PERPETUATE N' REVAMP TECH SOLUTIONS LLP

OPERATION AND MAINTENANCE OF PSA OXYGEN PLANT

Duration: 180 Hours

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Course information

1.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different Sectors of the economy/ labour market. The vocational training programs of short-term duration Are intended for up skilling of NTC/ NAC pass out candidates. After passing out of the course, the Trainee is awarded a competency-based certificate approved by DGT.

1.2 PROGRESSION PATHWAYS

• Can join industries as PSA Oxygen plant Operator and will be progress further As Senior Technician, Supervisor and can rise to the higher level.

• Can become Entrepreneur in the related field.

1.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements:-

1.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course Through formative assessment and at the end of the training programme through Summative assessment as notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by Formative Assessment Method by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed In assessment guideline.

b) The pattern and marking structure is being notified by DGT from time to time. The

Learning outcome and assessment criteria will be the basis for setting question papers for

Final assessment.

c) Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance
- Assignment
- Participation and punctuality

Evidences of internal assessments are to be preserved until forthcoming examination for

Audit and verification by examining body.

d) The minimum pass percentage for skill test is 60%.

Job role

2.1 Brief description of Job roles:

Engineers and Related Technologists, other Architects; Engineers and Related Technologists, Other include all other engineers and technologists, such as those engaged in proper utilization of Machine and manpower, safety devices and other industrial problems, research work in Laboratories and application of results thereof to manufacture and solve practical problems, not Elsewhere classified.

2.2 Operation and Maintenance of PSA Oxygen Plant:

• Proficiency to work as Plant operator of PSA Oxygen plant in the course of Plant and Personal Safety.

• Competent to do all the Maintenance aspects viz. preventive/ breakdown/ Predictive/corrective/ effective maintenance of Compressor, Refrigerant air drier, Filters and drains , bacteria filter ,silencers (Mufflers) , flow meter, different types of Valves , pressure and temperature gauges, booster compressor, etc. the PSA Oxygen Plant and troubleshooting of PSA Oxygen Plant.

• Do the functional checks as when and where required viz. the concentration of Oxygen from Oxygen gas analyzer

• Start and Shut down of PSA Oxygen Plant by SOP/ instructional manuals.

• Refill medical grade Oxygen in cylinders from Manifold station.

2.3 Reference NCO-2015:

2149.0100: Engineers and Related Technologists, other Architects

Learning Outcomes

Learning outcomes are a reflection of total competencies of a trainee and assessment will be Carried out as per the assessment criteria.

3.1 LEARNING OUTCOMES

1. Demonstrate the fundamentals of generating Oxygen gas from atmospheric air following all Prescribed safety norms.
2. Identify different blocks/ components from the generic layout of the PSA Oxygen generation Plant and demonstrate the working principle.
3. Identify, troubleshoot, replace and test the components of the PSA Oxygen generation plant.
4. Plan and execute routine maintenance, maintain the log book for the operation of the plant And record the operational / maintenance data.

Introduction to PSA

4.1 Background

• Second wave of Covid-19 in April- May 2021: high demand and acute shortage of Medical oxygen.

• Medical O2 as the single most important intervention for severe and moderate Cases.

• Lessons learnt the hard way: Empowered group for O2 management

• Absence of a proper Supply chain Management- Lack of availability, production Capacity and logistic issues.

• Based on various projections : 4 to 6 lakh cases per day and a peak active case load Of 55 lakh- 20% moderate to severe cases requiring Medical Oxygen.

• Oxygen management Plan: infrastructure to meet O2 demand in case of surge

• ODAS (Oxygen Demand Aggregation system) and ODTS (Oxygen Digital Tracking System)

• Pressure Swing Adsorption (PSA) plants in all hospitals as one of the strategy.

4.2 Medical Oxygen Augmentation Sources

Government of India worked towards Medical Oxygen Enhancement through below Mentioned Oxygen sources :

• Pressure Swing Adsorption Plants – 3503 (out of which 1222 PM CARES , 291 Other Ministries , 57 Foreign Aid , States initiatives – 1933)

• Liquid Medical Oxygen – 18886 Metric Tonnes(as on August 31,2021)

• Oxygen Cylinders – 402517 Nos.

• Oxygen Concentrators – 1,43,397 Nos. (out of which 100000 PM CARES ,14000 ERCP , 29397 Foreign Aid)

4.3 Pressure Swing Adsorption Plant

Need of the Oxygen :

• When Spo2 falls below 89%

• Supplemental oxygen is needed For patients Suffering from COPD , Sleep apnea, Hypoxemia

• Oxygen is an essential medicine required at all levels of the health care system; only high quality, Medical-grade oxygen should be given to patients.

• Pressure swing adsorption (PSA) oxygen generating plants are a source of medical-grade oxygen.

• PSA plant is a technology used to separate some gases from a mixture of gases under pressure According to the molecular characteristics & affinity for an adsorbent material like Zeolite ,used as Trap. The process then swings to low pressure to desorb the adsorbed material.

• PSA plant is used when purity requirement is 90-96% V/V, remainder should consist mostly N2 and Must monitor O2 concentration with ±1% accuracy ,with a prefilter (5

Mm) and coalescing filter (0.1Mm)

4.4 Pressure Swing Adsorption Plant – Need for Maintenance

• Set of organized activities to keep PSA plant in best operational conditional with minimum cost.

• All moving components wear down –Need to restore before performance reduction.

• Consumables viz Filters – Cleaning /Replacement.

• Safety and reliable order.

• Avoid/ Reduction unexpected Breakdowns & downtime-Preventions is better than cure.

• Repairs due to Incorrect operation.

• Save Power , Efficient Operation.

Trade Syllabus

5.1 SYLLABUS – Operation and maintenance of PSA (Pressure Swing Adsorption) Oxygen Plant.

Reference Learning outcome	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
Demonstrate the Fundamentals of Generating Oxygen gas from atmospheric air following all Prescribed Safety norms.	• Orientation training: Lab Visit. • Demonstration and practice on cryogenic safety guidelines by OSHA. • Demonstration of Fire safety in oxygen enriched atmosphere. • PPE and safety equipment used in oxygen plants. • Follow the hygiene practices as per the standards applicable for oxygen plants. • Welding section visit. • Hands on practice on oxygen cylinder, identification with colour code, cracking of cylinder, fixing the regulators and flow meters, checking and recording the cylinder pressure in Kg/cm2 and in PSI. • Performing cylinder leak proof test. • Maintenance section visit. • Hands on practice on reading the pressure gauge. • Operating the valves, draining out the water, filter cleaning etc. • Audio and Video presentation	• Importance of the course in the context of Covid-19 pandemic. • Need of oxygen gas for the society, Healthcare, available sources, and separation methods. • Plant safety and personnel safety and hygiene. Law and regulations of OSHA. Cryogenic safety hazards. Use of Protective clothing. • Explain terms such as hazard, risk, lower explosive limit, permissible explosive limit, time weighted average, short term explosive limit, etc. • Types of fires, prevention and control methods, fire triangle, fire safety in Oxygen enriched atmosphere. • Units (SI & English) and measurements. • Pressure, Temperature, Volume, Density, Energy and Power: Definitions and measurement techniques, Instrumentation. • Pressure- Volume (PV) Diagram. Pressure-temperature Diagram.

	show on oxygen plants and types of plants.	• Material Safety Data Sheet (MSDS) of Oxygen. • Properties of air, water and oxygen. Volumetric composition of air. Humidity • Atoms, molecules and adsorption, desorption. Difference between adsorption and absorption. • Oxygen and its properties. Uses of oxygen. • Transportation methods of different type of oxygen cylinders/ containers. • Industrial oxygen and medical Oxygen differences. • Air separation methods: cryogenic and non-cryogen, adsorption methods advantages and disadvantages. • Introduction to oxygen generating plants and its application. • Types of oxygen generation plants.
Identify different blocks/components from the generic layout of the PSA Oxygen generation plant and demonstrate the working principle.	• Audio and Video presentation show on oxygen plants layout and components. • Demonstration of PSA plant working principle. • Demonstration of Monitoring systems that can detect the onset of dangerous operating conditions and take appropriate actions to mitigate their consequences.	• PSA Plant layout & construction features. • Components of PSA plant : compressors, drier, filters, oxygen generators adsorption material, booster compressor, oxygen analyser, safety valves and PLC systems etc, • Working principle of PSA plant. • Monitoring systems for detection of fault and safety measures of PSA oxygen plant.
Identify, troubleshoot, replace and test the components of the PSA Oxygen generation plant.	• Visit to Pneumatic section • Identification of type of compressor Installed, directional control, pressure control and flow control valves. • Hand on practice on working of compressor i.e. compressor switching ON & OFF, general	• Compressors: types, advantages & disadvantages, construction and working principles of screw compressors used in PSA system. Maintenance features and trouble shooting. • Filters: types and features used

	maintenance of compressor, filters & types refrigeration and related equipment and different types of pipe fitting joints. • Hand on practice on control valve, solenoid valves, rota meter, pressure and temperature sensors/ transmitters and gauges. • Visit to Electrical section: • Demonstration on switches, starters, and motors. • Cleaning of the PSA plant considering the electrical safety precautions. • Hands on - cleaning of different types of filter which are used in PSA oxygen plant.	in PSA systems, maintenance features and troubleshooting. • Refrigeration, dehumidifiers: construction features and maintenance. • Control Valves: construction and operating principles of directional control, pressure control and flow control valves: • Solenoid valves: construction and operation. • Rotameter: working principle and operation. • Gauges, Sensors and Reading of control panel. • PSA plant operating process. • Regenerative principles. • Functions of molecular sieves. • Zeolite types and filtering process. • Principles of vacuum pressure swing adsorption system. • Maintenance features of components.
Plan and execute routine maintenance, maintain the log book for the operation of the plant and record the operational / maintenance data.	• Preparation of maintenance strategy plan followed in PSA oxygen plant. • Demonstration of safety involved in storage of cryogenic liquid and high pressure gas storage. • Hand on experience on Refill of medical grade Oxygen in various types of cylinders along with proper hose and adapters from Manifold station. • Creating and implementation of log book and maintenance with safety features. • Demonstration on working of smoke detectors & fire alarms used in the oxygen plant. • Testing of alarms for leakage,	• Maintenance - PSA oxygen plants and its components. • Log Books maintenance and its importance. • Safety precautions before and after operating the plant and its necessities. • Awareness of Do's and Don'ts. • Safety precautions on management of oxygen. • Need and procedure of NABL/ NABH Calibration gauges, valves etc. • Safety measures for storage of cryogenic liquid and high pressure gas storage.

	over/ under pressure and operational, other malfunction & faults. • Monitor, control and Test operating pressures. • Testing of oxygen concentration.	

Onsite Training Activities

1. Recognize & comply safe working practices to be followed in Oxygen processing plants, environment regulation, personal hygiene and housekeeping.
2. Observing the Fire safety norms in oxygen enriched atmosphere and use of protective clothing.
3. Identify the Components of PSA Oxygen plant, understand flow chart of plant and line tracing, familiarize individual functions and overall functions.
4. Awareness of the Do's and Don'ts before start of the plant.
5. Visit the panel boards, alarming systems and witness the operation of different switches.
6. Identify the compressor air flow system and filter assembly.
7. Participate in dismantling, assembly and cleaning of air filter used in various stages by removing condensates like water, oil, dirt, scale etc.
8. Identify and understand the operating procedure of various pressure relief and flow control valves used in the plant.
9. Identify various pressure gauges and sensors used in the plant and note the reading.
10. Open the drainage plugs for removal of condensates and ensuring the proper disposal of the same.
11. Check the purity of oxygen at the output side.
12. Observation of HMI control panel for alarms.
13. Perform testing of alarms for leakage, over/ under pressure and operational malfunction / faults.
14. Refer the maintenance log book and records for the required data of the system at the stipulate intervals as per SOP.
15. Participate in the basic regular and preventive maintenance of the plant by following the procedure described in the plant operating manual and as per OEM.
16. Perform the basic troubleshooting work in the eventuality of abnormal functions of the system components and entire plant.
17. Perform Refilling of medical grade Oxygen in various types of cylinders along with proper hose and adapters from Manifold station.