

Wiped Film Evaporator (WFE) 1st Stage Process Guide

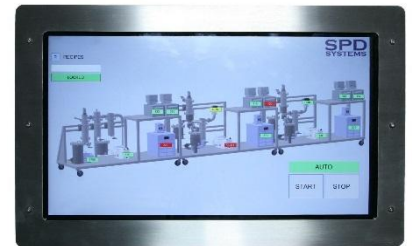
1. Controls

a. Fully Automated Systems

- i. SPD Systems features a revolutionary fully automated control system.
- ii. PC based User Interface
 1. 21" Industrial Touch Screen
 2. Network / Internet Connectivity
 3. Remote Monitoring / Diagnostics
- iii. PLC Controller in Industrial Enclosure
 1. Fully Integrated Controls
 2. Process Monitoring / Reporting
 3. Control and/or Monitor All Components From Touch Screen
 - a. Temperature
 - b. Vacuum
 - c. Flow Rates
 - d. Levels
 - e. Sensors / Meters
 4. No Manual Valves
- iv. Modular and Scalable
 1. Modules are built in manageable sections for portability and maintenance.
 2. Add Additional Stages
 3. Trade-Up Program for Larger Capacity Components

b. Manual Systems

- i. Traditional manually operated systems available.



2. Vacuum Pump

- a. Rotary Vane Vacuum Pumps are utilized to remove the air from the system.
- b. Vacuum reduces the boiling points of liquids, makes the distillation process more efficient, and prevents damage to the product being distilled.

3. Feed Tank

- a. Client's "Fed Product" (not explicitly defined by customer) will be introduced into a heated and jacketed feed tank where temperature will be controlled.
- b. Once feed temperature is reached, the product will be discharged from the feed tank, into the evaporator.



4. Primary Feed Pump

- a. The primary feed pump is a vacuum rated gear pump which introduces product into the 1st stage evaporator.
- b. Depending on the process, a jacketed feed pump may be required.

5. Evaporators

- a. The evaporator will usually be a Wiped Film Evaporator (WFE) with an external condenser.
- b. It is also possible to use a Short Path Evaporator (SPE) as the 1st Stage, provided the feed product contains minimal volatile components, which may consume vacuum. (See Line 9.)

6. Wiped Film Evaporator (WFE).

- a. Fed product is delivered to the WFE.
- b. The WFE is constructed of 316 Stainless Steel throughout.
- c. The WFE contains a rapidly rotating wiper basket.
 - i. The top plate of this basket serves as a spinning disk to distribute and disperse the liquid evenly around the inside wall of the evaporator.
 - ii. SPD's precision "wiper basket" consists of four (4) strands of rollers supported by independent axle pins, which are fastened at the top and bottom to a circular plate, creating a precise, rigid, structural support.
 - iii. The basket is attached to a machined stainless steel pin which serves as an axle for the rotating basket.
- d. The evaporator is a gravity feed system.
 - i. The precision wiper basket uses the roller assembly to "wipe" the liquid to a uniform film thickness across the entire evaporator wall surface as the fed product flows down the wall.
 - ii. Even distribution of fed product maximizes the efficiency and speed of the evaporation process, while minimizing the fed product's exposure time to heat.
- e. A uniform film thickness is achieved by using a variable speed motor to adjust the speed of the wiper basket to optimize the film thickness based on viscosity of the fed product.



7. Evaporation Process

- a. The evaporator section's wall is typically heated from 50-350°C.
 - i. Heating is accomplished by utilizing an oil heated jacket which surrounds the evaporation chamber.
 - ii. Temperature range/capability is based on the temperature limits of the hot oil circulator selected/installed.

- b. As the feed product passes through the evaporator, the lighter (lower boiling point) portion of the feed product will be vaporized and pass to the condensation unit, while the heavier portion flows down the evaporator in a liquid state to a collection tank.

8. Condensation Process

- a. The vaporized product will enter the temperature controlled external condenser.
- b. It is critical to select the appropriate process coolant for your application.
- c. When the vapors pass through the condenser, they will transition back into a liquid state.
- d. A vacuum rated gear pump is used to pump the liquid distillate exiting the intermediate receiver to downstream vessels or packaging equipment.
- e. In some instances, larger product receivers may be utilized (operating under vacuum) to collect larger quantities of distillate prior to discharge.
- f. Larger vessels may also be useful to establish mass balance information, for improved process control.



9. Short Path Evaporator (SPE)

- a. If the 1st stage evaporator is a SPE (made by SPD Systems), the process flow described above associated with the evaporation and condensation of distillate products is similar.
- b. SPE units utilize a condenser that is an internal element, which is located inside of the evaporator.
 - i. This feature facilitates higher vacuum levels inside of the evaporator.
 - ii. In addition to the standard rotary vane pump, a deep vacuum pump is required.
- c. The liquid residue portion exiting from the evaporator flows through an intermediate residue receiver.
- d. The residue receiver operates under vacuum and can be equipped with a hand operated isolation valve.
- e. A vacuum rated gear pump is used to pump the distillate into the 2nd stage SPE for additional processing.
- f. Under normal processing conditions, the 1st stage distillate pump will operate continuously to provide feed material to the 2nd stage evaporator, or downstream processing equipment if the distillation system is only a single stage system.

