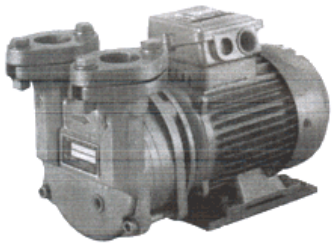
Vacuum Pumps Common Problems and Troubleshooting

Vacuum pumps and systems are one of the widely used equipment in process plants. It is very important to correctly size and select the vacuum pump as it is to lay down the right specifications. Understanding the fundamentals of vacuum as well as the system and its integration would enable the operators to deal with the day to day problems, which are inevitable.

This article highlights various trouble shooting guidelines for some of the most commonly used vacuum machines like liquid ring vacuum pumps, rotary piston vacuum pumps, dry vacuum pump, rotary vane vacuum pump and vacuum blower.



Several factors govern and influence the performance of a vacuum system. It is important to periodically inspect the vacuum system and all its accessories including the upstream and down-stream piping and equipment for leakages as it plays a major role in the performance of a vacuum system.

Some of the common problems faced in vacuum systems could be on account of the following major factors:

- Process conditions and variations
- Variation in utility specs
- Equipment malfunction

The suction load, temperature, leakage rate and other process parameters including the composition of suction gas are crucial for proper functioning of a vacuum system. These parameters can be estimated as per the standards of the Heat Exchange Institute and other standards. These standards can also be applied for testing the performance of the vacuum system. Once the external step is to evaluate and solve the problems associated with the vacuum unit.
Some of the most commonly observed problems in different kinds of vacuum pumps along with suitable trouble-shooting guidelines are discussed in this article.

Liquid Ring Vacuum Pump

High Horsepower

Causes of high horsepower can be various. Comparing actual data with performance curve is the best starting point. Probable causes are:

- V-belt misalignment and improper tensioning of the belts.
- Pump is severely overloaded with water.
- Restriction at the pump inlet or pump discharge
- Motor problem
- Pump running at a speed above the required speed.

Leakage

If the seal water is leaking from the pump, a careful observation of the exact location of the leak and the quantity of the leakage should be carried out. Most likely areas of leakage are:

- Gland packing area - It can be resolved by tightening the packing and if leak still persists, replace the packing.
- Leakage at body gasket – Torque the body bolts evenly, if leak does not stop, then replace the body gasket.
- Leakage at the body plugs – Tighten the plugs. If leak still persists, check for corrosion on plug threads and body threads. Replace plug if corrosion is severe.
- Leakage through castings – Causes can be erosion, corrosion or insertion of a hard object into the pump.

Noisy Pump Operation

Noisy pump operation could be due to:

- Foreign object trapped into the pump – This is a very serious case and is usually accompanied by erratic noise and vibration.
- Pump severely overloaded with water – Causes groaning and hydraulic noise.
- Cavitations – Sounds like marbles in the pump.
- Bearing noise – Possibility of bearing failure.
- Lots of carryover to the pump – This is accompanied by high horsepower.

Vacuum Problems

Could be due to:

- Vacuum surges – Surging is often caused by carryover from separators, or from low points in the line that accumulate water that burp over periodically into the pump. Look for piping problem in the inlet line.
- Restriction in the pump inlet piping – This could be due to closed or partially closed valves, object in the line, plugged inlet screen, etc. This restriction will cause pressure drop that gives low vacuum in the system and a higher vacuum in the pump.
- Check for correct seal water flow – Excessive or inadequate seal water flow will adversely affect vacuum level.
- Variation in seal water temperature – If temperature of the seal water is too high, the pump may operate at a reduced capacity. The higher the vacuum level, the more important it is to have cool water in sufficient quantities.
- Variation in pump rpm – If rpm is low, pump will run at a lower capacity. Check motor and V-belt.
- System leaks – Sources of leaks can include open drain valves, blown gaskets, loose flanges, poorly packed valves, inadequate barometric drop legs on separator, broken pipes etc. Higher leakage will result in lower vacuum.
- Warn pump – This is indicated if vacuum loss has been gradual over a period of time. Check to see if any before the vacuum problem surfaced.

Vibration Problems

Vibration problems could sometimes be due to system problems but at times could also be related directly to the pump. They can be broadly classified into two categories, namely intermittent and continuous.

Intermittent vibration

- Check for liquid slugs or carry-over from separator.
- Check for low pockets in inlet piping where liquid can accumulate and burp over into the vacuum pump at irregular intervals.
- Check for irregular sources of vibration originating. Piping or separators can be the source of vibration if they are not properly secured in place or supported.

Continuous chronic Vibration

- Look for constant carryover and / or excessive seal water to the pump.
- Look at discharge piping or level indicator to be sure that the pump is not operated when in flooded condition.
- Check coupling or V-belt alignment and tensioning.
- Make sure pump is not started against blank suction subjecting it to immediate high vacuum. This does not allow the ring to form properly.
- If the unit is gear driven, make sure vibrations are not from gear itself.
- Check pump mounting and alignment. Loose feet, improper shimming, resonating bases and improper grouting can set up unwanted vibrations.
- Check bearings and lubrication and replace failed bearings.
- Check the inlet piping for vibrations.
- Check pump for excessive wear.

Rotary Piston Vacuum Pump

Excessively High System/Pump Ultimate Pressure

This could be due to:

- Faulty process equipment faulty or improper functioning of the vacuum pump – Check pump performance.
- Process equipment contaminated by high vapor pressure material – Clean equipment with acetone or alcohol, or either Pump down with vacuum pump overnight.
- Process equipment leaks – Check process equipment for leaks.
- Improper flow of vacuum pump oil – Clean oil ducts.
- Contamination of vacuum pump oil – Change pump oil,
- Discharge valves malfunctioning – Check valves per “Discharge Valves”.
- Vacuum pump leaks – Check pump for leaks
- Vacuum pump shaft seal malfunctioning – check shaft seal
- Internal parts worn or damaged – Disassemble pump and inspect internal part.
- Oil flow blocked – Clean oil lines.

Excessive Pump Noise at Low Pressure

Could be due to:

- Hydraulic noise of pump discharge – Open gas ballast valve.

Pump Stalls

Pump stalls could lead to production loss. Probable causes could be:

- Electrical power loss – Check power at pump.
- Pump malfunctioning. Pump oil contaminated or pump is insufficiently lubricated.
- Pump discharge line blocked – Clear pump discharge line, check oil mist eliminator element for blockage.

Pumps does not Start

- Electrical failure – Check for power supply at pump Check motor.
- Pump flooded with oil – Clear oil from pump by turning over manually or disassembling the pump.
- Excessively low temperature – Heat pump to recommended minimum starting temperature.

Oil Discharged from Oil Mist Eliminator

- Excess oil on discharge side of oil mist eliminator – Unscrew oil mist eliminator and pour oil through the discharge fitting back into the pump, or reduce pump inlet pressure below certain set pressure to allow collected oil to drain back through the integral check valve in to the oil mist eliminator.

Dry Screw Vacuum Pump

Insufficient Pumping Capacity

Probable causes:

- Suction filter or strainer is clogged – Clean or change it
- Too much Clearance – Check clearance

Overload on Electric Motor

Probable causes:

- Foreign matter could be caught in the pump – Adjust or replace the screw and casing
- Pressure loss in piping increases – Check the pressure difference between inlet and outlet
- Interference between screws – Adjust side clearance, clearance between screw and casing larger
- Discharge port or line is clogged & back pressure is increased – Drain and clean discharge port and line

Overheat

Overheating of the pump could be due to:

- Excessive lubricant in front end cover – check oil level
- High temperature at vacuum pump inlet – Reduce inlet temperature
- High compression ratio – Check suction and discharge pressure
- Interference between screw and casing – Search for the cause of interference
- Problem with cooling water flow – Clean cooling water line
- Discharge port or line is clogged and back pressure is increased – Drain and clean discharge port and line

Knocking

Probable causes:

- Incorrect positioning between timing gear and screw – Reposition the system.
- Improper assembly – Reassemble
- Damage on gear due to overload or improper lubrication – Replace timing gear

Damaged Bearing or Gear

Probable causes:

- Improper Lubricant – Change Lubricant
- Lubricant level low – Refill lubricant

Rotary Vane vacuum Pump

Pump does not start

- Connect the pump correctly, if not connected properly
- Set motor protection switch properly, if incorrectly set
- If operating voltage does not match with motor, replace motor
- Replace motor if motor is malfunctioning
- If oil temperature is blow 12^{o}C, Heat the pump or pump oil or use different grade of oil
- If oil is too vicious – Use appropriated oil grade
- Exhaust filter / exhaust line is clogged, replace filter or clean exhaust line

Pump does not Reach Ultimate Pressure

- Gauge is unsuitable – Use correct gauge
- External leak – pipe fittings may be loose. Check and tighten all fittings
- Float valve does not close – Repair the valve
- Inadequate lubrication due to unsuitable or contaminated oil clogged oil filter or clogged oil lines – Change oil replace filters or clean Oil line ad casing.
- Vacuum lines are dirty – Clean vacuum lines
- Pump capacity is too low – Check required pump capacity, and replace the pump if necessary

Pumping Speed is too Low

- Dirt – trap in the intake port is clogged – Clean the dirt-trap. Make sure that dust filter is installed in the intake line.
- Exhaust filter is clogged – Install new filter elements
- Connecting lines are too narrow or too long – Use adequately wide and short connecting lines
- Anti-suck back valve is hard to open – Check spring for free length.

After Switching off Pump under Vacuum, Pressure in System Rises too Fast

- System has a leak and should be checked
- Malfunctioning of the anti-suck back valve – Repair the valve.

Vacuum Boosters

Knocking or Rapping

- Unit out of time due to worn bearings or gears – Replace worn parts.

- Rotors touching each other due to excessive temperature – Reduce temperatures by lowering differential pressure.

Excessive Operating Temperatures

- Pressure differential too high – Reduce pressure across booster by lowering cut in pressure. Also check blank-off pressure of fore pump and system for leaks

Lack of Volume

- Worn clearances – Re-establish clearance
- Reduce speed – Check motor

Abnormal Bearing and Gear Wear

- Inadequate lubrication – Maintain correct oil levels, improve frequencies of oil change and initiate oil sampling program

Loss of Oil

- Worn seals – Replace seals

Conclusion

A step-by-step procedure, adopted in troubleshooting vacuum pump and / or system helps in easily locating the problem and in finding appropriate solution. In general, the first step is to compare the original design conditions with the existing conditions. Any change in design conditions including utilities may have a direct impact on the performance of the unit. Once it is ascertained that external factors are not responsible for malfunctioning of vacuum system, trouble shooting of equipment should be done.

Reference Book:

Chemical Industry Digest
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