REPORT ON INDUSTRIAL TRAINING

Military Institute of Science and Technology

Industrial Training

at

Linde Bangladesh Limited, Rupganj site

Prepared By

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ABSTRACT

Linde Bangladesh Limited is the Bangladeshi venture of Linde Group. It operates its business in industrial and medical gases more than 100 countries. The product portfolio includes hydrogen, acetylene, carbon monoxide, carbon dioxide, shielding gases for welding applications, noble gases and specialty gases. Linde Industrial Gases produces and distributes the atmospheric gases oxygen, nitrogen and argon, all of which are manufactured in Linde's air separation unit. In addition, Linde develops and distributes procedures and systems for gas applications in several technological application centers. Linde is the world's largest supplier of welding and safety products. Linde Healthcare provides pharmaceutical and medical gas products and services for healthcare professionals. This paper presents an extensive literature review of methodologies to the filling, packaging & distribution process of gases.

ACKNOWLEDGEMENT

The main objective of this report is to accumulate and uphold the brief of Linde Bangladesh Limited as per our learning and acquisition covered. Most of the information were collected from the lectures provided by the instructors during training period and a little help from internet is nothing but cherry on the top. We take the responsibility of any misprint and wrong information or unwanted mistakes and hope everyone will consider the case in the eye of mercy. It would be remiss not to acknowledge those who provided us by great support throughout the training.

At the very outset we would like to express our gratitude to the Almighty Allah for allowing us to successfully complete the training without any hazard or complicacy.

It is our radiant sentiment to place on record our best regards, deepest sense of gratitude and special thanks to **Mr. Shamsul Haque Sarker Sir** and **Mr. Ismail Hossain Sir** who in spite of being very busy with his duties, took time out to hear, guide and keep us on the correct path and allowing us to carry out our learning in an enjoyable manner at Linde Bangladesh.

We express our deepest thanks to **Mr. Asif Zaman Sir, Mr. Ruhul Amin Sir, Mr. Debashish Sir, Mr. Adij Zamal Khan Sir, Mr. Ariful Islam Sir** for taking part in useful decision & giving necessary advices and guidance and arranged all facilities to make life easier. We chose this moment to acknowledge gratefully.

Special thanks to **Mr. Kamruzzaman Sir** for providing us safety issues and other facilities. His valuable guidance about working environment will encourage us to work in a safe environment and ensure safe working environment for our coworkers.

We would like to express our sincere gratitude to **Kafi Mahmood Nahin Sir, Nazmul Islam Sir** for teaching us about the working principle, role of an engineer in this industry and giving company to us.

Tons of wishes and thanks to all the group members for being so supportive, co-operative throughout the time and we can all say that we really had some good memories here and obviously we render and express our gratitude and thanks from the core of our hearts to the honorable Head of the Department of Mechanical Engineering, MIST **Colonel Humayun Sir** and our supervisor **Cdr Masum-ul Haque Sir** who really took a lot of troubles for arranging this great opportunity. We perceive as this opportunity as a big milestone in our career development. We will strive to use gained skills and knowledge in the best possible way and we will continue to work in order to attain desired career objectives. Hope to continue cooperation with all of you in the future.

Authentication

This is to certify that all the information in this report is valid. Shaharear MD Emtiaz- 201618018, Rushad Jubair– 201618020, Radin Khan– 201618034, Asif Ahmed– 201618055 were attached in the ASU, CO_2, PGP & electrode plant, Rupgonj Site, Narayangonj. They were given some tasks and the results shown in this report is checked.

We wish them all the best and success in their future endeavors.

Mr. Ismail Hossain

Plant Head

Linde Bangladesh Ltd

Rupganj Site, Narayanganj

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History of Linde Bangladesh Limited

Corporate History

The Linde Group has a history of over 130 years built on a heritage of innovation with a strong focus on technology. The company's founder, Carl von Linde, invented refrigeration technology and pioneered a process of air separation. Today, we are a global market leader in gases and engineering solutions.

Operation of Linde in Bangladesh

Linde Bangladesh Limited**,** a member of the Linde Group, has been contributing towards the development of the nation as a silent partner. A strong in–built culture with work values reinforced and developed Linde Bangladesh over the years which are reflected in the performance of its employees for more than 50 years with continuous expansion in operations and business.

They sell our products to more than 35000 customers from a wide spectrum of industries running from chemicals and petrochemicals to steel. Their team of around 400 trained, motivated and professional members manages 24 hour operations at three major locations across the country to support our customers.

In Linde Bangladesh Limited they are committed to the quality of our product & services. Their motto is to ensure optimum conditions in health, safety and the environment for employees, customers and stakeholders.

Their milestones at a glance

1958		Pakistan Oxygen Limited.
1971		Renamed as to Bangladesh Oxygen Limited (BOL).
1973		Incorporated in the joint stock companies and received government approval as the first full-fledged "Company" of the newly formed country.
1976		First CO_2 plant was introduced.
1979		Welding Training Centre started its journey
1995		The company changed its name from "Bangladesh Oxygen Limited" to "BOC Bangladesh Limited".
1997		Rupganj ASU Plant was commissioned.
1999		Shitalpur plant was bought over with 20TPD production facility.
2000		ASPEN and LPG Bottling plant was commissioned.
2004		Moved into newly built Corporate Office.
2006		Acquisitioned by the Linde Group.
2010		Achieved BDT 100 Crore Profit.
2011		3rd Welding production line at Rupganj was commissioned.
2011		The company changed its name from "BOC Bangladesh Limited" to "Linde Bangladesh Limited."
2012		4th Welding production line at Rupganj was commissioned.
2013		LPG Plant at Bogra decommissioned.

Linde Bangladesh Rupganj Site

Linde Bangladesh Rupganj Site has quite a few operational plants. They are Air Separation Unit (ASU) plant, CO_2 plant, Dissolved Acetylene (DA) plant, Package Gas & Production (PGP) plant, Hardgoods plant. Apart from these there is power generation unit of Linde itself.

We were attached for 4 weeks at Linde Bangladesh Ltd. In these 4 weeks, we were given few tasks. Working through those tasks, we learned about the technical details of ASU, CO_2 , PGP, Electrode plant.

Report on the Working Procedure of ASU (Air Separation Unit) plant

Coordinator

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Dept. of Mechanical Engineering

MIST.

Supervisor

Engr. Asif Zaman,

Linde Bangladesh Ltd.

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Signature

1. **Title of the Report:**
   Report on the working procedure of ASU (Air Separation Unit) plant.

2. **Period Covering the Training:**
   From 09 December 2018 to 17 December 2018.

3. **Objectives of the Report:**

- To study the Layout of the plant.
- To study the working process of the plant.
- To study the overall cost.
- To study the maintenance aspects of the plant.

4. **Activities Carried Out:**
   This report is for the 100 TPD air separation plant in Rupganj, Bangladesh. Containing working procedure and different machine parts of the plant.

Modular Process Description

i. Air Compression

The incoming air is first cleaned from dust and other particles in an air filter S1146 and then compressed to the required process pressure to about 20 bar by multistage inter-cooled turbo-type air compressor C1161.

ii. Molecular sieve station

The contaminants in the process air such as water vapor, CO_2, N_2 and potentially hazardous hydrocarbons are absorbed from the air by passing through one of the two molecular sieve absorbers A2626 A/B. one absorber is in operation while the other one is in regeneration mode.

The regeneration cycle consists mainly of:

a) Heating
b) Cooling
c) Pressurizing and Depressurizing Cycles

The regeneration is coming from the distillation unit as a waste gas (N_2). It is heated up in the electrical regeneration gas heater (E2618) during the heating period. During cooling cycle, the waste gas passes through the heater (which is switched off) and the heat is pushed out of the absorber. At the end of the regeneration cycle the regenerated absorber goes into operation and the other one begins with the new regeneration cycle the cycles are automatically controlled by DCS.

iii. Process Streams distribution and process refrigeration

The dry and purified processed air after the molecular sieve unit A2626 A/B passes through the cold booster and warm booster respectively then it passes through air to Plant valve (HV 2615) to the main heat exchanger (E 3116) where it is divided in two streams. The main stream of the compressed air is fed in high pressure column (T 3211) through JT valve (FV 3210).

Second stream of the compressed dry air after cooling down in main HE E3116 to approx.-143 C expands in cold turbo expander (X 3471). After expansion one part of the stream is fed in HP column and other part is fed into warm turbo expander (X 3472). After expansion from warm turbo expander the stream passes through main HE and it vented to atmosphere.

iv. Refrigeration

The refrigeration requirements of the plant are due to insulation losses, heat exchange losses and removal of cold liquids out of the low temperature section. These losses are met by isenthalpic expansion and by isentropic expansion of air in the expansion turbines (X3471/2).

v. Rectification, high pressure column T3211

In the high pressure column T3211, the process air separates into pure N_2 yielding at the top, and into O_2 rich liquid at the bottom. Gaseous N_2 is withdrawn in the high pressure column (Sealed gas), Warmed up in the main heat exchanger E3116 and send out. The required reflux for rectification is provided by condensing the gaseous N_2 against boiling O_2 in the condenser/Re boiler E3216. A part of the liquid N_2 is used as reflux for the high pressure column. Liquid withdrawn from the HP column at intermediate stage is subcooled in E3116, throttled in a valve to about 1.5 bar and given to the top of the low pressure column.

vi. Rectification, Low pressure column T3212

In the low pressure column T3212 the final separation into a pure O_2 fraction in the bottom and waste N_2 fraction at the top takes place. O_2 enriched liquid is taken from the bottom of pressure column, fed through the exchanger E3316 and via argon column back to the LP column. Liquid O_2 product is taken out from the bottom of the LP column LOX is fed to the LOX tank.

A part of the Liquid O_2 product that is transferred to the LOX tank is sub cooled in the HE E3316 to keep the temperature at the inlet of the LOX tank by 90 kelvin. Gaseous waste N_2 is taken from the upper part of the Low pressure column T3212, heated in the sub cooler E3316 and the main heat exchanger E3116 before leaving the cold box as waste gas for cooling purposes in the EVC (E2417) or for mole sieve section for regeneration.

A small amount of gaseous O_2 is withdrawn from LP column section and warmed up in main Heat Exchanger. With incoming air, and it vented to the atmosphere. Gaseous N_2 withdrawn from LP column top and warmed up in main HE with incoming air and vented through silencer.

Apart of the liquid N2 (LIN) withdrawn on top of the LP column is fed to liquid N2 stroage tank. The rest covers the reflux needed for the Low pressure rectification.

vii. Argon extraction

The argon recovery system is achieved completely by rectification. In the argon column oxygen is removed by means of cryogenic reflection. The LAR transfer pump P4565 helps to transfer the reach oxygen to LP column T3212. In the upper part of the crude argon column T4111, residual nitrogen is removed from the argon system by venting a small portion of gas from the crude argon condenser E4166.

The pure liquid argon product (LAR) is withdrawn as a side stream from the crude argon column and fed into the LAR storage tank.

Machines:

i. Valves

Task: Sealing or throttling of gas or liquid stream.

Design: Depending on the types of sealing, the following valves are used:

- Globe valves
- Throttle valves
- Control valves
- Ball valves
- Gate valves
- Check valves.

The valves used in low temperature section are called cold valves. They differ from the normal type of valve. The material are suitable for low temperature materials and the valves have longer stems.

ii. Main Air Compressor (MAC)

Task: Compression of process air to the required operating pressure

Design: The compressor is a four stage centrifugal compressor with intercoolers and one aftercooler. The drive is a HV electric asynchronous motor.

iii. Coolers

Intercooler (C1161):

Task: The cooling of the air stream leaving the first and second and third stage of the main air compressor.

Mode of operation: Heat is exchanged between air and cooling water. The air stream is cooled down to near the cooling water temperature.

After cooler of the main air compressor (C1161):

Task: The cooling of the air stream leaving the final stage of the main air compressor.

Mode of operation: Heat is exchanged between the compressed air and the cooling water. The gas stream is cooled down to near the cooling water temperature.

iv. Moisture separator

Task: Separation of water droplets from wet air from wet air from MAC to prevent carryover to molecular sieve bed.

Design: moisture separator is a cylindrical vessel fitted with a demister pad at its top and a level control valve at its bottom. There is also a manual drain valve at the bottom.

v. Molecular sieve absorbers for air

Task: Removal of moisture, CO_2 and most of the hydrocarbons from the process air.

Design: Molecular sieve absorbers are cylindrical vessels filled with Alumina balls and molecular sieve packing supported between sieves at the gas inlet and outlets. The packing can be added and removed by the manhole at the top of the absorber. The basic construction can be seen in the following sketch.

Each of the mole sieve vessels contain a bottom layer of activated alumina gel and a top layer of molecular sieve absorbent. The incoming air flows upward through the absorber bed, where water vapor, CO_2 and heavy hydrocarbons are removed from the process stream. Detail explanation of the absorption process is very complex and beyond the scope of the description. However a simple analogy is to think of a chemical hooks expanding out of the surface of the absorbent pellets. These hooks have a preference for H_2O and CO_2 molecules and latch onto such molecules. Countless hooks provide the ability of removing the contaminants from the compressed air stream. The result is a (virtually) complete dry gas leaving at the top of the vessel. Upon leaving the vessel, the water and CO2 contains have been reduced to about 0.01 vpm a level necessary to prevent the plating out of these components in the following cryogenic process equipment. However, the absorbent cannot absorb water and CO2 molecules indefinitely, and must therefore be regenerated by a combination of hot and cold gas at regular intervals. Regeneration gas used is waste gas flowing downwards through the vessel. The regeneration gas heats up in the electric heater (E2618).

The combination of low pressure at high temperatures distracts the latch of the CO_2 and H_2O molecules and the components are carried out together with the regeneration gas. After heating the absorbent beds have to be cooled down, so that they can absorb CO_2 and H_2O again. During the cooling step the heater is stopped. The wet, CO_2 loaded regeneration gas is released to atmosphere by silencer (N2653).

vi. Regeneration Gas Electric Heater E2618

Task: Compression of process air to the required operating pressure/expansion of the compressed process air for the necessary cold production.

Mode of operation: The booster compressor is driven by the expansion turbine and serves as a compressor and simultaneously as brake of the expansion turbine. The expansion turbine produces the necessary coldness for the process by expansion,

vii. Heat Exchanger/Evaporator/Condenser (Coldbox)

Task: Heat exchange between two or more gas or liquid streams.

Design: Plate heat exchangers. Plate fin heat exchangers consist of stapled, brazed aluminum plates with spacers. Gas respectively liquid streams are parted in a number of passages which are separated from each other by plane plates.

Mode Of operation: The heat exchangers can be used for various applications. The mode of operation of the heat exchangers in this plant is described on the following pages.

viii. Main Heat Exchanger

Task: Heat exchanges between the process air and the various cryogenic product waste gas streams.

Design: Plate fin heat exchangers have a stratified construction gas respectively liquid streams are parted in a number of passages which are separated from each other by planes plate.

Mode of operation: The process air cools down near its liquefaction temp at the cold end of the main HEX and the further compressed process air streams cool down from a warm temp to the inlet temp of the expansion turbine stream resp. to near its liquefaction temp at the cold end of the main HEX

ix. Subcooler:

Task: Subcooling of cryogenic liquids.

Design: Plate fin heat exchangers have a stratified construction .gas respectively liquid streams are parted in a number of passages which are separated from each other by planes plate.

Mode of operation: The cold liquids from pressure column T3211 and the LOX product from the main condenser are subcooled by exchanging coldness with the colder nitrogen gas streams

from the low pressure column T3212.Thje purpose of subcooling is to reduce evaporation losses especially during throttling of the cryogenic liquid.

x. High/Low pressure Column/crude argon column:

Task: Separation of vapor liquid mixtures into pure components or impure components having a higher concentration of one of the components.

Sieve Trays: These columns are vertical cylindrical vessels containing sieve trays.

Packing's: These columns are vertical cylindrical vessels containing a number of packing sections .A packing section is designed of structured perforated sheets which are arranged in layers. They form intersecting crossing channels.

Sieve Trays: The liquid reflux trickles from tray to tray to the bottom of the column. The weirs are constructed so that they cause the liquid to flow across the trays. The inlet weirs form a seal so that no gas bubbles can rise in the down coming liquid. The outlet weirs ensure that the liquid level on each tray remains above a minimum.

Packing's: The liquid reflux trickles over the webbed surface of the packing unit in an easy zig zag downward motion. The total surface is wetted and all meshed openings are covered by a liquid film which distributes evenly over the total cross section.

Production:

The production of the plant is 100 TPD (Ton per day).

Storage:

The Storage capacity of the O_2 storage is 7 lakhs liter.

The N_2 Storage capacity is 1 lakh liter.

The Argon Storage is of 30,000 liter.

Safety aspects:

1. Lock out-Tag out system is maintained while working on the plant.
2. Before starting any work check if PPE (Personal protective Equipment) is ensured.

In air separation plant areas and in all facilities in which the product gases of these plant are stored, handled and further treated, the following safety aspects must be strictly followed

- Fire and explosion dangers
  All naked fire source is extremely prohibited, possible sources of additional ignition should be under special attention
- Blasting
  This is applicable for removing all kinds of contaminations from surface on plain parts and on straight pipes. Use vitreous sand, steel ball or slag as blasting material
- blowing out
  Applicable to remove dissolute particles from system.

Maintenance:

Any maintenance and repair work on operating plants must be carried out with a valid working permit under consideration of the written safety instructions. Working permits only must be issued from a person component and responsible for that,

Mainly the following has to be observed:

- Rules for the prevention of accident;
- Safety precautions according item.
- Safe and tight cut off from process gas sources that may cause inadmissible alteration of the normal nitrogen-oxygen-proportion, e.g. removal of spool pieces, installation of blinds or if justifiable from safety, valves may be locked close.
- Release system pressure.

5. Conclusion:

The ASU plant is the heart of Oxygen, Nitrogen and Argon production. The Continuous running of this plant is must to meet the demand. 6 engineers continuously working by shifts to keep the plant running 24/7.

Report on Power Generation and Distribution System of Plant.

Coordinator

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MIST.

Supervisor

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Signature

1. Title of the Report

Report on power generation and distribution system of plant.

2. Period Covering the Training

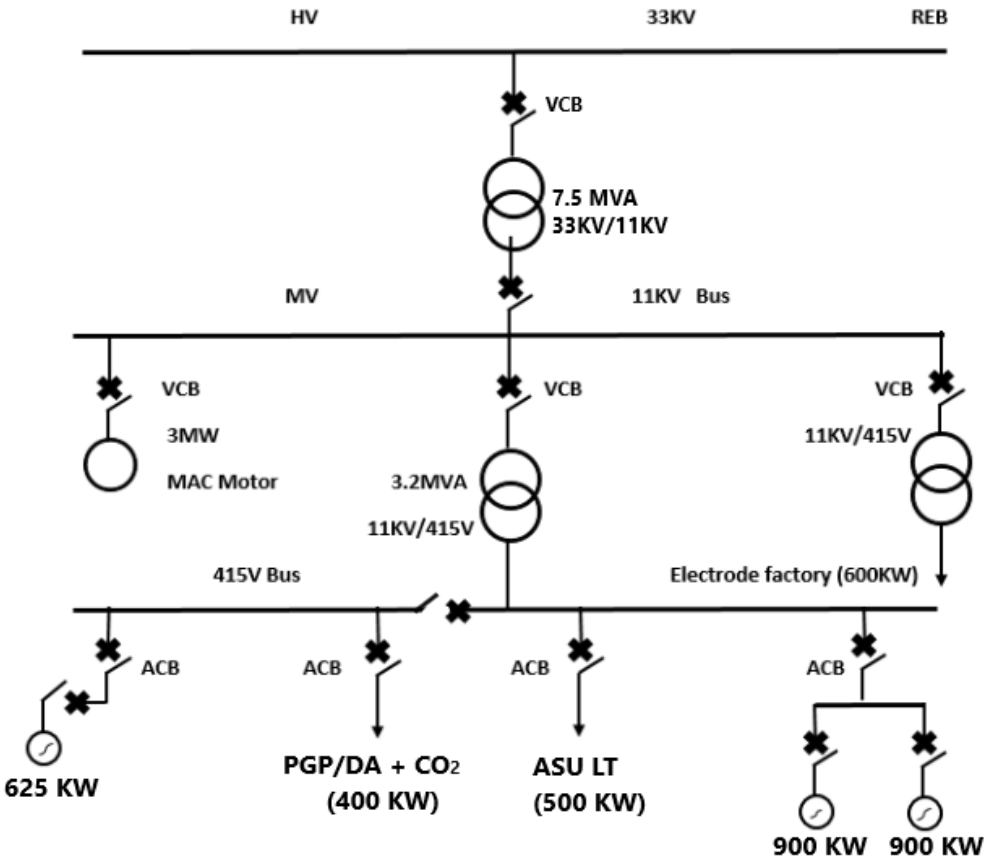
09 December 2018 to 17 December 2018

3. Objectives

- To study power source.
- To study power distribution process.
- To study overall cost.

4. Activities carried out

To run the plant, it requires total power of 4.5 MW per day. The main source of power is Rural Electrical Board (REB). Besides plant has its own generators to support.



Process:

At first substation of REB supplies the main power at 33 kV. Later 33 kV turns into 11 kV by using a step down transformer. Then 11 kV voltage passes through a 11 kV switch gear.

From switch gear MAC (Main Air Compressor) motor takes 11 kV directly, when the motor runs at 3 MW. As well as the electrode factory gets power from 11 kV switch gear through a step down transformer. The transformer steps down from 11 kV to 415 V.

Another step down transformer from 11 kV bus is used to step down 11 kV to 415 V which runs through a 415 V switch gear. This 415 V supplies power to PGP, DA, CO2 and ASU plant. This bus is connected to two generators of 900 kW and a generator of 625 kW. The 900 kW generators are synchronized with the REB source using a synchronizer.

The 625 kW GEG can only be used to run PGP/DA plant. The air circuit breaker (ACB) between 415 LT bus and 625 kW generator remains open at the time of load-shedding also. If 625 kW generator is in offline due to maintenance the circuit breaker is closed so that the PGP and CO2 plant can be run by the two 900 kW generators.

On the other hand 900 kW generator supply power to ASU plant, MAC, Electrode plant etc.

Machines:

i. Air Circuit Breaker:

Air Circuit Breaker (ACB) is an electrical device used to provide Overcurrent and short-circuit protection for electric circuits over 800 Amps to 10K Amps. These are usually used in low voltage applications below 450V. We can find these systems in Distribution Panels (below 450V). Air circuit breaker is circuit operation breaker that operates in the air as an arc extinguishing medium, at a given atmospheric pressure.

ii. Vacuum Circuit Breaker:

A vacuum circuit breaker is a kind of circuit breaker where the arc quenching takes place in vacuum medium. The operation of switching on and closing of current carrying contacts and interrelated arc interruption takes place in a vacuum chamber in the breaker which is called vacuum interrupter.

iii. Transformer:

Transformers are electrical devices consisting of two or more coils of wire used to transfer electrical energy by means of a changing magnetic field. Transformers are used for increasing or decreasing the alternating voltages in electric power applications.

iv. CT and PT:

CT means Current transformer and PT and Potential transformer.

CT and PT form the sub parts of instrument transformer. They are extensively used in power system for metering and protection purpose. These 2 form the most important part of any substation. Since in actual electrical power system we deal with high voltage and high current and it is not feasible and economical to manufacture devices to measure such high values. So to measure high values in power system use CT and PT.

v. Insulator:

An electrical insulator is a material that does not easily conduct electrical current.

vi. Switchgear:

The apparatus used for switching, controlling and protecting the electrical circuits and equipment is known as switchgear. During normal operation, switchgear permits to switch on or off generators, transmission lines, distributors and other electrical equipment. On the other hand, when a failure (e.g. short circuit) occurs on any part of power system, a heavy current flows through the equipment, threatening damage to the equipment and interruption of service to the customers.

vii. Bus bar:

In electric power distribution, a bus bar is a metallic strip or bar, typically housed inside switchgear. This is used to connect high voltage equipment at electrical switchyards, and low voltage equipment in battery banks. They are generally uninsulated, and have sufficient stiffness to be supported in air by insulated pillars.

Product:

4.5 MW electricity.

Manpower:

One engineer and one attendant at per shift.

Cost:

Per unit electricity from REB costs 8.5 taka

Per unit electricity from GEG costs 3.75 taka.

Quality aspects:

Power factor should be 0.95 or above

Safety aspects:

- Personal protective equipment like helmet, show, gloves.
- Logout and tagout system.
- During load-shedding generator power from GEG is not allowed to go through 11 kV bus. Otherwise it may cause accident because of high voltage difference.

Maintenance:

There are three types of maintenance.

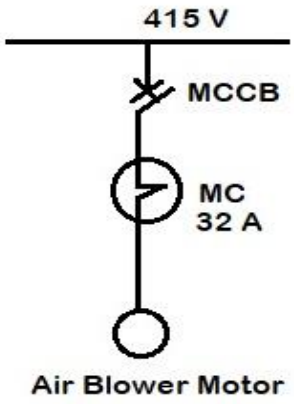
a) Preventive Maintenance: Yearly basis test. For example, Earth pit resistance test, Oil test of transformer, Megger test of motors, Relay and circuit breaker's functionality test. The plant needs to shut down for 5-7 days.
b) Predictive Maintenance: Like checking the vibration, load, noise, temperature of motors.
c) Breakdown Maintenance: Rewinding motors, circuit breakers when they are damaged.

5. Conclusion:

The plant runs by the combined power supply of REB and GEG. The plant is dependent on outer supply REB. Which causes both more cost and production discontinuation.

This can be solved or improved by installing new GEG of 4.5 MW, which will reduce cost and increase production.

CASE STUDY



Root Cause:

Sometimes in GEG of 625kW voltage drops from 415V to 360V. As a result the load increases.

We know,

Load, P= $\sqrt{3} \times V \times I \times \cos\theta$

Or, $I = \frac{P}{\sqrt{3} \times V \times \cos\theta} = 22 \times 1000 / \sqrt{3} \times 415 \times 0.95$

$= 32\ A$

Now, same as for V=316 V we get, $I = 37\ A$

Root Cause Analysis (RCA):

The magnetic contactor (MC) gets burnt.

Corrective Action Plan (CAP):

We have to change the Auto Voltage Regulator (AVR) in 625 kW GEG.

Report on CO_2 plant.

Coordinator

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Dept. of Mechanical Engineering

MIST.

Supervisor

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Linde Bangladesh Ltd.

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Signature

1. Title of the report:

Report on CO_2 plant.

2. Period covering the training:

09 December 2018 to 17 December 2018

3. Objectives:

- To study the layout of the plant
- To study the process of production
- To study the machine parts of the plant

4. Activities carried out:

Process:

i. The CO_2 production is initiated by burning air and fuel gas mixture in the regenerator

ii. Then the hot flue gas enters DCC from the bottom. The processed water from DCC and make up water by removing heat at the exchanger (HXOO4) enters DCC and showers from the top and removes impurities like dust particle and drains out the DCC at the bottom. The showering water also decreases the temperature of the hot flue gas.

iii. Then the cold flue gas enters the absorber tower at the bottom and gradually comes upward. The MEA solution from the shell of the boiler at 115^0C after removing heat to the heat exchangers(HX003A) and (HX003B) enters the absorber tower at around 375^0C. The role of the MEA (monoethanolamine) solution is to absorb CO_2 from the flue gas. It absorbs CO_2 at around 35^0 -45^0 C and releases CO_2 at around 100^0 C . After absorbing the cool rich MEA exits absorber tower and the residual gas vents to atmosphere from the top of the tower.

iv. The cool rich MEA solution then enters the stripper at the top at 102^0 C by gaining heat to heat exchanger HX003A. At 102^0C the MEA releases CO_2 and comes back to the shell of the boiler. So the MEA circulates in this way and helps to separate CO_2 from the flue gas.

v. Then the CO_2 gas including some impurities enters the two purifier T-101 and T-102 via a cooler HX-002. $KMNO_4$ is used to purify CO_2 gas in this two purifier. After purification the CO_2 enters the deodorizer . Deodorizer removes ink like substances and stink from the gas.

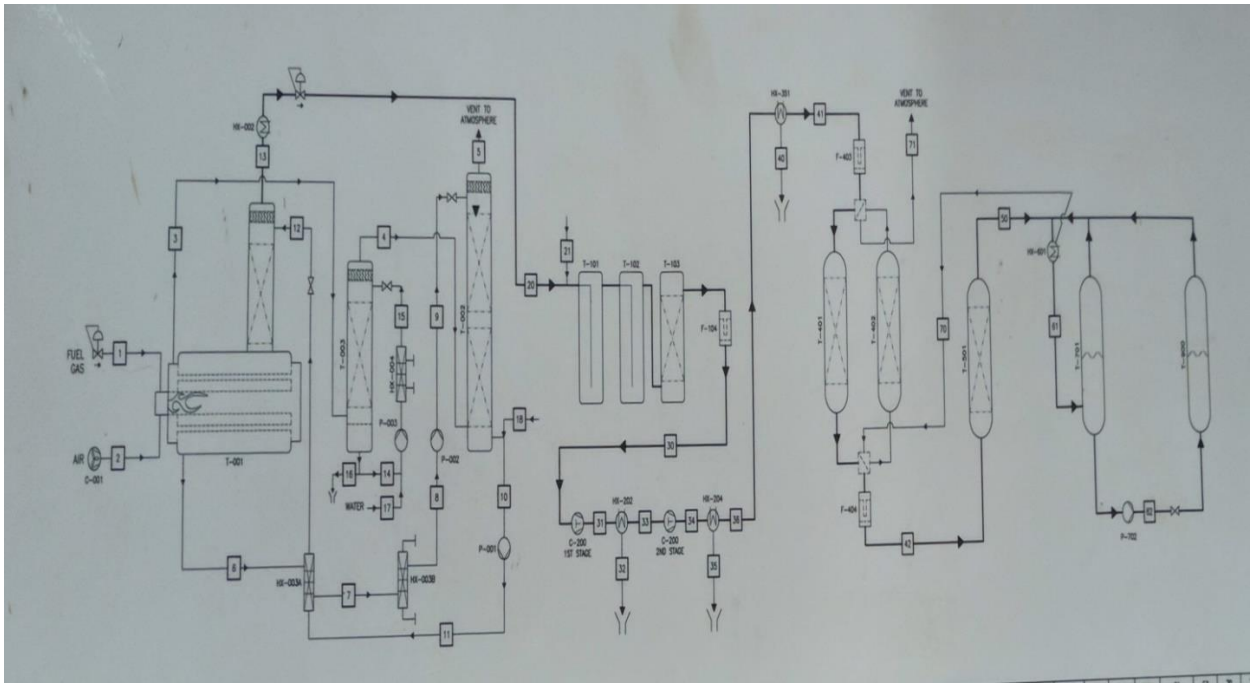
vi. Then the CO_2 gas enters a filter. After that the gas enters the dryer via some stages of compression and cooling. There are two dryer. One is at online and the other one is at standby (regenerating state). Silicon is used to remove moisture from the gas in the dryer.

vii. Then the CO_2 gas enters carbon tower. It removes the very small portion of impurities if it is left in the gas somehow.

viii. After that 99.95% pure CO_2 gas is liquefied as a refrigerant in this process.

ix. Then the liquid CO_2 is stored at the storage tank.

CO_2 plant layout



Storage capacity: There are three storage tankers. Two of them are 50000 kg and one of them 25000. So total storage is 125000 kg.

Product: Per day production of CO_2 plant is 12-13X10^3 kg.

Manpower: There are one engineer and one operator are assigned per shift to look after the plant.

Quality: The product remains 99.95% pure CO_2.

Machines:

Regenerator (boiler): A regenerative heat exchanger, or more commonly a regenerator, is a type of heat exchanger where heat from the hot fluid is intermittently stored in a thermal storage medium before it is transferred to the cold fluid. To accomplish this, the hot fluid is brought into contact with the heat storage medium, then the fluid is displaced with the cold fluid, which absorbs the heat.

In regenerative heat exchangers, the fluid on either side of the heat exchanger can be the same fluid. The fluid may go through an external processing step, and then it is flowed back through the heat exchanger in the opposite direction for further processing. Usually the application will use this process cyclically or repetitively.

Stripper: Stripper is a chimney like system which is used for a special purpose. stripper is mounted on top of the regenerator, therefore the temperature at the top of the stripper remains somewhat close to the temperature of the regenerator which is 100-115°C. MEA solution absorbs CO_2 at around 40°C and releases CO_2 at around 90-100°C. The stripper is used so that the cool rich MEA solution can release CO_2 with the help of the temperature of the regenerator. So no extra heater is needed for this purpose.

Intercooler: An intercooler is any mechanical device used to cool a fluid, including liquids or gases, between stages of a multi-stage compression process, typically a heat exchanger that removes waste heat in a gas compressor. They are used in many ways, including air compressors, air conditioners, refrigeration, and gas turbines, and automotive engines. Here it is used to reduce the temperature of the hot gas with circulating cold water.

Heat exchanger: A **heat exchanger** is a device used to transfer heat between two or more fluids. In other words, heat exchangers are used in both cooling and heating processes. The fluids may be separated by a solid wall to prevent mixing or they may be in direct contact. They are widely used in space heating, refrigeration, air conditioning, power stations, chemical plants, petrochemical plants, petroleum refineries, natural-gas processing, and sewage treatment. The classic example of a heat exchanger is found in an internal combustion engine in which a circulating fluid known as engine coolant flows through radiator coils and air flows past the coils, which cools the coolant and heats the incoming air. Another example is the heat

sink, which is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant.

Safety: Before starting any work on the site PPE(Personal protective equipment) is ensured.

Case Study:

We have observed a problem during our session in CO_2 plant. The production rate is somehow dropped to some extent. After observation a problem was found at the path after the two purifier.

There was unusual pressure difference in that zone. Normally pressure at the inlet purifier 1 is 8 bar. The normal inlet pressure of the purifier is 7 bar and the normal pressure at the deodorizer inlet is 5-6 bar.

But from the control panel we saw that the inlet pressure before purifier 2 and 1 increased up to 10 bar and the inlet pressure of the deodorizer was at 2 bar. By this we could understand that there might be some kind of blockade in the trap before the deodorizer inlet. Then the plant was shut down and workers opened the trap between the purifier 2 and the deodorizer and cleaned the trap under the supervision of the engineer. The problem as fixed in a while and the plant was ready to start again.

5. **Conclusion:** Natural gas and air is the main raw material where air is free but natural gas come with some cost. Instead of them any material burning which gives CO_2 (Example: Polythene, paper etc.) and which don't have any other use maybe used, which will both reduce the cost of raw material and help us to use some material which will otherwise harm the environment.

Report on PGP plant.

Coordinator

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MIST.

Supervisor

Engr. Adij Zamal Khan and

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Linde Bangladesh Ltd.

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Signature

1. Title of Report:

Report on PGP Plant.

2. Period Covering the Training:

From 17 December 2018 to 26 December 2018

3. Objectives of Report:

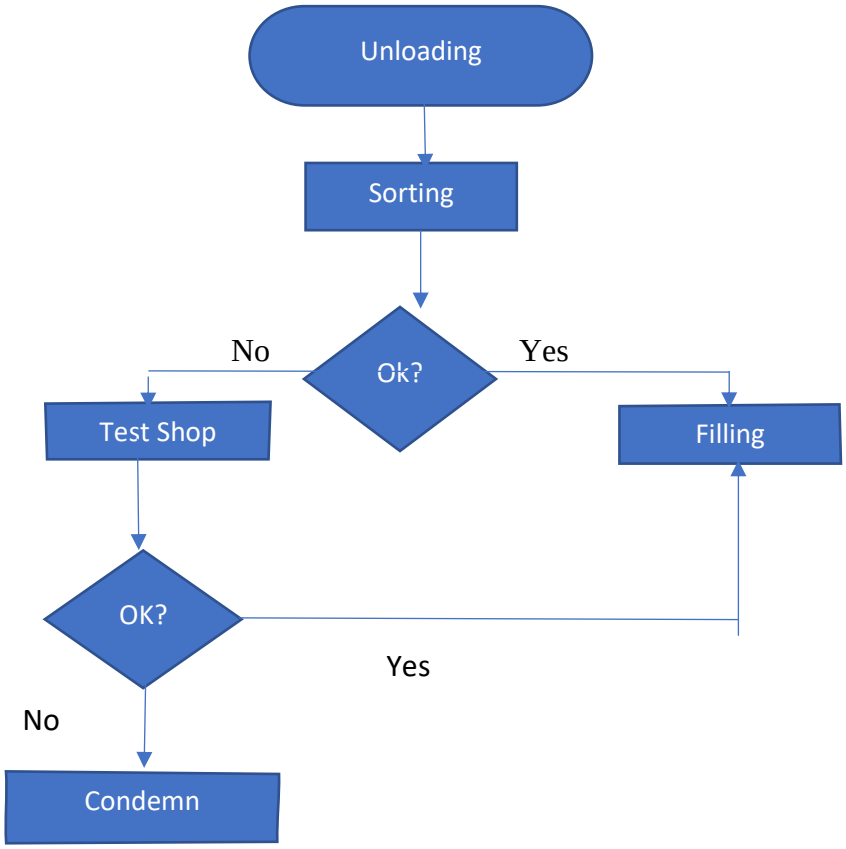
- To study compression of gases into cylinder.
- To study types of cylinders.

4. Activities Carried Out:

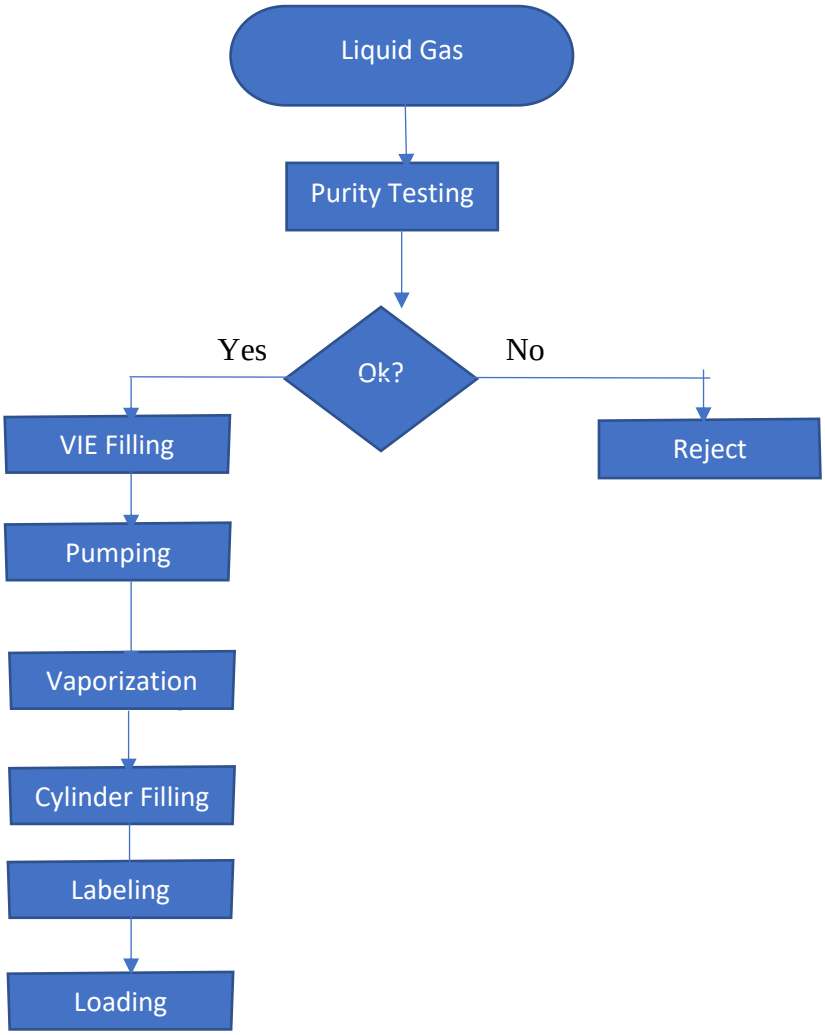
Operational Activities on PGP Plant

The total operational activities of this plant is based on two approaches. One approach is starts with cylinders, and the other one starts with the gases. Both approaches are shown through two separate flow charts below:

First Approach



Second Approach



Cylinder unloading:

The empty cylinder is collected and gathered in the Linde sales Centre. The sales center send these empty cylinder to the PGP plant which is situated in Rupganj with the help of their own transportation system.

The unloading place is called the unload bay. The cylinder is lift out from the vehicle and placed in the bay for the next stage.

The NDT (Non Destructive test) of the cylinder:

The NDT is divided into two phases. They are:

(1) Valve checking: In this process they check the valve of the cylinder. To do so,

-Oil and grease check: Either there are any oil or grease in the valve

-Valve thread check: This is done by the help of a go and not go gauge.

-**Valve condition and specification:** Check the valve condition such as if there any corrosion exists or not, if the valve fitting is ok or not etc.

(2) Cylinder checking: In this process they check the body of the cylinder. To do so,

- Oil and grease check: Either there are any oil or grease in the cylinder body

-Test due: The cylinder is tasted in an interval of time and after every test the company seals a tag in the body of the cylinder which contain the next test date. This test date is check either it is over or not.

-Fire spot: To check for burning spots which means whether the cylinder was exposed to fire.

-Weld spot: To check for welded spots which means whether the cylinder was welded.

-Unauthorized Repair: To check whether it was repaired unofficially or not.

-Modification: To check whether the customer modified the cylinder such as changing a MOX cylinder into a CO_2 cylinder.

-Corrosion: To check for the corrosion.

-Product level and service: To check the product label (sealed tag of the good).

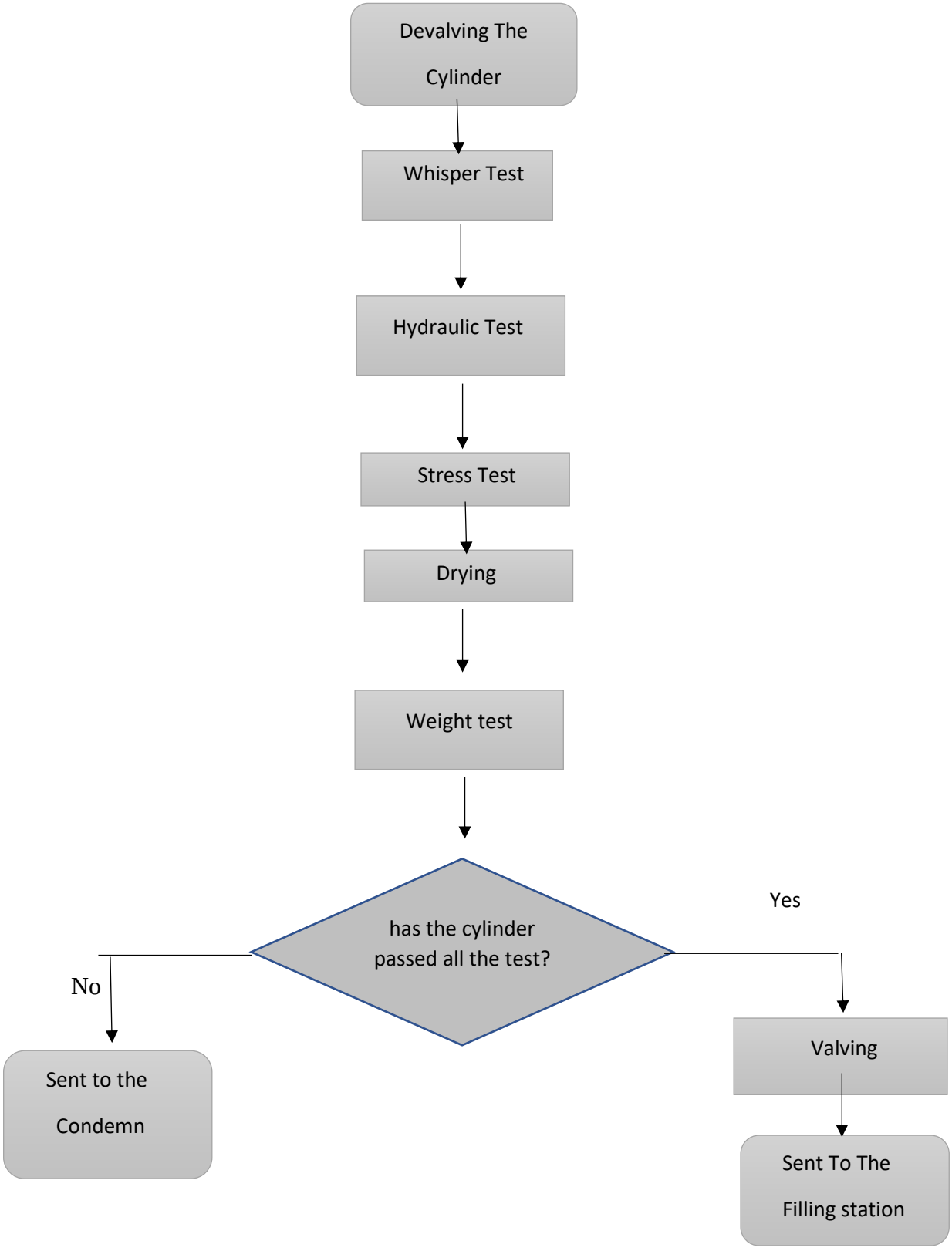
-Painting condition: To check the painting condition of the cylinder.

If a cylinder passes all this test then it is sent to the filling station. On the other hand it is sent to the Mechanical testing bay. If the painting condition is not ok then it is sent to the painting ground for repainting.

Mechanical testing of the cylinder:

In this process the cylinder is deeply tested. On basis of this test, it is decided whether a cylinder would go for filling or it would be condemned (destroying the cylinder for ensuring it cannot be reused).

This testing process is a chain process that is given by a flow chart:


Devalving The Cylinder
Whisper Test
Hydraulic Test
Stress Test
Drying
Weight test
has the cylinder passed all the test?
Yes
No
Valving
Sent To The Filling station
Sent to the Condemn

Description of flow process is given below:

(a) ELECTRIC VALVING/ DEVALVING:

Electric valving or de-valving allows to screw and unscrew valves from gas cylinders.

STANDARD MODEL
EL60 - power supply 400/50 Volt/Hz - cylinder accepted Ø 80 to 320 mm

(b) AUTOMATED HIGH PRESSURE TESTING:

The whole working cycle:
1) Cylinder filling,
2) High pressure testing,
3) Cylinder emptying
4) Drying by an advanced superheated vapor system.

The machine ensures very high productivity, more than thirty cylinders per hour with one and only operator managing the whole cycle directly on the control panel.

It is manufactured either for 6 cylinders (single bench) or for 6+6 cylinders (DUO version), for additional productivity.

The test bench can be integrated with a high pressure steam dryer allowing to dry the tested cylinders directly on the test bench (only for steel cylinders).

(c) DRYING UNIT CIL:

CIL units quickly and safely remove the internal moisture generated inside a cylinder (or an extinguisher) during the hydraulic testing operations or by other contaminations.

Cryogenic Standard Tanks

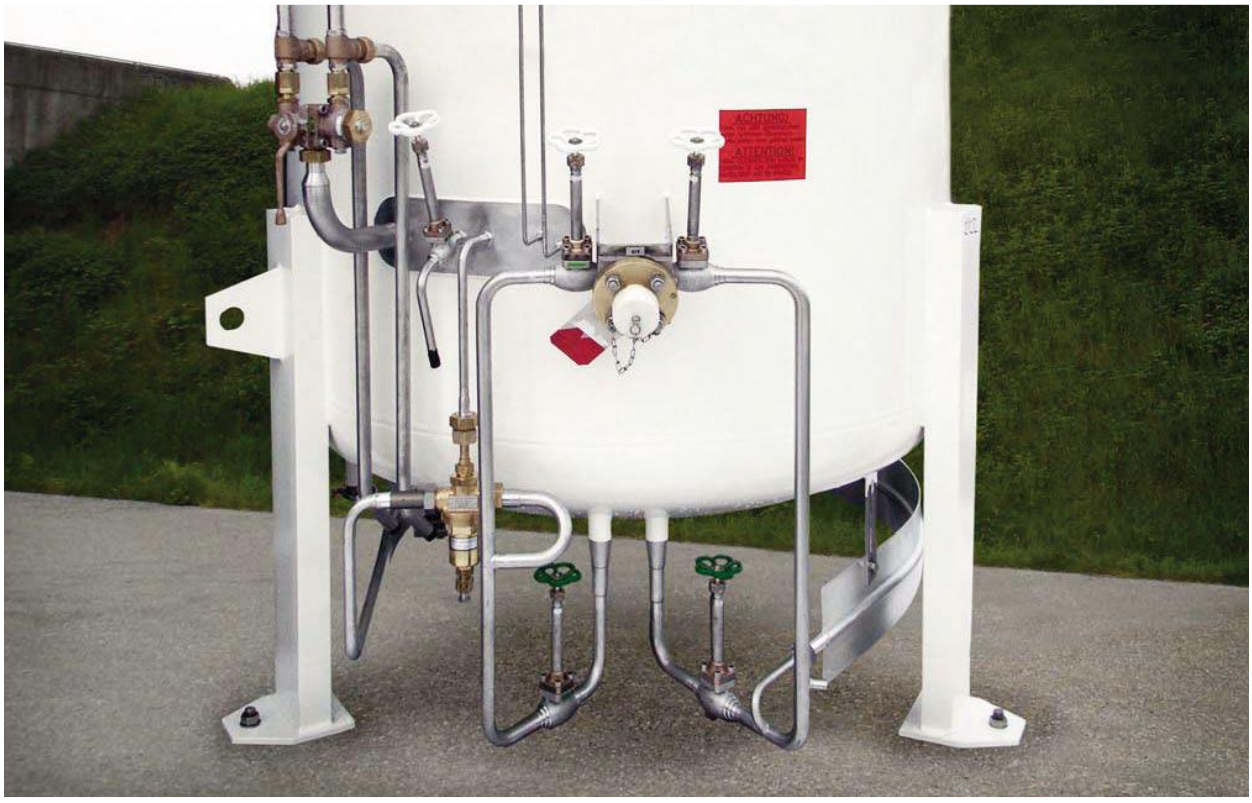
To an increasing extent, industrial gases such as oxygen, nitrogen and argon are delivered to customers in liquid form at cryogenic temperatures and stored by the customer in tanks before further use.

The pressure ratings and sizes of these tanks have been standardized in accordance with the requirements of distribution logistics and economical series production.

Vacuum Insulated Evaporator:

A vacuum insulated evaporator (VIE) is a form of pressure vessel that allows the bulk storage of cryogenic liquids including oxygen, nitrogen and argon for industrial processes and medical applications.

The purpose of the vacuum insulation is to prevent heat transfer between the inner shell, which holds the liquid, and surrounding atmosphere. Without functioning insulation, the stored liquid will rapidly warm and undergo a phase transition to gas, increasing significantly in volume and potentially causing a catastrophic failure to the vessel due to an increase in pressure. To combat such an event, VIEs are installed with a pressure safety valve.



Color code of cylinders:

Cylinder Safety:

We can identify the gas inside a cylinder based on the cylinder's label or collar. The label also provides vital safety information. The image below shows the different elements of a typical cylinder label:

- Product name
- Physical properties
- Hazard pictograms
- Transportation information
- Safety information

Cylinder Valves

Positive pressure valves

A wide range of positive pressure cylinder valves are available from stock. Valves are available for most industrial and hospitality (leisure products) applications and gases at pressures up to 300 bar (g).

Valves can be supplied with either side or top outlet configuration and with hand-wheel or key operated action.

The valves incorporate a non-return valves and minimum positive pressure device which retains pressure of 2 to 5 bar in the cylinder.

Standard valves

A wide range of standard cylinder valves are available for use with most industrial and medical gases at pressures up to 230 bar (300 bar on certain valves.)

Valves can be supplied with either side or top outlet and either key or handwheel operation.

Our Tasks

In this 1 week at the PGP Plant of Linde Bangladesh Limited we were appointed on 3 tasks. They are:

1) Finding the cylinder filling time for different gases.
2) Finding the time for cylinder testing at test shop.

Task 1

There are total 7 filling stations for 7 seven different gases. We determined required time of filling in different cylinders.

Name of Gas	No of Cylinders	Total Volume	Filling Time
Medical Compressed Air	15	96.41 m^3	54 min.
Industrial Oxygen	30	197 m^3	43 min.
Medical Oxygen (MOS and MOX)	78	273.4 m^3	40 mint.
Nitrous Oxide	1	29 kg	3.5 min
Carbon Di Oxide	1	30 kg	2.5 min
Argon	15	105 m^3	23 min
Nitrogen	15	102 m^3	16 min

Task 2

Process	Required Time
Blow down	10-15 mint
Devalving	20 sec
Internal Inspection	1 mint
Hydraulic Pressure Testing at Inverter-2	20-21 mint
Drying	15-20 mint
Date Stamping	2 mint
Valving	30 sec

5. Conclusion:

Linde Bangladesh Limited is truly a symbol of excellence. It is the perfect combination of excellent engineering and experience. Surely all its officials, engineers, technicians and employees are to be appraised for running production non-stop around the year and keeping it a profitable company. The best thing about Linde is that they take their job not only for profit; also they are committed to ensure high quality and safety. Despite being a highly profitable, safety comes first in LINDE. Every person working here is important in Linde. As their main customers are in medical industry, Linde values life most. Every product the produce and supplies are quality controlled. If the company continues to go in the way it is already going, its success cannot be stopped in any way.

Report on

Welding Electrode Manufacturing.

Coordinator

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Signature

1. **Title of the Report:**

Report on welding electrode manufacturing.

2. **Period Covering the Training:**

From 27 December 2018 to 1 January 2019

3. **Objectives of the Report:**

To get introduced with the manufacturing process of electrodes.

4. **Activities Carried Out:**

Though welding electrode is a highly consumable industrial item, the success of this project depends on marketing, financial planning and production of quality electrodes.

Process Flow Chart

The Process

a) PREPRATION OF CORE WIRE:

Electrode quality rimming wire of mild steel with low carbon and low silicon is available in the open market. The wire rod coils are converted to the drawn wire coils of sizes such as 3.2mm at the wire drawing plants in house or on job-work basis. It is then straightened and cut in to required lengths by 'Straightening and Cutting Machine'.

b) PREPARATION OF DRY MIX:

Low carbon Ferro Manganese, Cellulose, Titanium Di-Oxide, Mica, Feldspar, quartz, etc., are some of the chemical powders used as the raw materials for the preparation of flux. These chemicals are available world wide and they are weighed accurately as per the technology for each type of electrodes and they are mixed in a dry mixer to get homogeneous mix.

c) PREPARATION OF THE WET MIX:

Potassium Silicate is used as the Binding agent. The flux is mixed with Silicate in a correct proportion to obtain a wet mix in a mixer. The Wet mix is then pressed to form a briquettes in a hydraulically operated press in order to load the flux in the flux cylinder of the extruder.

d) APPLICATION OF THE COATING BY EXTRUSION:

The coating of flux is done by the extrusion press in which the flux fed through a cylinder under pressure. While the wire is fed from the wire magazine of the electrode press the briquettes are introduced into the extrusion cylinder of the press. During extrusion the core wire is fed one by one from wire feeder and coated with the flux by way of nozzle/die box system incorporated in the extrusion press. The electrodes coming out from the press are tested in an eccentricity tester. The rejected electrodes are taken into the flux stripping machine where the flux is stripped off. The core wire and flux can be re-used. The electrode coming out from the press is passed through a conveyor to the brushing machine for brushing of holding end and cleaning the same on tip end side for easy striking. After that the electrodes are spread on the collecting tray for air drying and after certain period they are fed into the oven.

e) BAKING OF COATED ELECTRODE:

After air drying of the coated electrodes they are baked in oven. Depending on the type of electrode the baking cycle will vary. The moisture content in the electrode should not exceed 4 percent. The electrodes are kept in tunnel oven for approx. 3 hours. There are total 3 part in a tunnel oven.

They are- Airing Zone, Preheating Zone (90 ℃ temp) and Heating Zone (120 ℃ temp)

The Machine

- Wire straightening and cutting machine
- Dry mixer
- Wet mixer
- Briquetting press
- Wire feeder
- Vertical extruder
- Horizontal extruder
- Conveyer
- Tunnel oven
- Printing unit
- Inspection table

Wire straightening and cutting machine

Dry mixer

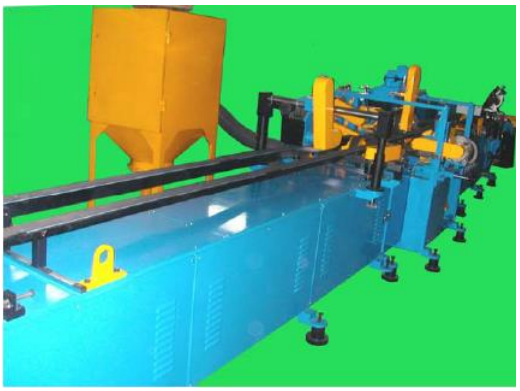
Wet mixer

Briquetting press

Wire feeder

Vertical extruder

Horizontal extruder



Conveyer

Tunnel Oven

Printing Unit

The Product

After heating in tunnel oven for 3 hours we finally get our required electrode products. As their temperature is very high heat suction process is applied. Then the products are sent for quality check again.

Around 146 numbers of electrode are packed in a single packet. Then they are wrapped in polythene and by heating the packets are sealed.

Quality aspects

Quality control in electrode making shop calls for, constant checking of the ground ingredients their proportioning and mixing, application procedures, moisture content and drying conditions. In addition, the chemical analysis of the core wire, powders and bonding materials are determined, the coating thickness is measured and the electrodes are tested on trail plates.

5. Conclusion:

The requirement of welding electrode is directly proportional to the steel production in any country. Electrodes are needed both in bulk and small quantity of production. The most important factor in marketing this product is consumer satisfaction and this can be achieved by producing good quality electrodes and selling at the most economical price with the best sales network.