<p>K1: Different end-use applications and biogas consumption rates of different appliances</p> <p>K2: Various end-use applications of biogas</p> <p>K3: Harmful effect of biogas when escaped in atmosphere</p> <p>K4: Characteristics and benefits of bioslurry</p> <p>K5: Methods of bioslurry applications</p> <p>K5: Nutrient content on composted bioslurry and its comparative benefit over FYM</p>
<p>C7.5: Instruct users for effective operation and maintenance of biodigester</p>	<p>P1: Inform potential problems and likely solutions to users</p> <p>P2: Teach users to carry out effective operation works</p> <p>P3: Teach users to carry out minor repair and maintenance works</p>	<p>K1: Common/ potential problems and likely solutions</p> <p>K2: Facilitation skill, effective operation activities</p> <p>K3: Facilitation skill, repair and maintenance skill</p>
<p>C7.6: Ensure sustainable benefits from biodigester</p>	<p>P1: Provide warranty to ensure long term functioning of biodigester</p> <p>P2: Perform timely after-sale services</p> <p>P3: Provide user's manual</p>	<p>K1: Guarantee provisions and criteria</p> <p>K2: Provision of effective after-sale-services</p> <p>K1: Importance of user's manual</p>

## Standard 8: Practice quality norms and ensure the compliance of quality standards while construction

Overview: This competency standard ensures that the participants are able to realize the importance of quality assurance and practice quality norms while construction and installation. .

Competency Unit	Performance Criteria	Knowledge and Understanding
C8.1: Describe the importance of quality assurance	P1: Describe the definition of quality assurance while constructing biodigester P2: Explain why quality is needed while construction/installation P3: Explain how quality is maintained during construction/installation	K1: Quality assurance norms and methods  K2: Effect of sub-standard quality of work on functioning of a biodigester K3: Methods to maintain quality
C8.2: Practice quality norms during construction	P1: Explain quality standards to be complied while construction/installation P2: Comply with set quality standards while constructing biodigester	K1: Quality standards and norms  K2: Methods to comply with quality standards and norms
C8.3: Describe the roles and responsibilities of a biogas technician	P1: Tell roles and responsibilities of a biogas technician while construction P2: Describe what happens if a biogas technician does not fulfil his/her responsibilities	K1: Internalization of roles and responsibilities of a biogas technician K2: Effects of sub-standard works on quality of end-product and functioning of a biodigester
C8.4: Practice occupational health and safety measures	P1: Demonstrate proper use of personal safety gears such as helmet, dongri, safety shoes, safety belt P2: Exhibit safe use of construction tools and equipment P3: Practice safety measures at works	K1: Use of safety gears during construction and their uses  K2: Construction tools and equipment and their safe uses K3: General safety measures at work

## List of Tools, Machinery & Equipment

<b>Name of Trade</b>		Training of Biodigester Technicians (Masons) to Construct Floating drum Biodigesters for Running Pumps
<b>Duration</b>		Four weeks (24 days or 192 hours)
<b>Sr. No.</b>	<b>Name of Item/ Equipment / Tools</b>	<b>Quantity</b>
	<b>Training Equipment</b>	1
1.	Computer	1
2.	Over-head Projector with screen	1
3.	White board	1
4.	Model/prototype of biodigester	1
5.	Flip chard board and paper	1
6.	Camera	1
7.	Construction video/DVD	1
8.	Calculators	1
	<b>Masonry Tools</b>	
9.	Measuring tape – 5m and 30m length	5
10.	Plumb-bob	5
11.	Water level	2
12.	Mason's Trowel	25
13.	Plastering trowel- 2 types	5
14.	Pointing trowel	5
15.	Pick axe with handle	5
16.	Wheel barrow	2
17.	Chisel sets – 9" and 12"	5
18.	Mason's hammer	5
19.	Hammer – 1.5 kg and 3 kg	5
20.	Straight Edge (4 ft long), metal or wooden	5
21.	Level pipe (transparent plastic)	2
22.	String/thread roll	5
23.	Lime for layout	5 kg
24.	Iron trough/mortar pan – GI 18" dia (for handling concrete, mortar)	10
25.	Line and pins	LS
26.	Spirit level	3
27.	Brushes (wire brush, painting brush)	10
28.	Shovel with handle	5
29.	Builders square	5
30.	Striker for horizontal and vertical joints	5

31.	Steel float – small, medium and large	5
32.	Wooden float – small, medium and large	5
33.	Mason's Tool bag	25
	<b>Plumbing tools</b>	
34.	Hexa-frame and blade sets	5
35.	Pipe wrench – 9" and 12"	2
36.	Plier/slide wrench	2
37.	Spanners	2
38.	Needle file	2
39.	Dice and vice set	1
	<b>Personal Protective equipment</b>	
40.	Helmet	25
41.	Dungaree (Working Uniform)	25
42.	Safety belt	25
43.	Boots/shoes	25
44.	Gloves	25
45.	Rain coats	25
	<b>Biogas Related Appliances/Equipment</b>	
46.	Pressure gauge	1
47.	Biogas analyser	1
48.	pH meter	1
49.	Thermometer with probes	1
50.	Foot or hand pump	1
51.	Gas flow meter	1

## List of Consumable Supplies

<b>Name of Trade</b>	Training of Biogas Technicians (Masons) to Construct Floating drum Biogasifiers for Running Pumps	
<b>Duration</b>	Four weeks (24 days or 192 hours)	
<b>Sr. No.</b>	<b>Name of Consumable Supplies (for a group of 25 participants)</b>	<b>Quantity</b>
	<b>Stationaries</b>	
1.	Flip chart paper	60 sheets
2.	Meta cards – different colours	100 sheets
3.	Marker pens (Permanent and board marker)	10
4.	Masking tape (rolls)	5
5.	Cello tape	2

6.	Lime or marking powder	2 kg
7.	Biodigester drawing	25
8.	Construction manuals	25
9.	Operation manual	25
10.	Ball pen	35
11.	Pencils	35
12.	Erasers	35
13.	Writing pad/note book	25
14.	Glue stick	2
15.	Brochures of biodigester technology	50
16.	Plastic bag	25
17.	White paper (A4)	1 rim
	<b>Construction Materials and appliances for 20 m<sup>3</sup> floating drum biodigester</b>	
18.	Cement	
19.	Bricks	
20.	Sand	
21.	Aggregates 20mm	
22.	Inlet pipes PVC 110 mm diameter 3 m long	
23.	MS Rod 10 mm diameter	
24.	Binding wire	
25.	Gas storage drum	
26.	Angle Iron for Guiding frames	
27.	Scaffolding	
28.	PVC/GI pipe and fittings as per site condition	
29.	Biogas filters (CO <sub>2</sub> scrubber, H <sub>2</sub> S remover, moisture remover)	
30.	Biogas appliances (as per sit condition and users' need)	
31.	Control valves – as per site condition	
32.	Main gas pipe – GI 1.5” diameter, 1 m long with reducing elbow	
33.	Teflon tape	
34.	Pressure gauge	
35.	Biogas flow meter	
36.	Temperature gauge	
37.	Pressure meter	

## Worker Traits and Related Knowledge

### Traits:

- Physically fit/healthy
- Sincere
- Interactive
- Good listener

- Able to work under pressure and difficult circumstances
- Polite
- Cooperative
- Dedicated
- Working with humility
- Intuitive and creative
- Motivating
- Team-spirit
- Trustworthy
- Good communicator
- Influencing
- Hard working
- Out-spoken
- Helpful
- Friendly
- Proactive/ active

**Related Knowledge:**

- Basic principle of biogas generation
- Types and functioning of a biodigester
- Measurement, Units of measurements
- Basic mathematics/calculations
- Drawing reading an interpretation
- Masonry works/ construction methods
- Plumbing works
- Mechanical works
- Operation and functions of different biogas appliances
- Quality standards of construction materials and appliances
- Use of biogas
- Application of bioslurry
- Routine Operational activities
- Minor repair and maintenance of biodigester
- Potential problems and likely solution
- Gas filtering mechanisms
- Effective communication



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