An efficient steam system will collect condensate in the plant and either return it to a deaerator, send it to a boiler feed tank, or use it in another process. A high percentage of these systems are modulating process steam systems, where steam pressure to the heat transfer varies with the processes.

These modulating systems require condensate to flow by gravity from the heat transfer equipment to a vented condensate tank system. The condensate tank system is always vented to the atmosphere to keep pressure out of the condensate return lines.

**Purpose of the Vented Condensate Tank**

One purpose of the vented condensate tank is to deliver the condensate back to the boiler where there is insufficient differential pressure to flow the condensate to the boiler plant. Another common application: at the main condensate collection point in the boiler operation where there is a need to collect the condensate, then pump it to the pressurized deaerator system.

The preferred method of receiving and delivering condensate to the boiler plant operation is by using a properly sized and designed vented condensate tank with an electric-motor-driven pump. This electrical condensate tank system will provide reliable operation for six years or more if properly designed and correctly installed. Let’s look at the tank and motor-driven pumps separately.

**Choosing a Vented Condensate Tank**

Here are some things to consider when selecting an ideal vented condensate tank:

- The tank must be designed so it will not create any backpressure during tank operation.
- The condensate tank must be vented to the condenser or the atmosphere so that the flash steam dissipates and does not pressurize the tank.
- The flash steam vent line off the condensate tank to the atmosphere must have design velocities that will not exceed 3,000 feet per minute.
Types of Condensate Pumping Systems

1.2.1. Electric (On-Off)
As the condensate level in the tank increases to a certain level, contacts close in a float switch and start the condensate pump. The pump operates until the condensate level decreases to a point where the float switch contacts open and the pump stops. This operation repeats as the water level rises and falls.

Selection Process
- Condensate capacities of 12,000 lbs. per hour or less
- Single pump or dual pump
- Gravity, low-pressure, or medium-pressure return systems

Advantages
- Low cost
- Simple operation

Disadvantages
- Low capacities
- Surging in the condensate lines during pumping mode
- No allowances for net positive suction head (NPSH)

1.2.2. Electric (Continuous Flow)
The condensate level is controlled by a modulating valve on the discharge line or variable-speed drive motor, which modulates to keep a constant condensate level in the tank. As demand increases and the level starts to increase, the valve opens or the motor speeds up to pump more condensate flow into the condensate return system. As demand decreases and the level begins to drop, the valve closes down or the motor is slowed and reduces the amount of condensate being discharged.

Selection Process
- Condensate capacities above 12,000 lbs. per hour (high capacities)
- Single pump operation (most common)
### Disadvantages
- High energy cost to operate
- Low capacities
- Needs a fill head
- Mechanical failures of the mechanism are common
- Venting on flash steam in the chamber is limited

### 1.2.3. Steam Motive Pump (Self-Actuating)
The operating force of this type of pump is steam. A vented receiver or collection header is an essential part of the installation -- any flash steam should be separated from the condensate before the condensate flows into the pump chamber.

### Selection Process
- Condensate capacities of 12,000 lbs. per hour or less

### Advantages
- No electricity is required
- Used in explosion-proof areas

### Steam Motive vs. Electric Pump Systems
The question arises as to when to use a steam motive type of pump vs. the electricity-driven pump arrangement. Steam motive pumps will cost the plant eight times more in energy per year than using an electric-motor-driven pumping system. The electric condensate pump should always be the first choice when pumping condensate for cost and other reasons:

#### 1.3.1. Operational Cost*
Cost of operation for one year:
- Electric = $2,254.37
- Steam motive = $6,232.00
Cost calculations are based on the following:

- Condensate system: Gravity flow to condensate pumping system
- Condensate flow: 8,200 lbs. per hour
- Condensate return line pressure: 25 psig
- Number of hours of operation: 8,740

Steam motive pump operation:

- Number of pump actions per hour: 6
- Quantity of steam per actions: 42 lbs.
- Number of hours: 8,760
- Steam motive pressure: 60 psig
- Condensate main line pressure: 25 psig

Electric pump operation

- Horsepower: 4 horsepower
- Electrical cost: $0.08 kWh
- RPM: 1,800

*There are many variables in calculating the cost such as tank size, steam motive pressure, tank configuration, etc. The calculations are based on a set of parameters believed to be conservative for the calculations.

1.3.2. Reliability

A correctly designed electric-motor-driven pump arrangement routinely exceeds six years of operation without repairs. However, a typical steam motive pump system rarely delivers six years of maintenance-free operation.

**Required System Information**

To ensure a successful condensate pumping installation and operation, the following parameters should be benchmarked:

1. Condensate flow rate:
   - Maximum
   - Minimum
   - Normal
2. Flash steam flow rate:
   - Maximum
   - Minimum
   - Normal
3. Condensate line:
   - Pressure back to boiler plant
4. Electrical requirements:
   - Voltage available
5. Pump:
   - Should operate at 1,800 rpm