Competency Standards

for

Biogas Technical Supervisor (Fixed Dome Biodigesters) (Level 3)

National Vocational & Technical Training Commission
# Table of contents

Competency Standards: Biogas Technical Supervisors (Fixed Dome Biodigesters) .................................................................................................................. 3

Standard-1: Describe basic concepts of biogas production and benefits of biodigester technology .................................................................................. 3

Standard 2: Describe basic concept of designing a fixed dome biodigesters and perform cost and quantity estimation ................................................. 5

Standard 3: Read and interpret drawings of fixed dome biodigesters ................................................................................................................................. 6

Standard 4: Select suitable type and appropriate size of biodigester ............................................................................................................................. 7

Standard 5: Select construction materials and construction site ............................................................................................................................... 8

Standard 6: Supervise the construction of civil engineering component of a fixed dome biodigester ........................................................................... 10

Standard 7: Supervise the installation of pipeline, appliances and electro-mechanical components ......................................................................... 12

Standard 8: Ensure effective operation and timely maintenance of the installed biodigesters ................................................................................... 14

Standard 9: Perform technology promotion and quality assurance tasks .................................................................................................................. 16

List of Tools, Machinery & Equipment ........................................................................................................................................................................... 18

List of Consumable Supplies ......................................................................................................................................................................................... 19

Worker Traits and Related Knowledge ........................................................................................................................................................................... 20
## 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C1.1: Explain prerequisites for biogas generation</strong></td>
<td>P1: Explain methods of biogas production</td>
<td>The participant will have knowledge and understanding of:</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, prerequisites for biogas production</td>
</tr>
<tr>
<td></td>
<td>P3: Explain merits and demerits of different feeding materials</td>
<td>K2: Different types of inputs to operate a biodigester</td>
</tr>
<tr>
<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>
</tr>
<tr>
<td></td>
<td></td>
<td>K4: Reasons for the use of cattle dung as the popular feeding material for biodigesters</td>
</tr>
<tr>
<td><strong>C1.2: Explain basic concept of micro-biological activities inside the biodigester</strong></td>
<td>P1: Explain ideal conditions for biogas generation</td>
<td>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</td>
</tr>
<tr>
<td></td>
<td>P2: Describe inhibiting factors for gas production</td>
<td>K2: Microbiological activities and effect of toxicity and aerobic condition on biogas generation</td>
</tr>
<tr>
<td></td>
<td>P3: Describe the basic concept of waste-to-energy</td>
<td>K3: Different organic and inorganic wastes and management of waste</td>
</tr>
</tbody>
</table>
| C1.3: Describe types and functioning/working of biodigesters | 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 | 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 |
|---|---|---|
| C1.4: Describe benefits of biodigesters and importance of the technology in Pakistan | 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 | 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 |
**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.

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

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| **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: H₂S filter, moisture filter, CO₂ 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>C5.1: Name different types of construction materials needed for constructing a fixed dome biodigester</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>
| 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... |
| C5.4: Explain steps (sequences) of construction of a fixed dome biodigester | P6: Explain the characteristics of best site for constructing biodigesters | ground movements  
K6: Characteristics of best site for construction of a 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| C6.1: Supervise the construction of digester | P1: Demonstrate methods for lay out (demarcation) of biodigester  
P2: Supervise the excavation of pit  
P3: Prepare mortar  
P4: Prepare base of the digester and construct foundation  
P5: Construct digester walls  
P6: Fix inlet pipes  
P7: Plaster digester walls  
P8: Maintain plumb of digester wall  
P9: Coach and mentor masons to construct digester | K1: Use of drawing, methods of measurement and marking  
K2: Pit diameter and depth, use of excavation tools  
K3: Mixing ratio of cement and sand, and methods of preparing mortar of different ratio  
K4: Methods of leveling, compacting and ramming  
K5: Methods of use of different construction tools and equipment, masonry skills  
K6: Proper location of inlet pipes  
K7: Plastering methods, ratio of cement and sand on mortar  
K8: Proper use of plumb-bob  
K9: Coaching and mentoring techniques |
| C6.2: Supervise the construction of gas holder and turret | P1: Prepare scaffolding and formworks for dome casting  
P2: Select and use proper size of templates  
P3: Prepare mortar and cast gas holder  
P4: Remove scaffolding and frameworks  
P5: Carry out inside plastering of gas holder  
P6: Coach and mentor masons to construct gas holder and turret | K1: Fitting of scaffolding and formworks for casting gas holder  
K2: Sizes and uses of templates  
K3: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete  
K4: Safety precautions while removing scaffolding/frameworks  
K5: Importance of gas tightness and methods to apply different layers of plasters to ensure leak-proof gas holder  
K6: Coaching and mentoring techniques |
| C6.3: Supervise the construction of 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  
P6: Coach and mentor masons to construct outlet | 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 |
| --- | --- | --- |
| C6.4: Supervise the construction of inlet and mixing tank | 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 | K1: Use of different construction tools and equipment, methods of doing masonry works  
K2: Brick and stone masonry woks  
K3: Plastering techniques, ratio of cement and sand on mortar  
K4: Methods of fixing vertical and horizontal mixture machines  
K5: Coaching and mentoring skill |
| C6.5: Supervise the construction of 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  
P4: Construct walls and roof of the pits  
P5: Coach and mentor masons to construct slurry pits | 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 |
**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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C7.1: Supervise the installation of pipeline</strong></td>
<td>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  P6: Coach and mentor masons to install pipelines</td>
<td>K1: Quality standards of pipes and fittings  K2: Selection of pipe size based upon distance and flow of biogas  K3: Effect of longer pipe on cost as well as risk of biogas leakage  K4: Plumbing techniques; fittings and sealing agents such as Teflon tape  K5: Methods to protect pipeline against possible damage  K6: Coaching and mentoring techniques</td>
</tr>
<tr>
<td><strong>C7.2: Supervise the installation of appliances</strong></td>
<td>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: Supervisor the installation of gas flow meter, temperature gauge and pressure gauge  P5: Coach and mentor technicians</td>
<td>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 understanding of functioning of gas flow meter, temperature gauge and pressure gauge  K5: Coaching and mentoring skill</td>
</tr>
</tbody>
</table>
| C7.3: Supervise the fabrication/manufacturing and preparation of filtration systems | 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 | 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 |
| C7.4: Supervise the installation of gas filtration/purification system | 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 | 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 |
| C7.5: Supervise the installation of pump and/or generator | 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 | 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 |
### 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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| C8.1: 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 |
| C8.2: 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 |
| C8.3: 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 |
| C8.4: 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 | K1: Different end-use applications and biogas consumption rates of different appliances  
K2: Various end-use applications of biogas |
| C8.5: 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 and likely solutions  
K2: Facilitation techniques, effective operation activities  
K3: Facilitation techniques, repair and maintenance methods |
| --- | --- | --- |
| 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 | K3: 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 |
| C8.6: Plan, conduct and facilitate users’ training | P1: Organize, conduct and facilitate user’s training on operation and maintenance  
P2: Demonstrate effective use of biogas  
P3: Demonstrate methods of using bioslurry | K1: Training and facilitation techniques, planning and organizing adult training  
K2: Methods of optimal use of biogas  
K3: Methods of bioslurry application and handling |
| C8.7: 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 and criteria  
K2: Need of effective after-sale-services  
K1: Importance of user’s manual |
**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.

<table>
<thead>
<tr>
<th>Competency Unit</th>
<th>Performance Criteria</th>
<th>Knowledge and Understanding</th>
</tr>
</thead>
</table>
| 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 |
<table>
<thead>
<tr>
<th>C9.6: Conduct routine quality control visits and manage data properly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>P1:</strong> Fill quality control forms and formats</td>
</tr>
<tr>
<td><strong>P2:</strong> Ensure proper management of data and information</td>
</tr>
<tr>
<td><strong>P3:</strong> Coach and mentor the masons/technicians as and when needed</td>
</tr>
<tr>
<td><strong>K1:</strong> Different forms and formats for quality control</td>
</tr>
<tr>
<td><strong>K2:</strong> Data collection, data handling and data management techniques</td>
</tr>
<tr>
<td><strong>K3:</strong> Coaching and mentoring techniques</td>
</tr>
</tbody>
</table>
List of Tools, Machinery & Equipment

<table>
<thead>
<tr>
<th>Name of Trade</th>
<th>Training of Biodigester Technical Supervisors to supervise the construction of Fixed Dome Biodigesters for Running Pumps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>Four weeks (33 days or 264 hours)</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Name of Consumable Supplies (for a group of 25 participants)</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Stationaries</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Flip chart paper</td>
<td>60 sheets</td>
</tr>
<tr>
<td>2.</td>
<td>Meta cards – different colours</td>
<td>100 sheets</td>
</tr>
<tr>
<td>3.</td>
<td>Marker pens (Permanent and board marker)</td>
<td>10</td>
</tr>
<tr>
<td>4.</td>
<td>Masking tape (rolls)</td>
<td>5</td>
</tr>
<tr>
<td>5.</td>
<td><strong>Plumbing tools</strong></td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>Hexa-frame and blade sets</td>
<td>5</td>
</tr>
<tr>
<td>36.</td>
<td>Pipe wrench – 9” and 12”</td>
<td>2</td>
</tr>
<tr>
<td>37.</td>
<td>Plier/slide wrench</td>
<td>2</td>
</tr>
<tr>
<td>38.</td>
<td>Spanners</td>
<td>2</td>
</tr>
<tr>
<td>39.</td>
<td>Needle file</td>
<td>2</td>
</tr>
<tr>
<td>40.</td>
<td>Dice and vice set</td>
<td>1</td>
</tr>
<tr>
<td>6.</td>
<td><strong>Personal Protective equipment</strong></td>
<td></td>
</tr>
<tr>
<td>41.</td>
<td>Helmet</td>
<td>25</td>
</tr>
<tr>
<td>42.</td>
<td>Dungaree (Working uniform)</td>
<td>25</td>
</tr>
<tr>
<td>43.</td>
<td>Safety belt</td>
<td>25</td>
</tr>
<tr>
<td>44.</td>
<td>Boots/shoes</td>
<td>25</td>
</tr>
<tr>
<td>45.</td>
<td>Gloves</td>
<td>25</td>
</tr>
<tr>
<td>46.</td>
<td>Rain coats</td>
<td>25</td>
</tr>
<tr>
<td>7.</td>
<td><strong>Biogas Related Appliances/Equipment</strong></td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>Pressure gauge</td>
<td>1</td>
</tr>
<tr>
<td>48.</td>
<td>Biogas analyser</td>
<td>1</td>
</tr>
<tr>
<td>49.</td>
<td>pH meter</td>
<td>1</td>
</tr>
<tr>
<td>50.</td>
<td>Thermometer with probes</td>
<td>1</td>
</tr>
<tr>
<td>51.</td>
<td>Foot or hand pump</td>
<td>1</td>
</tr>
</tbody>
</table>

**List of Consumable Supplies**

**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)
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<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>
</tr>
<tr>
<td>11.</td>
<td>Pencils</td>
</tr>
<tr>
<td>12.</td>
<td>Erasers</td>
</tr>
<tr>
<td>13.</td>
<td>Writing pad / notebook</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>Bag</td>
</tr>
<tr>
<td>17.</td>
<td>White paper (A4)</td>
</tr>
</tbody>
</table>

**Construction Materials and appliances for 20 m² 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 (CO₂ scrubber, H₂S remover, moisture remover)
29. Biogas appliances (as per site 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