A

Report of

Summer training

On

"GROUP GATHERING STATION"

At

OIL AND NATURAL GAS CORPORATION LTD

AHMEDABAD ASSET

TRAINING PERIOD: (5th June 2019 to 5th July 2019)

SUBMITTED TO:

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DGM (P),

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(PE, 4th SEM Student)

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CERTIFICATE OF COMPLETION

This is to certify that **PRANAY NARENDRABHAI PATEL**, a **B.Tech** (**Petroleum Engineering**) student from **Pandit Deendayal Petroleum University** has successfully completed the summer training on Group Gathering Stations, Avani Bhavan, Ahmedabad ONGC. The project was carried out from 5th June 2019 to 5th July 2019.

DGM (P)
ONGC Ahmedabad

ACKNOWLEDGEMENT

The training here at Oil & Natural Gas Corporation (ONGC), Ahmedabad Asset in Production Team has been a great experience, both educative and enjoyable at the same time. I would like to thank the entire Human Resource. Department of the Ahmedabad Asset for their support and co-operation throughout the training period 05/05/19 to 05/06/19. Limited (ONGC) for his esteemed guidance and giving me an opportunity to gain an insight into the working of an industry.

I would specially like to thank M.K. Parmar DGM (P) for his support and vital encouragement throughout the training period. I also express my deepest thanks to my guide R.D. Harit for his vital encouragement and guidance to carry out my industrial training work at Ahmedabad Asset.

Last but not the least; I am sincerely grateful to the corresponding authorities of our university for providing us an opportunity for summer training at such a reputed institute and worthy asset.

PRANAY PATEL
Student of B.Tech (PETROLEUM)

Pandit Deendayal Petroleum university, Gandhinagar

Trainee

Camp: Oil & Natural Gas Corporation Limited,

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Contents:

Oil and Natural Gas Corporation(ONGC)

ONGC is the one of the largest Asia based oil and gas exploration and production company and produces around 72% of India's crude oil and 48% of its natural gas.
ONGC has been ranked 357th in the fortune global 500 list of the world's biggest corporations for the year 2012. It is also among the 250 global energy companies by Plats

ONGC was founded on 14th Aug 1956. It is involved in exploring for and exploiting hydrocarbons in 26 sedimentary basins and India and owns and operates over 11000 km of the pipelines in the India.

ONGC Represents India's Energy Security through its Pioneering Efforts

ONGC is the only fully–integrated oil and gas company in India, operating along the entire hydrocarbon value chain. It has single-handedly scripted India's hydrocarbon saga. Some key pointers:

- ONGC has discovered 6 out of the 7 oil and gas producing basins in India:
- This largest energy company in India has established 8.70 billion tonnes of in-place hydrocarbon reserves. It has to its credit more than 570 discoveries of oil and gas with Ultimate Reserves of 3.02 Billion Metric tonnes (BMT) of Oil Plus Oil Equivalent Gas (O+OEG) from domestic acreages.
- It has cumulatively produced 998 Million Metric Tonnes (MMT) of crude and 645 Billion Cubic Meters (BCM) of Natural Gas.
- ONGC has won 115 out of a total 254 Blocks (more than 50%) in the 8 rounds of bidding, under the New Exploration Licensing Policy (NELP) of the Indian Government.
- ONGC's wholly-owned subsidiary ONGC Videsh Ltd. (OVL) is the biggest Indian multinational, with 41 Oil & Gas projects in 20 countries.
- ONGC produces over 1.26 million barrels of oil equivalent per day, contributing around 70% of India's domestic production. Of this, over 75% of crude oil produced is Light & Sweet.
- The Company holds the largest share of hydrocarbon acreages in India (61% in PEL Areas & 81% in ML Areas).
- ONGC possesses about one tenth of the total Indian refining capacity.
- This E&P Company has a well-integrated Hydrocarbon Value Chain structure with interests in LNG and product transportation business as well.
- A unique organization in world to have all operative offshore and onshore installations (403) accredited with globally recognized certifications.

ONGC's growth towards its self-reliance

ONGC was set up under the visionary leadership of Pandit Jawaharlal Nehru Pandit Nehru reposed faith in Shri Keshav Dev Malviya who laid the foundation of ONGC in the form of Oil and Gas division, under Geological Survey of India, in 1955. A few months later, it was converted into an oil and Natural Gas Directorate. The Directorate was converted into Commission and christened Oil & Natural Gas Commission on 14th August 1956. In 1994, Oil and Natural Gas Commission was converted in to a Corporation, and in 1997 it was recognized as one of the Navratnas by the Government of India. Subsequently, it has been conferred with Maharatna status in the year 2010.

Over 56 years of its existence ONGC has crossed many a milestone to realize the energy dreams of India. The journey of ONGC, over these years, has been a tale of conviction, courage and commitment. ONGC'S' superlative efforts have resulted in converting earlier frontier areas into new hydrocarbon provinces. From A modest beginning, ONGC has grown to be one of the largest E&P companies in the world in terms of reserves and production.

ONGC as an integrated Oil & Gas Corporate has developed in-house capability in all aspects of exploration and production business i.e., Acquisition, Processing & Interpretation (API) of Seismic data, drilling, work-over and well stimulation operations, engineering & construction, production, processing, refining, transportation, marketing, applied R&D and training, etc.

Today, Oil and Natural Gas Corporation Ltd. (ONGC) is, the leader in Exploration & Production (E&P) activities in India having 72% contribution to India's total production of crude oil and 48% of natural gas. ONGC has established more than 7 Billion tons of in-place hydrocarbon reserves in the country. In fact, six out of seven producing basins in India have been discovered by ONGC.

JOURNEY OF CRUDE OIL

The Crude oil produced from various oil fields are being transported through pipelines to a Group Gathering Station (GGS). In GGS the oil is being separated from impurities and water by the process of three stages Separator which contains de-emulsifier (1G-Lube, Polarchem) injection in its first stage followed by heating process and electrostatic separation (Heater-Treater). The gas which is produced is transported through pipelines to Gas Collecting Station (GCS). In GCS the collected gas is subjected to Gravity Separation through various separators like HP Separators, LP Separators, Group Separators and Test Separators.

The Processed crude oil from many GGS is being transported to a Central Tank Farm (CTF) where again the crude oil is subjected to a separation process in a Heater-Treater in which the separation occurs in three stages. Later on the processed crude is transported to the desalter plant for reduction of salt and water content of the crude oil (water content<0.2%). In desalter plant the received oil is subjected to separation in three stages (heat exchange trains, heater-treater, and desalter tank). The final crude oil is recovered with 0.10% water-cut and is transported through a pipeline to a nearby refinery (The crude from desalter plant Navagam is sent to Koyali refinery Vadodara, Gujarat) for production of finished products.

The collected gas at GCS is at very low pressure of about 2-5 kg/cm2 which is being transferred to a Gas Compression Plant (GCP) to compress the gas to a pressure of about 40-45 kg/cm2 to use the gas for injection purpose so as to enhance the oil recovery through GGS.

The waste water collected from all separation processes are being sent to Effluent Treatment Plant (ETP) where the trace oil is being recovered from waste water. The treated water is being sent to a Water Injection Plant (WIP) which is being pumped to various wells so as to enhance the oil recovery process. The recovered water from the Desalter plant is being sent to Waste Water Treatment Plant (WWTP).

Oil is produced through three types of wells:

a) Self Drive Wells

b) Sucker Rod Pump (SRP) Wells

c) Artificial Lift Wells (gas injection/water injection)

Self-drive wells or Self-flow wells are the wells which flow from the support of their own pressure. Sucker Rod Pumps work on the principle of hand pumps to produce from the well. In artificial lift wells either gas is injected or water/polymer is injected for the production of oil.

When the oil well ceases to flow with own pressure then Artificial Lift System is installed for pumping out well fluid. The wells having high flux are mainly subjected to artificial lift technique. The gas injection process may either be continuous or intermittent (done in fixed intervals)

Process Description:-

Oil is received in GGS- 7(k) from the wells through 4" pipelines into the following headers

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1. Group header

2. Test header

3. Emulsion header

4. H.P header

Group Header (oil & gas):

Well fluid flows from the wells to header, to bath heater, for preheating & then to group separator Oil water mixture after separation of gas in group separator goes to heater Treater for emulsion treatment. Oil from HT goes to oil storage tank & from tank it goes it is pumped to CTF (K) with the help of oil dispatch pumps. Gas from the group separator goes to booster compressor for compression & goes to the gas grid of Kalol area to GGS (K) which is measured by flow recorder.

Test Header (oil & gas):

One test header with section valve is provided to facilitate testing of individual wells one well can be tested one at a time. The well to be tested is diverted to test separator where liquid & gas separation take place. Gas is sent to gas grid & liquid flow 2 TCS tanks. Metering facility is provided for oil & gas.

Emulsion Header:

Well fluid flows from the wells to header & goes to emulsion separator for separating liquid & gas. Liquid goes to heater treater for emulsion separation oil from HT goes to oil storage tank & gas from separator goes to the gas grid of kalol area of GGS which is measured by flow recorders.

HP header:

Well fluid flows from header & goes to emulsion separator to HP separators from separator liquid goes to heater treater for emulsion treatment & gas goes to the gas grid of kalol area to GGS kalol which is measured by the flow recorders and oil from HT goes to storage tanks.

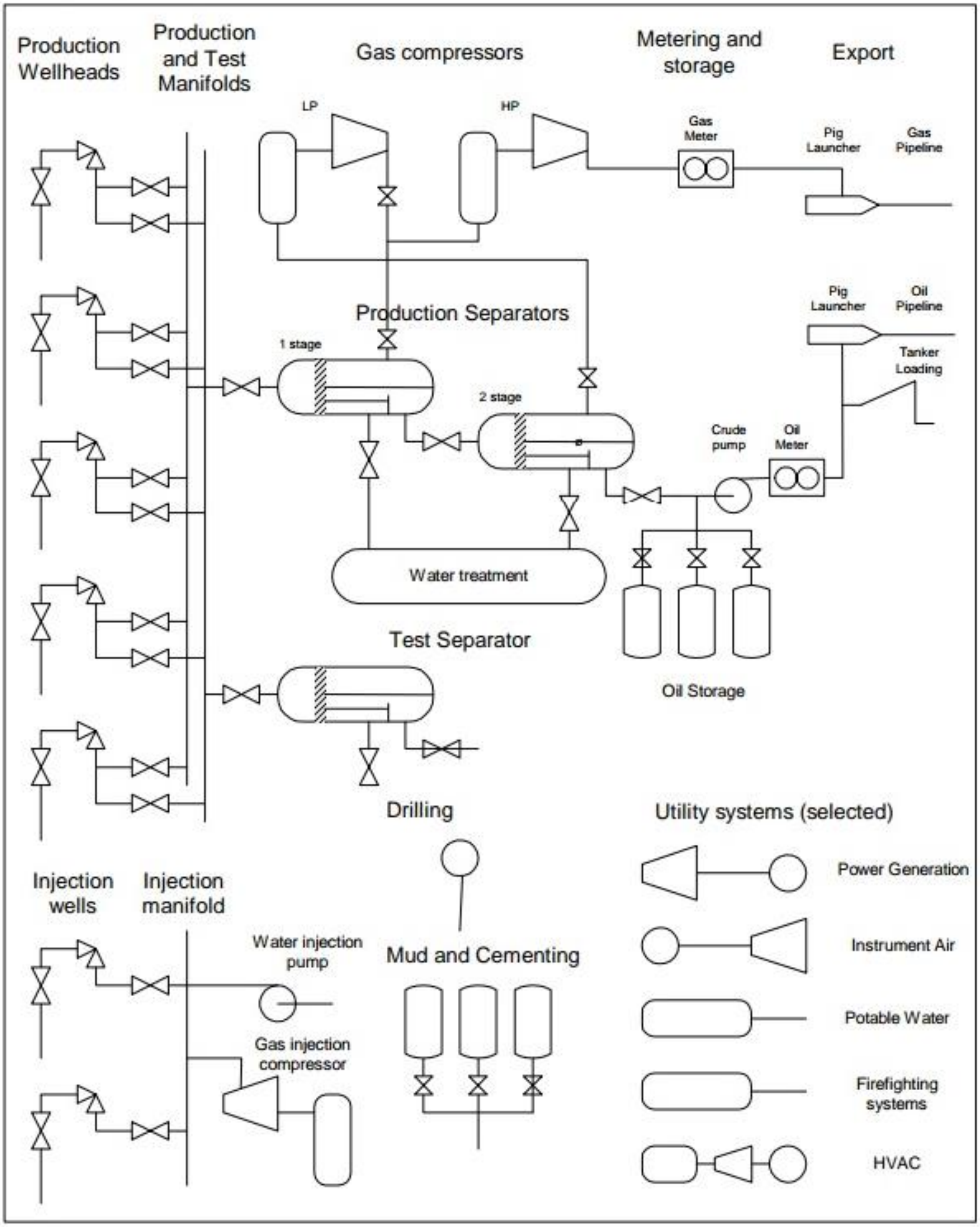
Emulsion Header/H.P. Header:

This system connects valve manifold to the separator via bath heater. It is meant for collecting oil from wells & diverting the same to the separators.

Separators:

There are four type of separators i.e. for group production, testing of wells, emulsion flow & HP (high pressure) separator to handle HP gas. Feed enters the separator from the valve manifold. The separator are separating vessel that are capable of separating liquid phase and gas phase. Flow recorders are provided to measure produced gas. The separated oil flows out from the separator on oil level to oil storage tanks via Heater-Treater. Pressure gauges are provided on the separators to monitor the operating pressure. All the separators are provided with pressure relief valve PSV to protect the vessel against over pressure.

Oil and gas production overview



GGS Motera

- Motera plant is a group gathering station which was commissioned on 20/03/92 for separating all the natural gas from the oil and then compress it to a certain pressure (approx. 4.5 kg/cm^2) which is then send to GCS (Gas Collecting Station) in Kalol.
- Again the gas from GCS passed to the GCP (Gas Compression plant) in kalol where the gas is pressurized to 45 kg/cm^2 and then the pressure is set in the line from where the respective GGS can consume the pressurized gas for injection purpose.
- Motera GGS inject back the compressed gas in the depleted wells to take maximum gas lift and the average oil production depth is around 1500 m.
- First the compressed natural gas is injected by yellow pipe line to the production well for a certain duration and the oil goes through the headers to the group separator ,low separator(when the production is received from artificial lift) or test separator(for testing the well).
- And after that the mixture first goes into the heat bath where the viscosity of oil in decreased by heating the mixture with the help of a heat exchanger, and the oil is then stored into the three storage tank each having capacity of 45m^3 and average one day oil production if Motera GGS is about 60m^3 and of gas is around 75,000 scf.

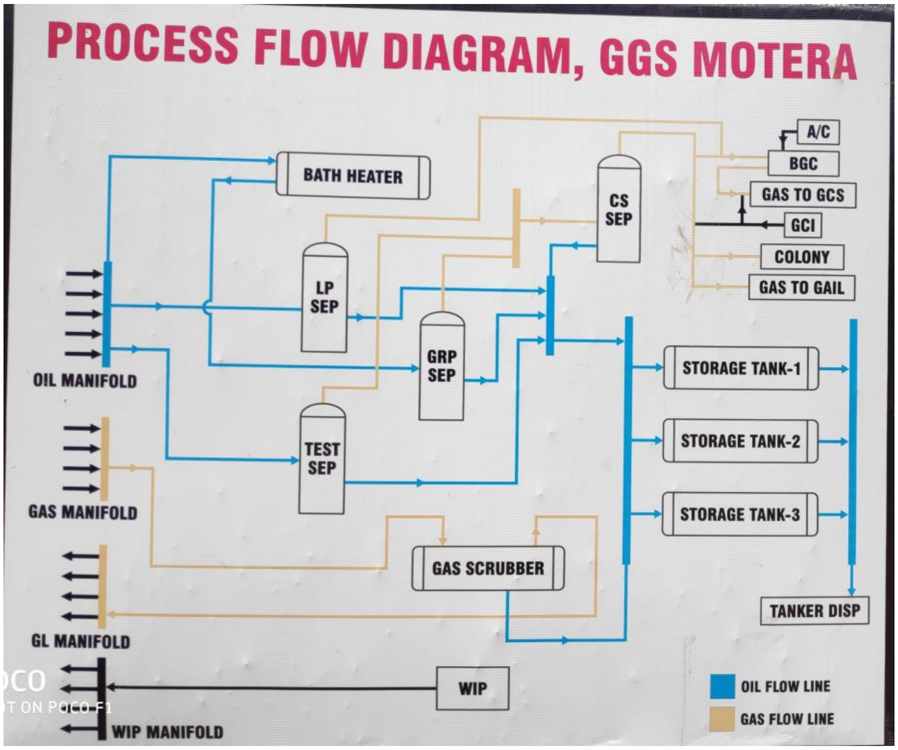
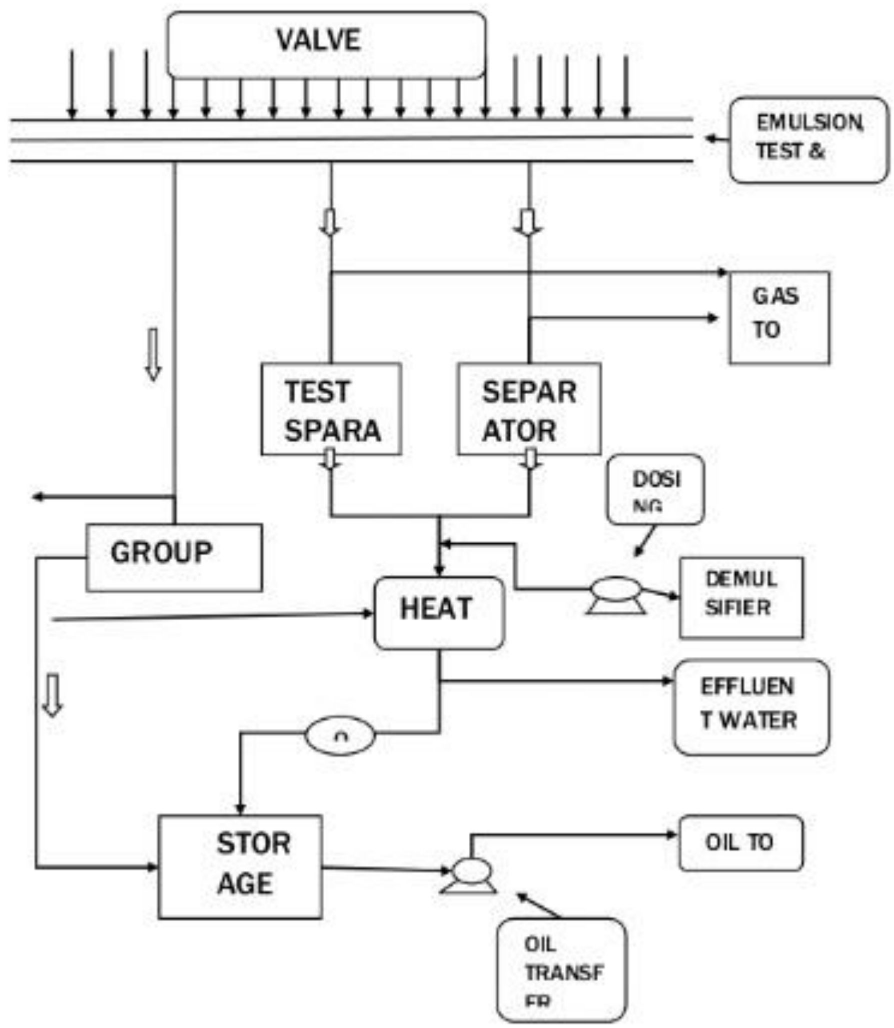


Fig. Overview of GGS Motera

Group Gathering System (GGS)

GGS (Group Gathering Station) is an installation which receives oil through manifolds from its different assigned fields. Crude is separated here in the form of oil, gas and water. Separated oil is sent to CTF (Central Tank Farm) for further treatment, and separated gas is sent to GCP (Gas Compressor Plant) through GCS (Gas Collecting Station) in order to receive back compressed gas sent at 3 kg/cm2 and received at 40-45 kg/cm2. Water from GGS is sent to ETP (Effluent Treatment Plant) and then to CWIP (Central Water Injection Plant) for its further treatment and injection into the well to enhance recovery. Gas injection programs are carried out and controlled by the specified GGS.



OPERATING SYSTEMS

1. **VALVE MANIFOLD**

Purpose:-

- To group the wells based on their pressure.
- To group the wells based on quality of oil i.e. pure or emulsion.
- To isolate any well for testing purpose.
- To divert any well to the required header through operation of valves.

2. SEPARATOR:

Purpose:-

Used primarily to separate a combined liquid-gas well stream into components that are relatively free of each other. The name separator usually is applied to the vessel used in the field to separate oil & gas coming directly from oil or gas well, or group of wells.

Process:-

Fluid enters tangentially and due to the sudden pressure drop to the set level, the fluid gets separated into liquid and gases. Baffles are fitted inside the separator to help in better separation of fluid. The fluid is given greater residence time to allow better separation.

FACTORS AFFECTING SEPARATION:

A. Operating pressure:-

1. Dependent on GOR
2. Change in pressure affects both the liquid and gas densities
3. On the allowable velocity
4. On actual flowing volumes

Net effect: increase in pressure leads to increased gas capacity of the separator in scf/cm.

B. Temperature:-

Affects gas-liquid capacities only when it affects the actual flowing volumes & densities. Temperature control usually involves cooling as well stream flow temperatures are generally above the optimum separation temperature. Expansion in the cooling system is widely used because HP gas is becoming more common and little capital outlay is required.

Net effect: increase in temperature leads to decrease in capacity.

C. Retention Time:-

After separation into gas and liquid in the separators the liquid containing oil and water and dissolved gas is sent to the 'Heater-Treater'. The gas from the separators is sent to GCS

HEATER-TREATER

Heater-Treater is a horizontal vessel employing a vertical flow pattern. Methods of heating, chemical action, electrical coalescence, water washing of oil & settling for emulsification are used. Movements of fluid are controlled by differential pressure combined with static head.

COMPONENTS/PARTS OF HEATER TREATER:

- Inlet degassing section
- Heating section
- Differential oil control chamber
- Coalescing section (Electrical chamber)

Inlet degassing section:

Oil mixed with demulsifies enters the Heater-Treater through degassing section, above the fire tubes. Free gas is liberated from the flow stream & equalized across the entire degassing & heater areas of the treater. The degassing section is separated from heating section by baffles. The fluid travels downwards from the degassing area and enters the heating section under the fire tubes through multiple orifice distribution.

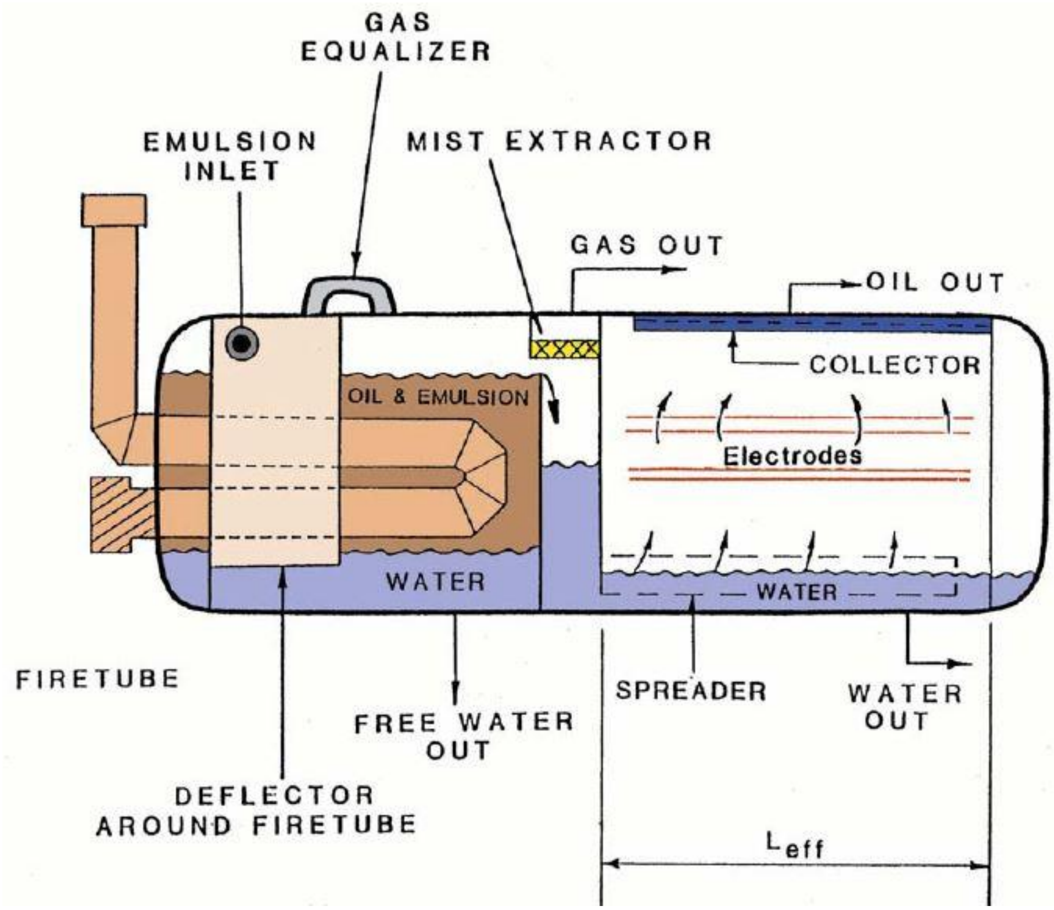


Fig. Heater-Treater

Heating section:

This section consists of a fire tube (U-tube) bent at 180 degrees. The constant level is maintained by weir height. Oil enters this section from bottom of the degassing section & passes through heater at the bottom and washing action takes place & free water & solids fall out of oil stream. The water level in this section is controlled by a weighted, displacement type interface control valve. The oil and entrained water flow upwards from the distributors around the fire tubes, where the required temperature is reached. The increase in temperature of oil releases some additional gas. The heat released gas then joins the free gas from the inlet section and is discharged from the Treater through a gas pressure control valve. Burners are designed for maximum heat output with minimum fuel consumption & maintenance requiring little adjustments. Plots are fixed type and require no adjustments. Fuel gas supply is to be properly adjusted and regulated which is free of liquid and solid particles.

Differential Oil Control Chamber:

The heated fluid transfers from the heating section over the fixed weir into a differential oil control chamber, which contains a liquid level control float. The fluid travels downwards to near the bottom of oil control chamber where the openings of the coalescing section distributors are located.

Coalescing section (Electrical Chamber):

Heater-Treater uses a high voltage potential on the electrodes for coalescing of water droplets in the final phase of processing. The electrodes are suspended on the insulated hanger from the upper portion of the vessel. The ground electrode is furnished with solid steel hangers to ensure grounding with the steel of the Treater. An externally mounted, oil immersed high voltage transformer is furnished to provide the power to the electrodes. The transformer uses 240 volts in primary and supplied about 16500 volts in secondary. The high voltage secondary is connected to charged electrode through a specially designed high voltage entrance. Secondary is also connected to voltmeter and external pilot indicating lamp. The oil and entrained water enter the coalescing section from the differential control chamber through multiple, full length distributors. As the oil and entrained water come into contact with the electrical field in the grid area, final coalescing of water takes place. The water falls back to the water area at the bottom and the clean oil continues to rise to the top, where it enters a collector and is discharged through the clean oil outlet control valve.

Checks for Heater-Treater:-

1. Burners
2. Valves and controls and sight glasses
3. Safety valve
4. Fire tube

From the heater treater the separated oil is sent to storage tanks and the water is sent to ETP (Effluent treatment plant) for further treatment.

Storage System:

Purpose-

- To store oil before being pumped to CTF
- To measure the oil produced.

Process-

- Oil from the Heater-Treater is taken into overhead cylindrical tanks and subsequently measured. From here the oil is sent to CTF, where oil from different GGS is collected and measured.

GCP (Gas Compression Plant)

INTRODUCTION

The main function of GCP (K) is to compress the gas received from GCS at 3.6 kg/cm² to 42 kg/cm² and send it for gas injection purpose. The production is 5x10 m^3/day. It has a total of 10 compressors (6 in old plant and 4 in new plant) and a water treatment plant with 2 reverse osmosis plants (RO plant) and a chemical treatment plant.

The GCP compresses the gas and sends it back to GCS from where it is sent to receivers like RIL, Bharat Vijay Mills etc. It receives gas from GCS at 3.6 kg/cm and compresses it to 42 kg/cm2 in two stages. In the first stage it compresses the gas from 3.6 kg/cm² to 13 kg/cm and in the second stage it compresses it from 13 kg/cm² to 42 kg/cm². This gas is then sent to GGS where it is used for gas injection.

Plant Description:

The various components of GDP are:

- Inlet separator
- Gas compressors
- Discharge separators
- Condensation drum
- Gas coolers
- Reverse osmosis plant (RO Plant)
- Degasser tank
- Cation and anion exchangers
- Cooling towers

Gas Compressor:

Gas compressors are used to compress the gas to a high pressure of 42kg/cm^2 so as to increase the flowing pressure. The compression is done in two steps, in the first step it is compressed from 3.6 kg/cm^2 to 13 kg/cm^2 and id the second step from 13 kg/cm^2 to 42 kg/cm^2.

Discharge Separator:

The function of the discharge separator is to separate the gas from the condensates during the discharge stage. It has the same process as that of inlet separator.

Fig. Compressor

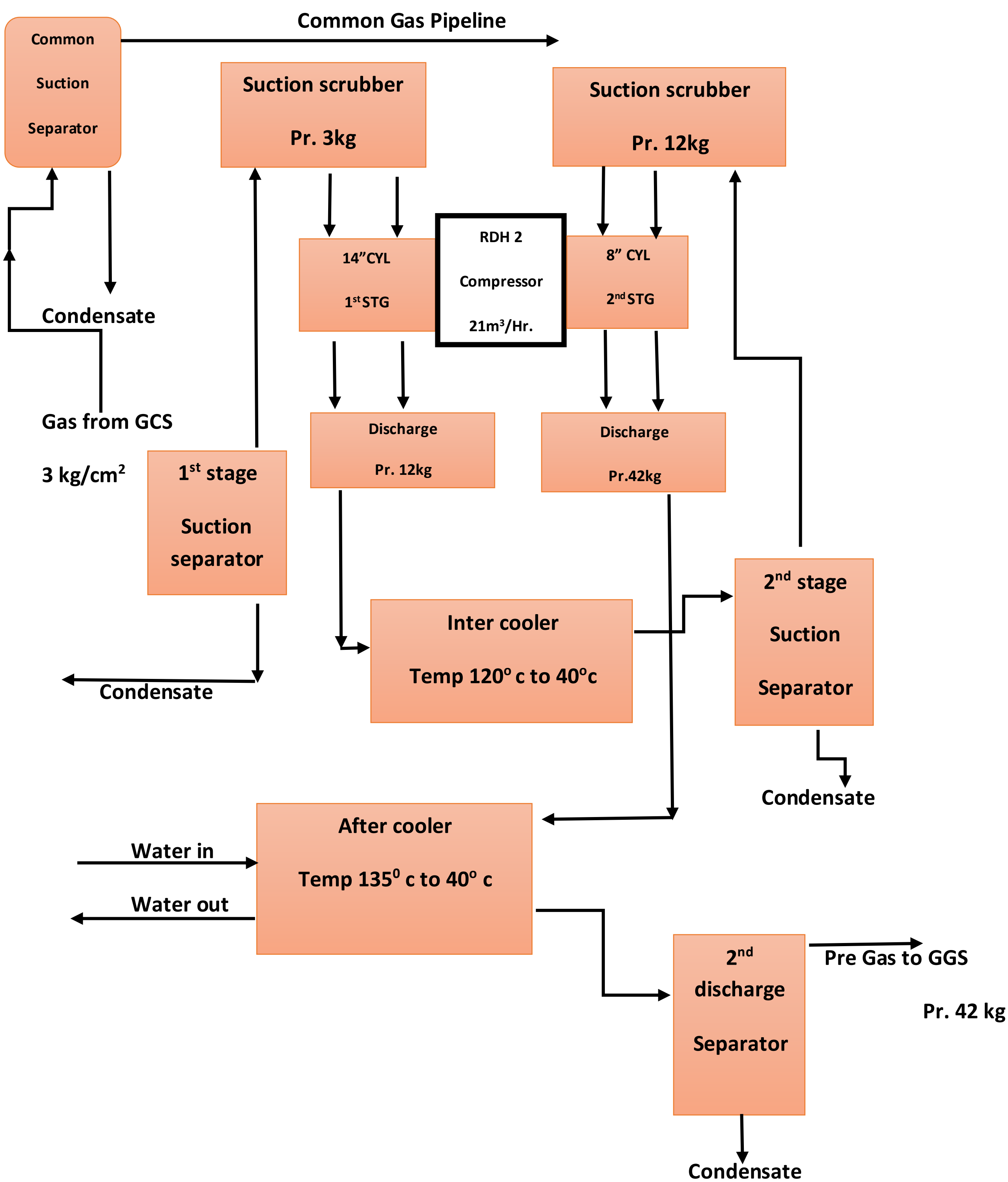
GAS COMPRESSION PLANT (GCP) Kalol

The gas compressor plant is related to the gas lift wells, it supplies the compressed gas for artificial gas lift well lit compressed natural gas available from the gas grid at 3 kg/cm2 to 42 kg/cm2.

Oil Transportation to Refinery:

The oil from different GGS is collected into Kalol CTF and sent to the desalter plant at Navagam, for desalination. After desalinating the crude and meeting the required specifications, the crude is sold to the customer, Indian Oil Corporation Limited (IOCL) refinery at Vadodara for downstream refining processes and marketing.

Overview of Gas Compression Plant Kalol



ENHANCED OIL RECOVERY (EOR)

Overview:

In order to further enhance the recovery, Enhanced Oil Recovery Techniques are used. The general principle of EOR is to improve sweep efficiency through reduction in mobility ratio. Reduction in interfacial tension/capillary forces between rock and targeted fluid i.e. oil

Both the processes lead to improve displacement efficiency to flooding force generated by injectant.

The different methods of EOR are:

- Chemical flood
- Polymer
- Surfactant slug
- Alkaline
- Miscellar
- Alkaline-surfactant-polymer (ASP)
- Miscible
- Hydrocarbon miscible flooding
- Carbon dioxide injection
- Nitrogen injection
- Thermal methods
- Hot fluid injection
- Cyclic steam stimulation
- Steam flooding
- In-situ combustion
- Steam -assisted gravity drainage

- MEOR

ARTIFICIAL LIFT (A/L)

Introduction:

Artificial lift refers to the use of artificial means to increase the flow of liquids, such as crude oil or water, from a production well. Generally this is achieved by the use of a mechanical device inside the well (pump or velocity string) or by decreasing the weight of the hydrostatic column by injecting gas into the liquid some distance down the well. Artificial lift is needed in wells when there is insufficient pressure in the reservoir to lift the produced fluids to the surface, but often used in naturally flowing wells (which do not technically need it) to increase the flow rate above what would flow naturally. The produced fluid can be oil and/or water, typically with some amount of gas included.

Why use Artificial Lift?

Any liquid-producing reservoir will have a reservoir pressure': some level of energy or potential that will force fluid and/or gas to areas of lower energy or potential. You can think of this much like the water pressure in your municipal water system. As soon as the pressure inside a production well is decreased below the reservoir pressure, the reservoir will fill the well back up, just like opening a valve on your water system. Depending on the depth of the reservoir (deeper results in higher pressure requirement) and density of the fluid (heavier mixture results in higher requirement), the reservoir may or may not have enough potential to push the fluid to the surface. Most oil production reservoirs have sufficient potential to produce oil and gas which are light naturally in the early phases of production. Eventually, as water which is heavier than oil and much heavier than gas encroaches into production and reservoir pressure decreases as the reservoir depletes, all wells will stop flowing naturally.

At some point, most well operators will implement an artificial lift plan to continue and/or to increase production. Most water-producing wells, by contrast, will need artificial lift from the very beginning of production because they do not benefit from the lighter density of oil and gas.

Hydraulic pumping systems transmit energy to the bottom of the well by means of pressurized power fluid that flows down in the wellbore tubular to a subsurface pump. There are two types of hydraulic subsurface pump:

a) A reciprocating piston pump, where one side is powered by the injected fluid while the other side pumps the produced fluids to surface, and

b) A jet pump, where the injected fluid passes through a nozzle creating a venture effect pushing the produced fluids to surface.

These systems are very versatile and have been used in shallow depths (1000ft) to deeper wells (18,000ft), low rate wells with production in the tens of barrels per day to wells producing in excess of 10,000 barrels per day (1,600 m^3/d).

Certain substances can be mixed in with the injected fluid to help deal or control with corrosion, paraffin and emulsion problems. Hydraulic pumping systems are also suitable for deviated wells where conventional pumps such as the rod pump are not feasible.

These systems have also some disadvantages. They are sensitive to solids and are the least efficient lift method. While typically the cost of deploying these systems has been very high, new coiled tubing umbilical technologies are in some cases greatly reducing the cost.

Most oil reservoirs are of the volumetric type where the driving mechanism is the expansion of solution gas when reservoir pressure declines because of fluid production. Oil reservoirs will eventually not be able to produce fluids at economical rates unless natural driving mechanisms (e.g., aquifer and/or gas cap) or pressure maintenance mechanisms (e.g., water flooding or gas injection) are present to maintain reservoir energy. The only way to obtain a high production rate of a well is to increase production pressure drawdown by reducing the bottom-hole pressure with artificial lift methods. Approximately 50% of wells worldwide need artificial lift systems. The commonly used artificial lift methods include the following:

- Sucker rod pumping (SRP)
- Gas lift (GL)
- Electrical submersible pumping (ESP)
- Hydraulic piston pumping
- Hydraulic jet pumping
- Plunger lift
- Progressing cavity pumping (PCP)

Gas Lift:

An artificial-lift method in which gas is injected into the production tubing to reduce the hydrostatic pressure of the fluid column. The resulting reduction in bottom hole pressure allows the reservoir liquids to enter the wellbore at a higher flow rate. The injection gas is typically conveyed down the tubing-casing annulus and enters the production train through a series of gas-lift valves. The gas-lift valve position, operating pressures and gas injection rate are determined by specific well conditions.

As the name denotes, gas is injected in the tubing to reduce the weight of the hydrostatic column, thus reducing the back pressure and allowing the reservoir pressure to push the mixture of produce fluids and gas up to the surface. The gas lift can be deployed in a wide range of well conditions (up to 30,000 bpd and down to 15,000ft). They handle abrasive elements and sand very well, and the cost of work over is minimum. The gas lifted wells are equipped with side pocket mandrel and gas lift injection valves. This arrangement allows a deeper gas injection in the tubing. The gas lift system has some disadvantages. There has to be a source of gas, some flow assurance problems such as hydrates can be triggered by the gas lift

Progressing Cavity Pump (PCP):

Progressing Cavity Pumps, PCP, are also widely applied in the oil industry. The PCP consists of a stator and a rotor. The rotor is rotated using either a top side motor or a bottomhole motor. The rotation created sequential cavities and the produced fluids are pushed to surface. The PCP is a flexible system with a wide range of applications in terms of rate (up to 5,000 bpd and 6,000ft). They offer outstanding resistance to abrasives and solids but they are restricted to setting depths and temperatures. Some components of the produced fluids like aromatics can also deteriorate the stator's elastomer.

image of progressive cavity pump

Progressive cavity pump

Sucker Rod Pump (SRP):

Sucker rod pumping is also referred to as "beam pumping." It provides mechanical energy to lift oil from bottom hole to surface. It is efficient, simple, and easy for field people to operate. It can pump a well down to very low pressure to maximize oil production rate. It is applicable to slim holes, multiple completions, and high-temperature and viscous oils. The system is also easy to change to other wells with minimum cost. The major disadvantages of beam pumping include excessive friction in crooked/ deviated holes, solid-sensitive problems, low efficiency in gas wells, limited depth due to rod capacity, and bulky in offshore operations. Beam pumping trends include 50 improved pump off controllers, better gas separation, gas handling pumps, and optimization using surface and bottom-hole cards.

An artificial-lift pumping system using a surface power source to drive a downhole pump assembly. A beam and crank assembly creates reciprocating motion in a sucker-rod string that connects to the downhole pump assembly (SRP). The rod pump is the most common artificial-lift system used in land-based operations. The relatively simple downhole components and the ease of servicing surface power facilities render the rod pump a reliable artificial-lift system for a wide range of applications.

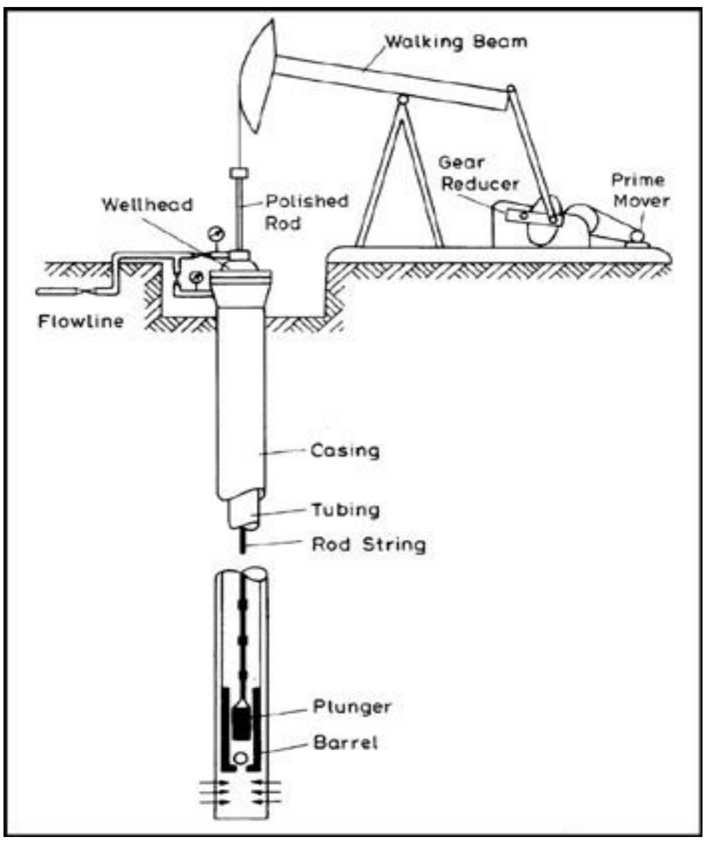


Fig. Sucker Rod Pump

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