

National Vocational Certificate Level 3 in Biogas Technology

Competency Standards



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Competency Standards: Biogas Technical Supervisors (Fixed Dome Biodigesters)

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

Overview: This competency standard will ensure that the trainees will be able to explain process of biogas production, micro-biological activities/process inside the biodigester, factor supporting and inhibiting 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>The participant will have knowledge and understanding of:</p> <p>K1: Basic bacterial activities to produce biogas, prerequisites for biogas production</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 popular feeding material for biodigesters</p>
C1.2: Explain basic concept of micro-biological activities inside the biodigester	<p>P1: Explain ideal conditions for biogas generation</p> <p>P2: Describe inhibiting factors for gas production</p> <p>P3: Describe the basic concept of waste-to-energy</p>	<p>K1: Effects of (i) temperature, (ii) pH, (iii) total solid (dilution factor) content, (iv) mixing quality, (v) carbon-nitrogen ratio, (vi) HRT and (vii) over and under-feeding on the production of biogas</p> <p>K2: Microbiological activities and effect of toxicity and aerobic condition on biogas generation</p> <p>K3: Different organic and inorganic wastes and management of waste</p>

<p>C1.3: Describe types and functioning/ working of biodigesters</p>	<p>P1: Describe different types of biodigesters and their strengths and weaknesses P2: Explain components of a fixed dome biodigester and function(s) of each component P3: Explain inter-relations of different components of a fixed dome biodigester P4: Describe the criteria to select a particular model of fixed dome biodigesters P5: Explain suitability of fixed dome designs for electricity generation</p>	<p>K1: Different types of biodigesters and their comparative advantages K2: Components and functions of a fixed dome biodigesters K3: Working principle of a fixed dome biodigester K4: Merits and demerits of different designs of fixed dome biodigesters in particular context K5: Strengths and weaknesses of fixed dome design for electricity generation</p>
<p>C1.4: Describe benefits of biodigesters and importance of the technology in Pakistan</p>	<p>P1: Explain the products of a biodigester P2: Recall various end use applications of biogas P3: Recall advantages of bioslurry over FYM P4: Explain benefits of biogas at household, community and commercial levels P5: Explain why biodigester technology is important for Pakistan</p>	<p>K1: Output/ products of biodigesters – Biogas and bioslurry K2: Different end-use application of biogas – cooking, lighting, running an engine K3: Comparative advantage and disadvantages of FYM and bioslurry K4: Benefits of biogas over conventional fuel sources K5: General energy scenario/situation in Pakistan</p>

Standard 2: Describe basic concept of designing a fixed dome biodigesters and perform cost and quantity estimation

Overview: This competency standard ensures that the participants are familiar with the concept of designing a fixed dome biodigester and they are able to calculate cost and quantity estimation of different sizes of fixed dome biodigesters.

Competency Unit	Performance Criteria	Knowledge and Understanding
C2.1: Describe basic criteria for designing a fixed dome biodigesters	<p>P1: Describe the relationship between feeding material (quantity and quality) and type and size of biodigester</p> <p>P2: Describe the steps of designing a fixed dome biodigester</p> <p>P3: Describe effects of the characteristics of construction site (site condition) on design</p>	<p>K1: Feeding requirements for a specific size of biodigester, importance of HRT</p> <p>K2: Sequential steps to design a fixed dome biodigester</p> <p>K3: Site information that need to be collected before starting the design</p>
C2.2: Interpret the relation between HRT, quantity of feeding materials and required size of biodigester	<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 biodigesters and quantity of feeding materials needed.</p>
C2.3: Carry out quantity estimation of different sizes of fixed dome biodigester	<p>P1: Practice basic mathematical calculations</p> <p>P2: Describe the quantity of various construction materials needed for different sizes of biodigesters</p> <p>P3: Prepare detailed quantity estimation of fixed dome biodigesters</p>	<p>K1: Basic addition, subtraction and multiplication and division , Use of calculators</p> <p>K2: Types and quantity of construction materials needed for construction</p> <p>K3: Quantity estimation format, norms and methods, use of calculators</p>
C2.4: Carry out cost estimation of different sizes of fixed dome biodigester	<p>P1: Collect information on market process of construction materials</p> <p>P2: Prepare detailed cost estimation of fixed dome biodigesters</p>	<p>K1: Market prices of various construction materials</p> <p>K2: Cost estimation formats, norms and methods, use of calculators</p>

Standard 3: Read and interpret drawings of fixed dome 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 fixed dome biodigesters.

Competency Unit	Performance Criteria	Knowledge and Understanding
C3.1: 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
C3.2: 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.
C3.3: Demonstrate ability of interpret drawing of fixed dome biodigesters	P1: Describe the dimensions of various components of a fixed dome biodigesters P2: Define plan, section, isometric view, and half sectional elevation of biodigesters P3: Describe inter-relationship of various components of a biodigester	K1: Functioning of biodigester, its components and dimension of various parts. K2: Methods of reading drawings of different components of a fixed dome biodigester K3: Inter-relationship of various biodigester components
C3.4: 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 ₂ S filter, moisture filter, CO ₂ filter

Standard 4: Select suitable type and appropriate size of biodigester

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
C4.1: Select suitable type of biodigester	P1: Explain pre-requisite for the selection of biodigester type such as consideration on durability, reliability, affordability, user-friendliness for construction and operation P2: Describe suitability of different designs in specific site conditions	K1: Criteria to select suitable type of biodigester K2: Different designs of fixed dome biodigester and their suitability in different context
C4.2: Select suitable size of biodigester	P1: Explain pre-requisite for the selection of biodigester size P2: Estimate the quantity of feeding materials (cattle dung) available and gas production P3: Estimate the quantity of gas required based upon end-use applications P4: Select suitable size of biodigester based upon main selection criteria	K1: Criteria to select suitable size of biodigester K2: Calculation of quantity of feeding materials and gas production K3: Various end-use application and gas requirements K4: Different sizes of biodigesters and gas production

Standard 5: 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 fixed dome biodigester and select construction materials to comply with the set quality standards.

Competency Unit	Performance Criteria	Knowledge and Understanding
C5.1: Name different types of construction materials needed for constructing a fixed dome biodigester	P1: State the type of construction materials needed for construction	K1: Different construction materials needed for fixed dome biodigesters
C5.2: 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 acrylic emulsion paint	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: Characteristics of acrylic, methods to apply paint
C5.3: 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 P3: Explain why the distance between biodigester and point of use should be as minimum as possible P4: Explain why biodigester should not be constructed too close to foundation of structures, growing trees, main trail and machines producing vibrations P5: Explain why biodigesters should not be constructed in water logging areas and slide-prone areas	K1: The fact that feeding will be difficult and tiresome if biodigester is far from cattle shed K2: Effect of outside temperature on biodigester K3: Effect of longer conveyance system on installation cost and operation and maintenance K4: Safety in construction, potential damage to biodigester because of roots of a tree and vibrating machines. K5: Potential danger of flooding and cracking of digesters because of water logging and

	P6: Explain the characteristics of best site for constructing biodigesters	ground movements K6: Characteristics of best site for construction of a biodigester
C5.4: Explain steps (sequences) of construction of a fixed dome biodigester	P1: Describe methods of construction of different components of a fixed dome biodigester P2: Describe relative positioning of different components of a fixed dome biodigesters P3: Explain the importance of reference line	K1: Sequence of construction activities K2: Functioning of different components of a fixed dome biodigesters K3: Reference line and its use during construction

Standard 6: Supervise the construction of civil engineering component of a fixed dome biodigester

Overview: This competency standard ensures that the participants are able to supervise the construction of civil structures of a fixed dome biodigester complying with set quality standards.

Competency Unit	Performance Criteria	Knowledge and Understanding
C6.1: Supervise the construction of 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 pipes</p> <p>P7: Plaster digester walls</p> <p>P8: Maintain plumb of digester wall</p> <p>P9: Coach and mentor masons to construct digester</p>	<p>K1: Use of drawing, methods of measurement and marking</p> <p>K2: Pit diameter and depth, use of excavation tools</p> <p>K3: Mixing ratio of cement and sand, and methods of preparing mortar of different ratio</p> <p>K4: Methods of leveling, compacting and ramming</p> <p>K5: Methods of use of different construction tools and equipment, masonry skills</p> <p>K6: Proper location of inlet pipes</p> <p>K7: Plastering methods, ratio of cement and sand on mortar</p> <p>K8: Proper use of plumb-bob</p> <p>K9: Coaching and mentoring techniques</p>
C6.2: Supervise the construction of gas holder and turret	<p>P1: Prepare scaffolding and formworks for dome casting</p> <p>P2: Select and use proper size of templates</p> <p>P3: Prepare mortar and cast gas holder</p> <p>P4: Remove scaffolding and frameworks</p> <p>P5: Carry out inside plastering of gas holder</p> <p>P6: Coach and mentor masons to construct gas holder and turret</p>	<p>K1: Fitting of scaffolding and formworks for casting gas holder</p> <p>K2: Sizes and uses of templates</p> <p>K3: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete</p> <p>K4: Safety precautions while removing scaffoldings/frameworks</p> <p>K5: Importance of gas tightness and methods to apply different layers of plasters to ensure leak-proof gas holder</p> <p>K6: Coaching and mentoring techniques</p>

<p>C6.3: Supervise the construction of manhole, outlet/ hydraulic chamber</p>	<p>P1: Maintain correct size of manhole 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 P6: Coach and mentor masons to construct outlet</p>	<p>K1: Methods of constructing manhole K2: Proper use of different construction tools and equipment, masonry skills K3: Plastering techniques, ratio of cement and sand in mortar K4: Proper use of plumb-bob K5: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete K6: Coaching and mentoring techniques</p>
<p>C6.4: Supervise the construction of inlet and mixing tank</p>	<p>P1: Construct platform for inlet tank P2: Construct walls of inlet tank P3: Plaster inlet tank P4: Fix mixing device P5: Coach and mentor masons to construct inlet and mixing tank</p>	<p>K1: Use of different construction tools and equipment, methods of doing masonry works K2: Brick and stone masonry works K3: Plastering techniques, ratio of cement and sand on mortar K4: Methods of fixing vertical and horizontal mixture machines K5: coaching and mentoring skill</p>
<p>C6.5: Supervise the construction of slurry collection and composting pit</p>	<p>P1: Select location of slurry collection and composing pit P2: Decide the size of collection and composing pits P3: Supervise excavation of pits P4: Construct walls and roof of the pits P5: Coach and mentor masons to construct slurry pits</p>	<p>K1: Methods of handling and application of bioslurry K2: General thumb rule to decide the size of slurry pit K3: Selecting pit dimensions, use of excavation tools K4: Use of different construction tools and equipment, masonry skills K5: Coaching and mentoring techniques</p>

Standard 7: Supervise the installation of pipeline, appliances and electro-mechanical components

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

Competency Unit	Performance Criteria	Knowledge and Understanding
C7.1: Supervise the installation of 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>P6: Coach and mentor masons to install pipelines</p>	<p>K1: Quality standards of pipes and fittings</p> <p>K2: Selection of pipe size based upon distance and flow of biogas</p> <p>K3: Effect of longer pipe on cost as well as risk of biogas leakage</p> <p>K4: Plumbing techniques; fittings and sealing agents such as Teflon tape</p> <p>K5: Methods to protect pipeline against possible damage</p> <p>K6: Coaching and mentoring techniques</p>
C7.2: Supervise the installation of appliances	<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: Supervisor the installation of gas flow meter, temperature gauge and pressure gauge</p> <p>P5: Coach and mentor technicians</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 understanding of functioning of gas flow meter, temperature gauge and pressure gauge</p> <p>K5: Coaching and mentoring skill</p>

<p>C7.3: Supervise the fabrication/ manufacturing and preparation of filtration systems</p>	<p>P1: Describe quality standards of fabrication/manufacturing of filter systems P2: Supervise the fabrication of CO₂ scrubber P3: Supervise the fabrication of H₂S remover P4: Supervise the fabrication of moisture removal</p>	<p>K1: Quality standards of biogas purification system K2: Plumbing skill, fixing and functioning of CO₂ scrubber K3: Plumbing skill, fixing and functioning of H₂S remover K4: Plumbing skill, fixing and functioning of moisture removal</p>
<p>C7.4: Supervise the installation of gas filtration/purification system</p>	<p>P1: Describe quality standards of installation of filter system P2: Install CO₂ scrubber (for bigger plants of more than 100 cum) P3: Install H₂S remover P4: Install moisture removal P5: Coach and mentor masons to install filters</p>	<p>K1: Quality standards of biogas purification system K2: Plumbing techniques, functioning of CO₂ scrubber and safe disposal practices of carbonated water K3: Plumbing techniques, functioning of H₂S remover K4: Plumbing techniques, functioning of moisture removal K6: Coaching and mentoring techniques</p>
<p>C7.5: Supervise the installation of 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, control systems and blowers/compressors P6: Coach and mentor masons to install pumps/generators</p>	<p>K1: Quality standards of pump/generators K2: Methods of calculating gas demand and suitable size of pump/generators K3: Working principle of biogas operated engines K4: Plumbing techniques, working of biogas operated engines K6: Coaching and mentoring techniques</p>

Standard 8: Ensure effective operation and timely maintenance of the installed biodigesters

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
C8.1: 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>
C8.2: Conduct minor repair and maintenance works	<p>P1: Demonstrate changing of washers</p> <p>P2: Perform greasing/oiling of gas taps</p> <p>P3: Perform minor repair of appliances</p> <p>P4: Perform repair of leaked pipeline</p>	<p>K1: Use of repair and maintenance tools</p> <p>K2: Greasing techniques</p> <p>K3: Working of appliances</p> <p>K4: Use of plumbing tools, and sealing agents</p>
C8.3: 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 leakages</p> <p>P3: Inspect the colour of bioslurry, water dung ratio, flow pattern and odour of bioslurry to assess potential problems</p>	<p>K1: Functioning and use of testing tools and equipment</p> <p>K2: Pressure testing methods and protocols</p> <p>K3: Changes in slurry during the process of biogas formation.</p>
C8.4: Explain methods for optimum utilization of biogas and bioslurry	<p>P1: Describe different uses of biogas and biogas appliances</p> <p>P2: Identify potentials for diversification of biogas end use applications</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>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>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>
C8.5: Instruct users for effective operation and maintenance of biodigester	<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 techniques, effective operation activities</p> <p>K3: Facilitation techniques, repair and maintenance methods</p>
C8.6: Plan, conduct and facilitate users' training	<p>P1: Organize, conduct and facilitate user's training on operation and maintenance</p> <p>P2: Demonstrate effective use of biogas</p> <p>P3: Demonstrate methods of using bioslurry</p>	<p>K1: Training and facilitation techniques, planning and organizing adult training</p> <p>K2: Methods of optimal use of biogas</p> <p>K3: Methods of bioslurry application and handling</p>
C8.7: Ensure sustainable benefits from biodigester	<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: Need of effective after-sale-services</p> <p>K1: Importance of user's manual</p>

Standard 9: Perform technology promotion and quality assurance tasks

Overview: This competency standard ensures that the participants are able to apply promotion and marketing techniques; and enforce quality assurance mechanisms for ensuring quality product.

Competency Unit	Performance Criteria	Knowledge and Understanding
C9.1: Promote biodigester technology in Pakistan	P1: Identify and explain unique-selling points for marketing biogas technology in Pakistan P2: Adopt different tools and techniques for the promotion of biogas technology	K1: Promotion and marketing of new technology K2: Promotion and marketing tools and their application
C9.2: Describe the importance of quality assurance	P1: Describe the definition of quality assurance while constructing biodigester P2: Explain why quality is needed while construction P3: Explain how quality is maintained during construction	K1: Quality assurance norms and methods K2: Effect of sub-standard quality of work on functioning of a biodigester K3: Methods to maintain quality
C9.3: Ensure that the masons/technicians practice quality norms during construction	P1: Explain quality standards to be complied while construction P2: Supervise the work of mason to comply with set quality standards while constructing biodigester	K1: Quality standards and norms K2: Methods to comply with quality standards and norms
C9.4: Describe the roles and responsibilities of a technical supervisor	P1: Tell roles and responsibilities of a biogas technical supervisor while construction P2: Describe what happens if a biogas technical supervisor does not fulfil his/her responsibilities	K1: Internalization of roles and responsibilities of a biogas technician K2: Effect of sub-standard works on quality of end-product and functioning of a biodigester
C9.5: Ensure that occupational health and safety measures are practiced properly	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: Safety gears during construction and their uses K2: Construction tools and equipment and their safe uses K3: General safety measures at work

<p>C9.6: Conduct routine quality control visits and manage data properly</p>	<p>P1: Fill quality control forms and formats</p> <p>P2: Ensure proper management of data and information</p> <p>P3: Coach and mentor the masons/technicians as and when needed</p>	<p>K1: Different forms and formats for quality control</p> <p>K2: Data collection, data handling and data management techniques</p> <p>K3: Coaching and mentoring techniques</p>
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List of Tools, Machinery & Equipment

Name of Trade		Training of Biodigester Technical Supervisors to supervise the construction of Fixed Dome Biodigesters for Running Pumps
Duration		Four weeks (33 days or 264 hours)
Sr. No.	Name of Item/ Equipment / Tools	Quantity
	Training Equipment	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
	Masonry Tools – for a group of 25 participants	
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.	Templates (different sizes according to size of biodigester)	2
21.	Straight Edge (4 ft long), metal or wooden	5
22.	Level pipe (transparent plastic)	2
23.	String/thread roll	5
24.	Lime for layout	5 kg
25.	Iron trough/mortar pan – GI 18" dia (for handling concrete, mortar)	10
26.	Line and pins	LS
27.	Spirit level	3
28.	Brushes (wire brush, painting brush)	10
29.	Shovel with handle	5
30.	Builders square	5

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

List of Consumable Supplies

Name of Trade	Training of Biogas Technical Supervisors to supervise the construction of Fixed Dome Biogasifiers for Running Pumps	
Duration	Four weeks (33 days or 264 hours)	
Sr. No.	Name of Consumable Supplies (for a group of 25 participants)	Quantity
	Stationaries	
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.	Bag	25
17.	White paper (A4)	1 rim
Construction Materials and appliances for 20 m³ fixed-dome biodigester		
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.	Acrylic emulsion paint	
26.	Scaffolding (if earthen mould is not used)	
27.	PVC/GI pipe and fittings as per site condition	
28.	Biogas filters (CO ₂ scrubber, H ₂ S remover, moisture remover)	
29.	Biogas appliances (as per sit condition and users' need)	
30.	Control valves – as per site condition	
31.	Main gas pipe – GI 1.5" diameter, 1 m long with reducing elbow	
32.	Teflon tape	
33.	Pressure gauge	
34.	Gas flow meter	
35.	Temperature gauge	

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
- 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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