

BIOGAS PLANT TECHNICIAN FLOATING DRUM

Competency Standards

National Vocational
Certificate Level 3

Version 1 - December 2014

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Competency Standards: Biogas Technical Supervisors (Floating drum 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 participants 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 use of cattle dung as the feeding material</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: Organic and inorganic wastes, 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 Floating drum biodigester and function(s) of each component P3: Explain inter-relations of different components of a Floating drum biodigester P4: Describe the criteria to select a particular model of Floating drum biodigesters P5: Explain suitability of Floating drum designs for electricity generation</p>	<p>K1: Different types of biodigesters and their comparative advantages K2: Components and functions of a Floating drum biodigesters K3: Working principle of a Floating drum biodigester K4: Merits and demerits of different designs of Floating drum biodigesters in particular context K5: Strengths and weaknesses of Floating drum 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 and community level P5: Explain why biodigester technology is important for Pakistan</p>	<p>K1: Products of biodigesters – Biogas and bioslurry K2: Diversified use 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 in Pakistan</p>

Standard 2: Describe basic concept of designing a floating drum biodigesters and perform cost and quantity estimation

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

Competency Unit	Performance Criteria	Knowledge and Understanding
C2.1: Describe basic criteria for designing a floating drum 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 Floating drum 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, understanding of HRT</p> <p>K2: Sequential steps to design a Floating drum 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: 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 floating drum 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 floating drum 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 Floating drum biodigester	<p>P1: Collect information on market process of construction materials</p> <p>P2: Prepare detailed cost estimation of floating drum 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 floating drum biodigesters

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

Competency Unit	Performance Criteria	Knowledge and Understanding
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 good drawing K2: 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 floating drum biodigesters	P1: Describe the dimensions of various components of a Floating drum biodigesters P2: Define plan, section, isometric view, and half sectional elevation of biodigesters P3: Describe inter-relationship of various components of a biodigester	K1: Biodigester, its components and dimension of various parts. K2: Reading drawings of different components of a floating drum 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 P2: Read drawing of biogas stoves and lamps P4: Read drawings of pipes and fittings P5: 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.

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

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 floating drum 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 Floating drum biodigester	P1: State the type of construction materials needed for construction	K1: K1: Different construction materials needed for floating-drum biodigesters (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)
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 steel floating drum P7: Describe quality standards of other types of floating drum (wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)	K1: Types and quality of bricks and stones and their uses, hitting and abrasion tests K2: Cement grade and OPC, storing and handling of cement K3: Bottle test for assessing quality of sand, calculations of % of impurity in sand K4: Different sizes of aggregate and their uses K5: Types of MS rod and their uses K6: Thickness of iron sheet, priming and coating (oil paints, synthetic paints and bitumen paints), welding and gas tightness K7: Thickness of drum, uniformity, smoothness, gas-tightness, slope of roof, welding and jointing
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	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

	<p>possible</p> <p>P4: Explain why biodigester should not be constructed too close to foundation of structures, growing trees, main trail and machines producing vibrations</p> <p>P5: Explain why biodigesters should not be constructed in water logging areas and slide-prone areas</p> <p>P6: Explain the characteristics of best site for constructing biodigesters</p>	<p>installation cost and operation and maintenance</p> <p>K4: Safety in construction, potential damage to biodigester because of roots of a tree and vibrating machines.</p> <p>K5: Potential danger of flooding and cracking of digesters because of water logging and ground movements</p> <p>K6: Characteristics of best site for construction</p>
<p>C5.4: Explain steps (sequences) of construction of a Floating drum biodigester</p>	<p>P1: Describe methods of construction of different components of a Floating drum biodigester</p> <p>P2: Describe relative positioning of different components of a Floating drum biodigesters</p> <p>P3: Explain the importance of reference line</p>	<p>K1: Sequence of construction activities</p> <p>K2: Functioning of different components of a Floating drum biodigesters</p> <p>K3: Use of reference line during construction</p>

Standard 6: Supervise the construction of structural component of a Floating drum biodigester

Overview: This competency standard ensures that the participants are able to supervise the construction of civil structures of a floating drum 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 and outlet pipes</p> <p>P7: Construct baffle walls</p> <p>P7: Plaster digester walls</p> <p>P8: Maintain plumb of digester wall</p> <p>P9: Coach and mentor technicians</p>	<p>K1: Drawing, measurement and marking</p> <p>K2: Pit diameter and depth, excavation tools</p> <p>K3: Mixing ratio and methods of preparing mortar of different ratio</p> <p>K4: Leveling, compacting and ramming</p> <p>K5: Use of different construction tools and equipment, masonry skills</p> <p>K6: Proper location of inlet and outlet pipes</p> <p>K7: Importance of baffle wall</p> <p>K7: Plastering skill, knowledge of ratio of mortar</p> <p>K8: Use of plumb-bob</p> <p>K9: Coaching and mentoring skill</p>
C6.2: Supervise the fabrication of floating drum (gas holder) – (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)	<p>P1: Describe the quality standard of Steel floating drum</p> <p>P2: Describe the quality standards of other types of floating drum (wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)</p> <p>P3: Check the compliance of quality standards of while fabricating the floating gas holder</p> <p>P4: Coach and mentor technicians</p>	<p>K1: Thickness of iron sheet, priming and coating (oil paints, synthetic paints and bitumen paints), welding and gas tightness</p> <p>K2: Thickness of drum, uniformity, smoothness, gas-tightness, slope of roof, welding and jointing</p> <p>K3: Quality control protocol and checking mechanisms</p> <p>K4: Coaching and mentoring skill</p>
C6.3: Supervise the installation of floating drum (gas holder) – (MS Steel drum or	<p>P1: Prepare scaffolding and formworks for erecting floating drum</p> <p>P2: Install central guide frame</p> <p>P3: Install internal/external guide frame and</p>	<p>K1: Fitting of scaffolding and formworks for casting gas holder</p> <p>K2: Positioning of central guide frame, maintaining verticality.</p>

<p>wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)</p>	<p>support ledge</p> <p>P4: Install floating drum (normal or water-jacket)</p> <p>P5: Remove scaffolding and frameworks</p> <p>P6: Coach and mentor technicians</p>	<p>K3: Positioning of guide-frame and support ledge</p> <p>K4: Installing water jacket-floating drum and normal floating drum, knowledge of different types of floating drum (MS Steel drum or wire-mesh-reinforced concrete or fiber-cement drum or glass-fiber reinforced plastic or high-density polyethylene or PVC drum)</p> <p>K5: Safety precautions while removing scaffoldings/frameworks</p> <p>K6: Coaching and mentoring skill</p>
<p>C6.4: Supervise the construction of outlet/hydraulic chamber</p>	<p>P1: Fix outlet pipe</p> <p>P2: Construct outlet walls</p> <p>P3: Plaster outlet walls</p> <p>P4: Maintain plumb of outlet wall</p> <p>P5: Cast concrete cover slab for outlet and fit in place</p> <p>P6: Coach and mentor technicians</p>	<p>K1: Methods of fixing outlet pipe</p> <p>K2: Use of different construction tools and equipment, masonry skills</p> <p>K3: Plastering skill, knowledge of ratio of mortar</p> <p>K4: Use of plumb-bob</p> <p>K5: Mixing ratio and methods of preparing mortar of different ratio, methods of casting concrete</p> <p>K6: Coaching and mentoring skill</p>
<p>C6.5: Supervise the construction of inlet and mixing tank</p>	<p>P1: Construct platform for inlet tank</p> <p>P2: Construct walls of inlet tank</p> <p>P3: Plaster inlet tank</p> <p>P4: Fix mixing device</p> <p>P5: Coach and mentor technicians</p>	<p>K1: Use of different construction tools and equipment, masonry skills</p> <p>K2: Masonry woks</p> <p>K3: Plastering skill, knowledge of ratio of mortar</p> <p>K4: Vertical and horizontal mixture machines</p> <p>K5: Coaching and mentoring skill</p>
<p>C6.6: Supervise the construction of slurry collection and composting pit</p>	<p>P1: Select location of slurry collection and composing pit</p> <p>P2: Decide the size of collection and composing pits</p> <p>P3: Supervise excavation of pits</p> <p>P4: Construct walls and roof of the pits</p> <p>P5: Coach and mentor technicians</p>	<p>K1: Handling and application of bioslurry</p> <p>K2: General thumb rule to decide the size of slurry pit</p> <p>K3: Pit dimensions, excavation tools</p> <p>K4: Use of different construction tools and equipment, masonry skills</p> <p>K5: Coaching and mentoring skill</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 technicians</p>	<p>K1: Quality standards of pipes and fittings</p> <p>K2: Flow of gas and distance vs. pipe size</p> <p>K3: Effect of longer pipe on cost as well as risk of biogas leakage</p> <p>K4: Plumbing skill and knowledge on fittings and sealing agents such as Teflon tape</p> <p>K5: Methods to protect pipeline against possible damage</p> <p>K6: Coaching and mentoring skill</p>
C7.2: Supervise the installation of appliances/accessories	<p>P1: Name different types of biogas appliances and end use applications</p> <p>P2: Describe quality standards of appliances</p> <p>P3: Fix biogas stoves, lamps and other appliances as per users' need</p> <p>P4: 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 (for biodigester bigger than 100 cum) 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, understanding of functioning of CO₂ scrubber K3: Plumbing skill, understanding of functioning of H₂S remover K4: Plumbing skill, understanding of 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 larger plants with capacity more than 100 m³) P3: Install H₂S remover P4: Install moisture removal P5: Coach and mentor technicians</p>	<p>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 K5: Coaching and mentoring skill</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 P4: Coach and mentor technicians</p>	<p>K1: Quality standards of pump/generators K2: Methods for calculating gas demand and suitable size of pump/generators K3: Working principle of biogas operated engines K4: Plumbing skill, knowledge of working of biogas operated engines K5: Coaching and mentoring skill</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 painting of floating-drum</p> <p>P2: Perform greasing/oiling of movable parts</p> <p>P3: Perform minor repair of appliances</p> <p>P4: Perform repair of leaked pipeline</p> <p>P5: Maintain central and side guide frames</p>	<p>K1: Methods to protect drum against corrosion, suitable coating products such as, oil paints, synthetic paints and bitumen paints.</p> <p>K2: Greasing techniques, use of repair and maintenance tools</p> <p>K3: Working of appliances, set of repair and maintenance tools</p> <p>K4: Use of plumbing tools, sealing agents, pressure testing and application of soap water solution</p> <p>K5: Need for the verticality of guide-frames, reasons for tilting of drum</p>
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</p>	<p>K1: Functioning and use of testing tools and equipment</p> <p>K2: Pressure testing methods and protocols</p>

	<p>leakages</p> <p>P3: Inspect the colour of bioslurry, water dung ratio, flow pattern and odour of bioslurry to assess potential problems</p>	<p>K3: Changes in slurry during the process of biogas formation.</p>
<p>C8.4: Explain methods for optimum utilization of biogas and bioslurry</p>	<p>P1: Describe different uses of biogas and biogas appliances</p> <p>P2: Identify potentials for diversification of biogas end use applications</p> <p>P3: Tell the effect of under-utilisation of biogas</p> <p>P4: Describe characteristics and benefits of bioslurry</p> <p>P5: Apply suitable methods for optimal utilisation of bioslurry</p> <p>P6: Describe the benefits of composting of bioslurry</p>	<p>K1: Different end-use applications and biogas consumption rates of different appliances</p> <p>K2: Various end-use applications of biogas</p> <p>K3: Harmful effect of biogas when escaped in atmosphere</p> <p>K4: Characteristics and benefits of bioslurry</p> <p>K5: Methods of bioslurry applications</p> <p>K5: Nutrient content on composted bioslurry and its comparative benefit over FYM</p>
<p>C8.5: Instruct users for effective operation and maintenance of biodigester</p>	<p>P1: Inform potential problems and likely solutions to users</p> <p>P2: Teach users to carry out effective operation works</p> <p>P3: Teach users to carry out minor repair and maintenance works</p>	<p>K1: Common/potential problems and likely solutions</p> <p>K2: Facilitation skill, effective operation activities</p> <p>K3: Facilitation skill, repair and maintenance skill</p>
<p>C8.6: Plan, conduct and facilitate users' training</p>	<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 skill, knowledge of planning and organizing adult training</p> <p>K2: Optimization of the use of biogas</p> <p>K3: Methods of bioslurry application and handling</p>
<p>C8.7: Ensure sustainable benefits from biodigester</p>	<p>P1: Provide warranty to ensure long term functioning of biodigester</p> <p>P2: Perform timely after-sale services</p> <p>P3: Provide user's manual</p>	<p>K1: Guarantee provisions and criteria</p> <p>K2: 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 biogas 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 biogas digester 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 biogas digester K3: Methods to maintain quality
C9.3: Ensure that the masons/technicians practice quality norms during construction and installation	P1: Explain quality standards to be complied while construction P2: Supervise the work of mason to comply with set quality standards while constructing biogas digester	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 biogas digester
C9.5: 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: 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</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 skills</p>
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List of Tools, Machinery & Equipment

Name of Trade		Training of Biodigester technical supervisors to supervise the construction of Floating drum Biodigesters for Running Pumps
Duration		Five and half 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	
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
52.	Gas flow meter	1

List of Consumable Supplies

Name of Trade	Training of Biodigester technical supervisors to supervise the construction of Floating drum Biodigesters for Running Pumps	
Duration	Five and half 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.	Plastic bag	25
17.	White paper (A4)	1 rim
	Construction Materials and appliances for floating drum biodigester	
18.	Cement	As per the size of OJT biodigester
19.	Bricks	
20.	Sand	
21.	Aggregates 20mm	
22.	Inlet pipes PVC 110 mm diameter 3 m long	
23.	MS Rod 10 mm diameter	
24.	Binding wire	
25.	Gas storage drum	
26.	Angle Iron for Guiding frames	
27.	Scaffolding	
28.	PVC/GI pipe and fittings as per site condition	
29.	Biogas filters (CO ₂ scrubber, H ₂ S remover, moisture remover)	
30.	Biogas appliances (as per sit condition and users' need)	
31.	Control valves – as per site condition	
32.	Main gas pipe – GI 1.5" diameter, 1 m long with reducing elbow	
33.	Teflon tape	
34.	Pressure meter	

Worker Traits and Related Knowledge

Traits:

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

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

Related Knowledge:

- Basic principle of biogas generation
- Types and functioning of a biodigester
- Measurement, Units of measurements
- Basic mathematics/calculations
- Drawing reading an interpretation
- Masonry works/ construction methods
- Plumbing works
- General mechanical works/welding 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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