Competency Standards

for

Biogas Technicians (Fixed Dome Biodigesters)
(Level 2)

National Vocational & Technical Training Commission
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### Competency Standards: Biogas Technicians (Fixed Dome 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

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1.1: Explain prerequisites for biogas generation</td>
<td>P1: Explain methods of biogas production</td>
<td>The participants will be able to understand:</td>
</tr>
<tr>
<td></td>
<td>P2: Explain different types of inputs (feeding materials) for biodigesters</td>
<td>K1: Basic bacterial activities to produce biogas</td>
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<td></td>
<td>P3: Explain merits and demerits of different feeding materials</td>
<td>K2: Different types of inputs to operate a biodigester</td>
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<td></td>
<td>P4: Describe why cattle dung is the best feeding material for Pakistan context</td>
<td>K3: Merits and demerits of different feeding materials</td>
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<td></td>
<td>P5: Explain ideal conditions for biogas generation</td>
<td>K4: Reasons for using cattle dung as the main feeding material in Pakistan</td>
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<td>P6: Describe effects of temperature on biogas generation</td>
<td>K5: Methods and prerequisites to ensure effective biogas production</td>
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<td></td>
<td>K6: Suitability of biodigester in different climatic conditions</td>
</tr>
<tr>
<td>C1.2: Describe types and functioning/working of biodigesters</td>
<td>P1: Describe different types of biodigesters and their strengths and weaknesses</td>
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<td></td>
<td>P2: Explain components of a fixed dome biodigester and function(s) of each component</td>
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<td>P3: Explain inter-relationships of different components of a fixed dome biodigester</td>
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<td>P4: Describe the criteria to select a particular model of fixed dome biodigesters</td>
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<td>P5: Explain suitability of fixed dome designs for electricity generation</td>
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<tr>
<td></td>
<td></td>
<td>K1: Different types of biodigesters and their comparative advantages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>K2: Components and functions of a fixed dome biodigesters</td>
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<tr>
<td></td>
<td></td>
<td>K3: Working principle of a fixed dome biodigester</td>
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<tr>
<td></td>
<td></td>
<td>K4: Merits and demerits of different designs of fixed dome biodigesters in particular context</td>
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<tr>
<td></td>
<td></td>
<td>K5: Strengths and weaknesses of fixed dome design for electricity generation</td>
</tr>
<tr>
<td>C1.3: Describe benefits of biodigesters and importance of the technology in Pakistan</td>
<td>P1: Explain the products of a biodigester</td>
<td>K1: Products/outputs of biodigesters – Biogas and bioslurry</td>
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<td></td>
<td>P2: Recall various end use applications of biogas</td>
<td>K2: Different biogas end-use applications – cooking, lighting, running an engine</td>
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<td></td>
<td>P3: Recall advantages of bioslurry over FYM</td>
<td>K3: Comparative advantage and disadvantages of FYM and bioslurry</td>
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<td></td>
<td>P4: Explain benefits of biogas at household, community and commercial levels</td>
<td>K4: Benefits of biogas over conventional fuel sources</td>
</tr>
<tr>
<td></td>
<td>P5: Explain why biodigester technology is important for Pakistan</td>
<td>K5: General energy situation in Pakistan</td>
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</tbody>
</table>
### Standard 2: 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| 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: Notions 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 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: Working 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 |
| 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: H₂S filter, moisture filter, CO₂ filter |
# Standard 3: Select suitable type and appropriate size of 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| **C3.1: 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 |
| **C3.2: 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 |
| **C3.3: Carry out basic calculations** | P1: Practice addition, subtraction and multiplication of measurement units  
P2: Calculate cost and quantity estimation of biodigesters  
P3: Describe the quantity of various construction materials needed for different sizes of biodigesters | K1: Basic addition, subtraction and multiplication  
K2: Use of calculators  
K3: Types and quantity of construction materials needed for construction |
| **C3.4: Interpret the relation between HRT** | P1: Describe the effect of HRT on size selection | K1: Concept of HRT and its effect on size |
| quantity of feeding materials and required size of biodigester | P2: Explain relation between quantity of feeding and HRT  
P3: Select size of biodigester based upon feeding materials and estimated HRT | selection  
K2: Types of feeding materials and estimated HRT  
K3: Different sizes of biodigesters and quantity of feeding materials needed. |
**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 fixed dome biodigester and select construction materials to comply with the set quality standards.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C4.1: Name different types of construction materials needed for constructing a fixed dome biodigester</strong></td>
<td>P1: State the type of construction materials needed for construction</td>
<td>K1: Different construction materials needed for fixed dome biodigesters</td>
</tr>
</tbody>
</table>
| **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 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 |
| **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  
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 | K1: Effects of long distance between digester and cattle shed on feeding of biodigester  
K2: Effect of outside temperature on digester temperature  
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. |
| C4.4: 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: Biodigester construction and sequence of construction activities  
K2: Functioning of different components of a fixed dome biodigesters  
K3: Reference line and its use during construction |
| --- | --- | --- |
| constructed in water logging areas and slide-prone areas  
P6: Explain the characteristics of best site for constructing biodigesters | K5: Potential danger of flooding and cracking of digesters because of water logging and ground movements  
K6: Basic criteria to select best site for construction |
**Standard 5: Construct civil engineering component of a fixed dome biodigester**

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

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
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<tbody>
<tr>
<td>C5.1: Construct digester</td>
<td>P1: Demonstrate methods for lay out (demarcation) of biodigester</td>
<td>K1: Use and interpretation of drawing, measurement and marking</td>
</tr>
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<td></td>
<td>P2: Supervise the excavation of pit</td>
<td>K2: Pit diameter and depth, excavation tools and their uses</td>
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<td></td>
<td>P3: Prepare mortar</td>
<td>K3: Mixing ratio and methods of preparing mortar of different ratio</td>
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<td></td>
<td>P4: Prepare base of the digester and construct foundation</td>
<td>K4: Methods of leveling, compacting and ramming</td>
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<td></td>
<td>P5: Construct digester walls</td>
<td>K5: Use of different construction tools and equipment, masonry skills</td>
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<tr>
<td></td>
<td>P6: Fix inlet pipes</td>
<td>K6: Location and fixation of inlet pipes</td>
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<td>P7: Plaster digester walls</td>
<td>K7: Plastering skill, ratio of mortar</td>
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<tr>
<td></td>
<td>P8: Maintain plumb of digester wall</td>
<td>K8: Proper use of plumb-bob</td>
</tr>
<tr>
<td>C5.2: Construct gas holder and turret</td>
<td>P1: Prepare scaffolding and formworks for dome casting</td>
<td>K1: Fitting of scaffolding and formworks for casting gas holder</td>
</tr>
<tr>
<td></td>
<td>P2: Select and use proper size of templates</td>
<td>K2: Sizes and uses of templates</td>
</tr>
<tr>
<td></td>
<td>P3: Prepare mortar and cast gas holder</td>
<td>K3: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete</td>
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<tr>
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<td>P4: Remove scaffolding and frameworks</td>
<td>K4: Safety precautions while removing scaffoldings/frameworks</td>
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<td></td>
<td>P5: Carry out inside plastering of gas holder</td>
<td>K5: Gas tightness and methods to apply different layers of plasters to ensure leak-proof gas holder</td>
</tr>
</tbody>
</table>
| C5.3: Construct manhole, outlet/hydraulic chamber | 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 | K1: Methods of constructing manhole  
K2: Proper use of different construction tools and equipment, masonry skills  
K3: Plastering skill, ratio of cement and sand on mortar  
K4: Proper 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 woks  
K3: Plastering skill, ratio of sand and cement on mortar  
K4: Fixation and use of vertical and horizontal mixture machines |
| C5.5: Construct slurry collection and composting pit | P1: Select location of slurry collection and composting pit  
P2: Decide the size of collection and composting pits  
P3: Supervise excavation of pits  
P4: Construct walls and roof of the pits | K1: Methods of 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: Proper 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| C6.1: Install pipeline | P1: Describe quality standard of pipes and fittings  
P2: Select correct size of pipes and fitting  
P3: Select best alignment for pipe laying  
P4: Join pipes using correct fitting and sealing agent  
P5: Protect pipeline against possible damage | K1: Quality standards of pipes and fittings  
K2: Selection of pipe-size based upon flow of gas and distance  
K3: Effect of longer pipe on cost as well as risk of biogas leakage  
K4: Plumbing skill, fixation of fittings and sealing agents such as Teflon tape  
K5: Methods to protect pipeline against possible damage |
| C6.2: Install appliances/accessories | P1: Name different types of biogas appliances and end use applications  
P2: Describe quality standards of appliances  
P3: Fix biogas stoves, lamps and other appliances as per users’ need  
P4: Install pressure gauge, gas-flow meter and temperature gauge | K1: Types of biogas appliances such as stoves, lamps, water heaters, rice-cookers, generators  
K2: Quality standards of biogas appliances  
K3: Methods of fitting appliances, plumbing skills  
K4: Plumbing skill, functioning of pressure gauge, gas-flow meter and temperature gauge |
| C6.3: Install gas filtration/purification system | P1: Describe quality standards of filter system  
P2: Install CO₂ scrubber (for larger biodigesters, more than 100 cum)  
P3: Install H₂S remover  
P4: Install moisture removal | K1: Quality standards of biogas purification system  
K2: Plumbing skill, understanding of functioning of CO₂ scrubber and safe disposal of carbonated water  
K3: Plumbing skill, understanding of functioning of H₂S remover  
K4: Plumbing skill, understanding of functioning of moisture removal |
C6.4: Install pump and/or generator

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<tr>
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<tbody>
<tr>
<td>P1: Describe quality standards of pump/generator</td>
<td>K1: Quality standards of pump/generators</td>
</tr>
<tr>
<td>P2: Calculate gas demand and select suitable pump/generator size</td>
<td>K2: Methods of calculating gas demand and suitable size of pump/generators</td>
</tr>
<tr>
<td>P3: Explain modifications of conventional machines to operate with biogas</td>
<td>K3: Working principle of biogas operated engines</td>
</tr>
<tr>
<td>P4: Install pumping arrangements, generators, control systems and blowers/compressors</td>
<td>K4: Plumbing skill, working of biogas operated engines</td>
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</tbody>
</table>
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.

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<thead>
<tr>
<th>Competency Unit</th>
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</table>
| C7.1: Describe routine operation activities for trouble-free functioning of biodigester | P1: Prescribe correct quantity of feeding  
P2: Describe the effect of under-feeding and over-feeding  
P3: Demonstrate efficient use of different appliances such as water drain, main valve, gas taps  
P4: Perform leakage testing  
P5: Explain dos and don'ts dos for effective functioning of biodigesters | K1: Quantity of feeding/biodigester loading rate  
K2: Effects of underfeeding and overfeeding, change in HRT  
K3: Operation of different appliances, working principle of appliances  
K4: Leakage testing methods and protocols, use of soap-water solution, colour smoke etc.  
K5: dos and don'ts dos for effective functioning of biodigesters |
| C7.2: Conduct minor repair and maintenance works          | P1: Demonstrate changing of washers  
P2: Perform greasing/oiling of gas taps  
P3: Perform minor repair of appliances  
P4: Perform repair of leaked pipeline | K1: Use of repair and maintenance tools  
K2: Greasing techniques  
K3: Working of appliances  
K4: Use of plumbing tools, and sealing agents |
| C7.3: Identify potential problems and likely solutions    | P1: Demonstrate the use of pH meter, pressure meter, foot pump, gas flow meter to identify potential problems  
P2: Carry out pressure testing to detect biogas leakages  
P3: Inspect the colour of bioslurry, water dung ratio, flow pattern and odour of bioslurry to assess potential problems | K1: Functioning and use of testing tools and equipment  
K2: Pressure testing methods and protocols  
K3: Changes in slurry during the process of biogas formation. |
| C7.4: Explain methods for optimum utilization of biogas and bioslurry | P1: Describe different uses of biogas and biogas appliances  
P2: Identify potentials for diversification of biogas end use applications  
P3: Tell the effect of under-utilisation of biogas  
P4: Describe characteristics and benefits of bioslurry  
P5: Apply suitable methods for optimal utilisation of bioslurry  
P6: Describe the benefits of composting of bioslurry | K1: Different end-use applications and biogas consumption rates of different appliances  
K2: Various end-use applications of biogas  
K3: Potential harmful effect of biogas when escaped in atmosphere  
K4: Characteristics and benefits of bioslurry  
K5: Methods of bioslurry applications  
K5: Nutrient content on composted bioslurry and its comparative benefit over FYM |
|---|---|---|
| C7.5: Instruct users for effective operation and maintenance of biodigester | P1: Inform potential problems and likely solutions to users  
P2: Teach users to carry out effective operation works  
P3: Teach users to carry out minor repair and maintenance works | K1: Common/potential problems to be encountered and likely solutions  
K2: Facilitation skill, effective operation activities  
K3: Facilitation skill, repair and maintenance skill |
| C7.6: Ensure sustainable benefits from biodigester | P1: Provide warranty to ensure long term functioning of biodigester  
P2: Perform timely after-sale services  
P3: Provide user’s manual | K1: Guarantee provisions for biodigesters and criteria  
K2: Effective after-sale-services  
K1: Importance of user’s manual |
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.

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<tr>
<th>Competency Unit</th>
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</table>
| 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 and installation  
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 |
| 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: Types of safety gears and their uses during construction  
K2: Construction tools and equipment and their safe uses  
K3: General safety measures at work |
### List of Tools, Machinery & Equipment

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

**Name of Trade** | Training of Biodigester Technicians (Masons) to Construct Fixed dome Biodigesters for Running Pumps  
---|---  
**Duration** | Four weeks (24 days or 192 hours)  
**Sr. No.** | **Name of Consumable Supplies (for a group of 25 participants)** | **Quantity**  
---|---|---  
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
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<tr>
<td>5.</td>
<td>Cello tape</td>
</tr>
<tr>
<td>6.</td>
<td>Lime or marking powder</td>
</tr>
<tr>
<td>7.</td>
<td>Biodigester drawing</td>
</tr>
<tr>
<td>8.</td>
<td>Construction manuals</td>
</tr>
<tr>
<td>9.</td>
<td>Operation manual</td>
</tr>
<tr>
<td>10.</td>
<td>Ball pen</td>
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<tr>
<td>11.</td>
<td>Pencils</td>
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<tr>
<td>12.</td>
<td>Erasers</td>
</tr>
<tr>
<td>13.</td>
<td>Writing pad/note book</td>
</tr>
<tr>
<td>14.</td>
<td>Glue stick</td>
</tr>
<tr>
<td>15.</td>
<td>Brochures of biodigester technology</td>
</tr>
<tr>
<td>16.</td>
<td>Bags</td>
</tr>
<tr>
<td>17.</td>
<td>White paper (A4)</td>
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</tbody>
</table>

**Construction Materials and appliances for 20 m² fixed dome biodigester**

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<table>
<thead>
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<tbody>
<tr>
<td>18.</td>
<td>Cement</td>
</tr>
<tr>
<td>19.</td>
<td>Bricks</td>
</tr>
<tr>
<td>20.</td>
<td>Sand</td>
</tr>
<tr>
<td>21.</td>
<td>Aggregates 20mm</td>
</tr>
<tr>
<td>22.</td>
<td>Inlet pipes PVC 110 mm diameter 3 m long</td>
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<tr>
<td>23.</td>
<td>MS Rod 10 mm diameter</td>
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<tr>
<td>24.</td>
<td>Binding wire</td>
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<tr>
<td>25.</td>
<td>Gas storage drum</td>
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<tr>
<td>26.</td>
<td>Angle Iron for Guiding frames</td>
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<tr>
<td>27.</td>
<td>Scaffolding</td>
</tr>
<tr>
<td>28.</td>
<td>PVC/GI pipe and fittings as per site condition</td>
</tr>
<tr>
<td>29.</td>
<td>Biogas filters (CO₂ scrubber, H₂S remover, moisture remover)</td>
</tr>
<tr>
<td>30.</td>
<td>Biogas appliances (as per site condition and users’ need)</td>
</tr>
<tr>
<td>31.</td>
<td>Control valves – as per site condition</td>
</tr>
<tr>
<td>32.</td>
<td>Main gas pipe – GI 1.5” diameter, 1 m long with reducing elbow</td>
</tr>
<tr>
<td>33.</td>
<td>Teflon tape</td>
</tr>
<tr>
<td>34.</td>
<td>Pressure gauge</td>
</tr>
<tr>
<td>35.</td>
<td>Biogas flow meter</td>
</tr>
<tr>
<td>36.</td>
<td>Temperature gauge</td>
</tr>
</tbody>
</table>

**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