Why Compressor's Fails.

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Types of compressors used in Air cond & Refrigeration

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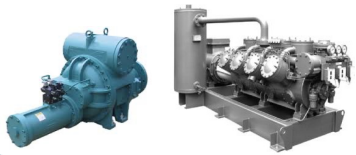
Types of compressors used in Ammonia Refrigeration

- There are mainly two types of compressor's are used in Ammonia i.e. Screw and Reciprocating



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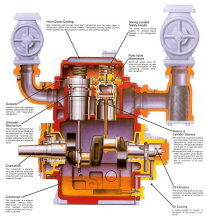
Reciprocating compressor



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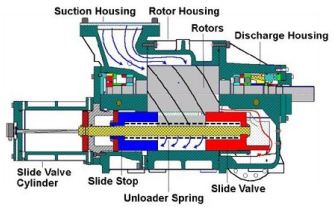
Screw Compressor



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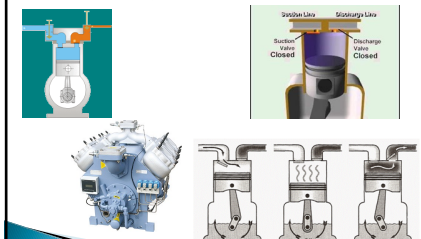
Compressor Operation - Reciprocating



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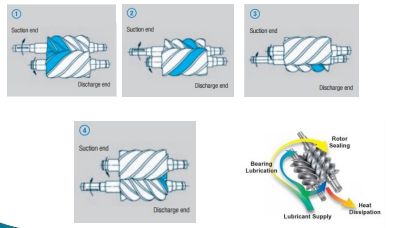
Compressor Operation - Screw



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OPERATOR RESPONSIBILITIES
What Operators Must Know

- The basic fundamentals of refrigeration, particularly the relationship between the temperature and pressure of ammonia. There is no compulsion of that the operator needs to have the capabilities to design a system, but rather that he should have sufficient knowledge:
- A. To operate the system safely.
- B. To understand the operation and function of each component.
- C. To be aware of the relationship between the various components in the system.

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **The Compressor**
- Each compressor manufacturer specifies application limits in which the compressor may be operated safely. The most important limits are protected by safety controls and the operator must make himself familiar with the operation, set point and function of the following:
- A. Low (suction gas) pressure cut-out
- B. High (discharge gas) pressure cut-out
- C. Low differential oil pressure cut-out
- D. High oil temperature cut-out
- E. High discharge temperature cut-out
- F. Any additional safety controls which may be fitted

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Oil In Refrigeration System**
- Where the refrigerant is essential for the cooling purpose of a refrigeration system, the refrigeration oil is also crucial for the correct & smooth functioning of the compressor.
- Oil used in compressor for reduce friction, prevent wear & tear, capacity control of compressor and act as a seal between the high and low pressure sides in screw compressor.
- Oil should not be travel in other parts of system other than Compressor to oil separator & back to compressor.

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Oil Separator**
- Operator should know about the function of the oil separator installed in our system. How it function, what accessories incorporated in it and frequency of the checking the accessories installed.
- Correct oil separator sizing is essential for proper oil separation and minimal pressure drop across the separator.
- As oil is act as insulation in colder area which reduces the refrigerating effect, to avoid oil carry over to other parts of system it requires good quality & efficient oil separators.

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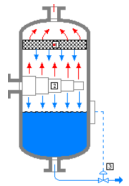
OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Oil Separator – Demister Type Oil Separator efficiency is ≤90%**



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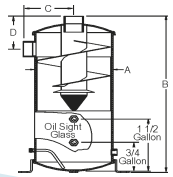
OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Oil Separator – Helical / Axial flow Type Oil Separator efficiency is ≤99%**



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TYPES OF OIL SEPARATOR

- Coalescing oil Separators - Oil Carry over is less than 10PPM

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Automatic Control Valves**
- The basic function of control valves is to regulate automatically the pressure, temperature, level and feed rate of refrigerant in the system. It is the responsibility of the operator to know:
- A. How a valve functions
- B. What the valve regulates
- C. How to adjust the valve
- D. What happens when the valve is opened or closed
- E. What happens when the valve is bypassed or isolated
- F. What happens during a power failure

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Isolating Valves**
- These valves are installed in a system in order to isolate certain components or to stop the flow of refrigerant. They may be manually operated, electrically operated or pneumatically operated. Each operator must know:
- A. Where each valve is located
- B. What the effect is of opening or closing each valve
- C. Whether a valve should normally be in the open or closed position
- D. How to determine whether a valve is opened or closed

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Pressure Relief Valves**
- In order to prevent unduly high pressures from causing rupture of components within the system, a number of spring-loaded pressure relief valves are normally provided. The performance of these pressure relief valves should be checked annually. Each operator should know:
- A. The location of each pressure relief valve
- B. The correct relief setting for each valve
- C. What part of the system the valve is designed to protect
- D. What action to take should the relief valve operate or fail to operate

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OPERATOR RESPONSIBILITIES
What Operators Must Know

- **Electrical Controls**
- Modern refrigeration system incorporates many controls like PLC, fuses, safety switches, capacity control switches, relays, timers, etc. these may be grouped together in a control panel. It is the responsibility of each operator to fully understand:
- A. The purpose of each control
- B. What each control is designed to protect
- C. What to do in case of power failure
- D. What sequence of action to take to shut down the plant
- E. What sequence of action to take to start up the plant

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Categories of Failures

- Incorrect application
- Incorrect design, installation and operation.
- System component failures
- Malfunctioning, wrong settings in controls.
- Improper maintenance
- Incorrect diagnosis

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The Failure

- Most Failures are preventable!
- Compressor failures can normally be traced back to:
  - 1. Refrigerant Slugging / Flood back
  - 2. Lack of Lubrication
  - 3. System Contamination
  - 4. Electrical Problems
  - 5. Overheating

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The Failure

- Many compressors run thousands of hours with out oil changes, new parts or any other form of maintenance.
- Preventative maintenance is the key to compressor Longevity.

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Slugging

- Slugging always occurs on startup, but a very rapid change in system operating conditions can also cause slugging.
- A loud knocking noise heard at the compressor start up is evidence of slugging. The noise is produced by hydraulic compression – the compressor is trying to do something it wasn't designed to do – compress a liquid.

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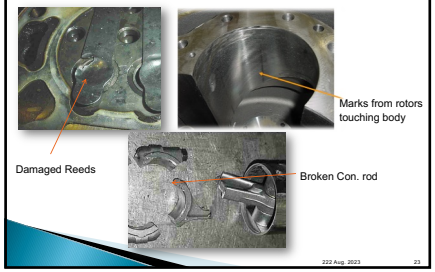
Liquid slugging



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Flooded start

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How can we prevent slugging / flooded start

- Improper setting / installation of level controllers or hand expansion valve.
- Also liquid slugging can prevent by installing correct size of accumulator or surge drum in suction line.

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Flood back

- Flooding is the continuous return of liquid refrigerant as droplets in the suction vapor instead of all super-heated vapor.
- This flood back washes oil off of piston and cylinder liner surfacees.
- All bearing surfaces will prematurely wear. Resulting in Overheating of compressor component.
- On a compressor with a crankcase sight glass, flooding can be observed as constant foaming of the oil during run. Flood back is always due to a problem with the expansion device/level controller in the evaporator, lack of the load or frosting on the external / internal surface of the tube.

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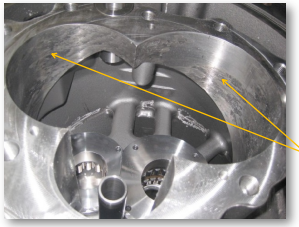
Result of Flood back



Liquid flooding Causes radial forces on the rotors and lend them to seize in the housing on the flange and slider

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How can we prevent Liquid flood back

- Avoid low load on the evaporator.
- Oversized Expansion device
- Maintaining Head pressure and low pressure according to the system requirement
- Low flow through Evaporator
- Oversized system

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Lack/loss of Lubrication

- Excessive oil throw out of compressor. Other causes of lack of lubrication could be as simple as not enough oil in the crankcase.
- During operation, always oil leave should be visible in the crankcase, separate oil from ammonia in oil separator and returning to the compressor at the same rate that it left the compressor.

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Result of Lack/loss of Lubrication

Due to loss of the oil film from cylinder liner, rubbing happens between piston rings and cylinder liner and cylinder liner dimeter increases.

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Result of Lack/loss of Lubrication

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How can we improve Lubrication

- Maintain adequate oil level in the compressor sump or in oil separator in case of screw compressor.
- By installing proper designed and efficient oil separator.
- Check and correct the worn out piston rings, cylinder liners & capacity control mechanism which controlled by oil pressure.
- Oil pump failure or dirty oil filters in the compressor, repair/replace the pump and oil filters.

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Contamination in the system

- Contamination was found to be the major cause of compressor failure.
- Refrigeration system should contains only two things inside is refrigerant and oil. Anything else is a contaminant!

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Contamination in the system

- The presence of water in a system can lead to other contaminations due to the formation of oxidation, corrosion, the refrigerant decomposition.
- Chemical breakdown results from excessive heat , results in oil and refrigerant breakdown, Ferric oxide (Fe2O3) - (Red iron oxide) or Ferrous oxide (Fe2O4) - (iron oxide black), acid formation creates higher wear of the bearing surfaces.

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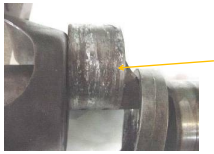
Result of Contamination - Moisture



Due to loss of lubrication properties of the oil, rubbing happens between con. rod and shaft journal.

Due moisture, corrosion had Happened.

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Result of Contamination – Dust / Dirt

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Result of Contamination – Dust / Dirt

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Over Heating

- If the heat Is high enough, the oil breaks down chemically.
- Compressors should operate within the safe limits of the discharge pressure/temperature.
- Oil and refrigerant break down In severe overheating and create CARBON and ACIDS, Which can cause harm throughout the entire system.

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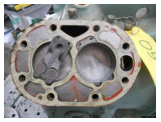
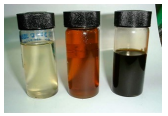
Examples of Overheating





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Preventative maintenance

- The most important factor contributing to a safe operation may be the operator's knowledge of preventive maintenance. Each component of a system requires routine checking, cleaning and possible replacement.
- Periodic checking / changing of oil
- Check pressure drops across condensers and chillers
- Draining of oil from various components
- Purging of non-condensable gases
- Checking of safeties
- Removal of scales from condensers
- Checking of Vibration levels in the compressor
- Annual checking of the compressors as per manufacturers guidelines.

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Maintenance checklist

- **Daily:**
- HP, LP & OP pressure
- Refrigerant level and oil level
- Water level in cooling tower / evaporative condenser
- Flow of media (water/brine/air) to be cooled
- Specific gravity of brine in case of brine chiller.

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Maintenance checklist

- Weekly:
- Cleaning of filters, strainers of pumps.
- Checking tension of compressor drive belts.
- Checking the proper oil return to the compressor from oil separator.

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Maintenance checklist

- Monthly:
- Air purging
- Draining of oil
- Sump cleaning of Cooling tower / evaporative condensers
- Checking of oil filters, liquid line strainers.

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Maintenance checklist

- Quarterly:
- De-scaling of condenser.
- De-scaling of water jacket of compressor head.
- Cleaning of pump impeller.
- Greasing of motors, pumps.
- Adjust belt tension of compressor and motor if required.

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Maintenance checklist

- Half Yearly:
- Checking of earth leakages.
- Cleaning of switch gear contacts and electrical panels.
- Checking of compressor and motor alignment.

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Maintenance checklist

- Yearly:
- Replacement/checking of internal parts of compressor
- Pressure testing of receiver, oil separator & condenser – factory act.
- Painting of equipments and pipelines as per standard colour code with arrow mark.
- Pipe line insulation repair / replacement.

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THANK YOU

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