Handling Solvents

The most common and preferred vacuum pumps for handling solvents are Liquid Ring and Dry Pumps. Both types of pumps do not require internal lubrication which allows solvent vapors to be sucked through the pumps without jeopardizing their lubrication whereas oil sealed pumps such as rotary vane or piston that do require internal lubrication might have a problem. The Liquid Ring has external grease packed bearings which are isolated from the process fluid by mechanical seals and the Dry Pump has external bearings which are either oil lubricated or grease packed and separated from the process by mechanical seals. In addition the Dry Pump also has oil lubricated timing gears to maintain the two parallel shafts rotating in the correct phase to avoid contact.

Liquid Ring

The Liquid Ring does require a liquid sealant for sealing the clearances and cooling the heat load which is composed of the pump’s BHP and any latent heat of condensation. The most common sealant is water but many process fluids can also be used which are compatible with the process and allow for recovery and return to the process to minimize waste. In some cases water is used as the sealant when the process solvent being handled is immiscible or only slightly miscible with water and can be decanted in an oversized separator tank. The Liquid Ring pump normally relies upon handling the process fluids as a vapor at inlet and condensing them to the liquid phase while passing through the pump. If the condensing process occurs at inlet while contacting the lower temperature sealant the pumping capacity will be increased but if it occurs later before discharging, due to the increase in pressure, the capacity will not be increased but the heat load due to the latent heat of condensation will still require handling, and if large enough, will increase the sealant ΔT. Since the Liquid Ring is operating with a liquid sealant it can handle a continuous liquid carryover from the process or from the condensate stream from an upstream condenser.

Dry Pump

The Dry Pump does not use a liquid sealant and relies upon small clearances between rotors and housing and higher rotational speed to reduce gas slippage. The lack of a liquid sealant also causes the discharge temperatures to be higher which helps maintain the “dry” feature of the pump by helping to keep the process vapors in the vapor phase from inlet to discharge. The Dry Pump does not benefit due to condensing effects but does benefit by keeping high vapor pressure solvents like Methylene Chloride, Acetone, MEK, etc in the vapor phase while passing through the pump. Some Dry Pumps can handle a small amount of process liquid carryover but if this occurs continuously the pump would not maintain its “dry” characteristics and performance would also become limited by the vapor pressure of the liquid. In cases of process liquid carryover due to upsets knock out traps are normally used to trap the liquid ahead of the Dry Pump. In many cases dual traps are used in parallel where one trap can be valved off and emptied while the other is placed on line. In some cases a valved bypass around the trap is used to allow the Dry Pump stay on line while the isolated trap is emptied. If an upstream condenser is used ahead of the Dry Pump the condensate would be collected in a separate condensate tank. Since the Dry Pump maintains the process vapors in the vapor phase passing through the pump an after condenser is normally used for collection.

When handling corrosive process fluids the Liquid Ring pump can use a corrosion resistant material of construction such as 316 SST and a nonaqueous sealant while the Dry Pump relies upon using a corrosion resistant coating such as Teflon and keeping the fluid in the vapor phase to minimize the corrosion potential.

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The Liquid Ring and Dry Pump each have their advantages and disadvantages some of which are shown below.

### Dry Pump Advantages:
- Lower ultimate pressure and higher capacity at low pressure end for single stage pump
- Lower power consumption
- Lower cooling water usage
- More compact footprint
- Can pump high vapor pressure solvents
- Environmentally friendly with less pollution

### Dry Pump Disadvantages:
- Higher purchase price
- Higher complexity effects reliability
- More difficult to disassemble on site by end user
- Solvent handling limited by auto-ignition temperature of solvent

### Liquid Ring Pump Advantages:
- Can perform as both vacuum pump and direct contact condenser
- Lower purchase price
- Simplicity of rotating parts improves reliability
- Low maintenance
- Because of pump simplicity, can be readily disassembled and reassembled on site by end user
- Lower operating temperature for thermal sensitive or polymerizable process material
- Liquid sealant allows for handling higher temperature inlet gases/vapors
- Can ingest liquid from process or condensater from upstream condenser
- Less sensitive to process particulate due to larger clearances
- Liquid within pump may act as quench to reduce chance of ignition from sparking

### Liquid Ring Pump Disadvantages:
- Normally higher operating cost than dry
- Higher power and cooling water consumption
- Larger footprint
- Pump performance is limited by vapor pressure of sealant
- Requires a supply of liquid sealant for makeup or change out
- Operation normally results in larger amount of hazardous waste

To learn more about Dry or Liquid Ring Vacuum Pumps for your application contact our technical sales team vacuum@tuthill.com.