

SOP

Continuous Deodorizer

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1. INTRODUCTION:

The process system is equipped with an advanced control system which is the primary entry point for the operator.

The description is part of the documents describing the Alfa Laval Deodorizer system.

The system is highly automated. However, It is capable of being controlled manually, by choosing manual mode. **WARNING:** It is not recommended to use manual settings unless you are familiar with the system and know the consequences. A maintenance mode is also available to authorized personnel that overrides process interlocks. Maintenance mode must never be used for production due to the risk of a severe process upset that could cause injury or property damage.

This chapter document is an outline of the process in order to explain the P&I Diagram (PID) for the Alfa Laval Deodorizer plant. The document should be read together with an A2 or A1 size plotted version of the P&I Diagram, 9680 00 9295 Rev 02. All operators are required to review and follow the SPCC plan prior to starting this unit, specifically

a. Discharge Prevention Measures [112.7(a)(3)(ii)] :

And

c. Countermeasures for Discharge Discovery, Response, and Cleanup [112.7(a)(3)(iv)]:

2. PROCESS DESCRIPTION

The plant is designed to continuously process vegetable oil as per the attached process flow. See P&I Diagram, 9680 00 9295 Rev 02. All pumps are positive displacement gear pumps equipped with inlet strainers, discharge check valves and pressure relief valves.

DEODORIZATION

The oil enters the plant through the inlet filter and passes through the steam heater to heat the oil to the deaeration temperature of 100C before entering the deaerator. Next the oil is moved using the deaerator pump to the final heater where it is heated to the intended deodorization temperature around 200C (actual deodorization temperature is determined by the type of oil being produced). The final heater heats the oil under vacuum with sparging steam providing improving heat-transfer and stripping of the most volatile compounds.

The oil flows by gravity from the top of the final heater to the distributor of the stripping column. The distributor evenly spreads the oil across the column cross-section. The oil trickles down the structured packing in a thin layer meeting stripping steam in counter-current flow. Volatile compounds, such as fatty acids and other odoriferous compounds are distilled off by the joint action of the vacuum and the stripping steam. The counter-current flow regime in the column reduces the amount of sparging steam drastically compared to the traditional tray system. The oil flows into the retention section where it is held at deodorization temperature for about one hour (actual retention time is determined by the type of oil being processed). Sparge steam keeps the oil agitated. The oil overflows into the cooling section where the oil is cooled to discharge temperature using cooling water. Oil flow from the deodorizer is controlled by pump P03 that is used to control the level in the cooling section. Sparge steam keeps the oil agitated.

ACID OIL RECOVERY

Vapors from the deodorizer and the deaerator are condensed in the scrubber. The vapor passes through a packed bed where it is in contact with cooled circulated distillate. The collected distillate is pumped from the scrubber, through a distillate cooler and back to the top of the previously mentioned packed bed to condense the vapor. Distillate is periodically discharged from the system. Due to the slow build up of distillate, 0.5 to 5 kg/hr, distillate must be pumped out manually.

3. BASIC PROCESS:

3.1 Feed Pump P01

The feed pulls the oil from the tote through a inlet filter and pushes it up to the feed heater.

3.2 Feed Heater W01

Feed heater brings the feed oil to deaerating temperature of approximately 100°C. Steam at 30 psig is used for heating, being controlled by control valve 27W01AV01 via temperature transmitter 27W01TT01. The pressure of the steam is low enough to make over heating the feed oil impossible.

3.3 Deaerator C01

Oil from feed heater is sprayed into deaerator 27C01C01 under vacuum. Water will boil off into the vacuum system. Level is maintained by level transmitter 27C01LT01, acting on feed pump (27P01P01). A high level switch protects against over filling, and will shut off the feed pump. A sight glass is installed for monitoring of the level and the performance of the spray nozzle.

3.4 Deaerator Pump P02

Oil is pumped from deaerator 27C01C01 to final heater by the deaerator pump 27P02P02. Modulation of the pump speed determines the flow and is measured by transmitter 27P02FT01. For dry running protection, the pump will shut down if the flow is below the lolo limit for 1 minutes.

3.5 Final Heater W09

From the deaerator pump, the oil enters the bottom of final heater where it is heated to around 250°C. The final heater has a drain valve which must be closed except when the system is being emptied out. Steam is added for pre-deodorization and agitation to improve heat transfer. The heater is operated under vacuum by electric elements controlled by temperature transmitter 27W09TT01. A maximum temperature on the surface of the thermoelectric element is ensured by the built-in temperature element. The heater is equipped with a sight glass for easy monitoring of performance.

3.6 Deodorizer C02

The hot oil enters the deodorizer through a distributor, spreading the oil over the surface of the packing material. On the way through the packing, oil meets steam in counter current, stripping the oil of odor and smell. Oil is collected in the retention tray, where it is held for retention time. 3 fixed outlets from the retention trays are provided for altering the retention time. Baffles ensure necessary plug flow. Steam is added in the retention tray for controlled agitation. Residual odor and smell is removed in the retention tray. From the retention tray the oil flows by gravity to the cooling tray where cooling water is used to bring the oil to approximately 120°C. Steam is added in the cooling tray for controlled agitation. The level in the cooling tray is controlled by level transmitter 27C02LT01 which modulates the speed of the product pump 27P03P03. A port for adding citric acid

is included in the discharge from the Deodorizer. Sparge steam is can be added at 3 places for optimizing operation. The deodorizer operates at a vacuum of around 2.5 mbar.

3.7 Product Pump P03

The product pump transfers the deodorized oil to a finished product container through the outlet filter or can be recycled back to the deaerator. It is equipped with a frequency drive, The pump speed is regulated by level 27C02LT01 in the cooling tray of the deodorizer. In automatic mode the pump is protected from running dry by the lolo level in the deodorizer. The pump must be operated in manual whenever the system is being emptied out.

3.8 Scrubber C03

Vapors (distillate) from final heater and deodorizer enter the scrubber, where they are condensed. Level of distillate is controlled manually using level switches 27C03LS01 & 27C03LS02. The operator should open the Fatty Acid Storage valve when they have set up to pump out the distillate and the high level switch is made. The level should be brought down until the low level switch is made. The low level switch will close the fatty acid storage valve unless in maintenance mode. Normally, the scrubber will not be emptied out so it will have fluid for the next operation. If it must be emptied then it must be refilled until the low level switch is surpassed before the system can be operated.

Vapors from the deodorizer and deaerator flow through a packing material, where it meets cooled distillate in counter current flow condensing the fatty acids in the vapors. A demister pad provided at the top of the scrubber prevents carryover of the fatty acid to the vacuum system. The pipes are traced and the scrubber 27C03W01 is equipped with a steam coil To protect against solidification. Sight glasses are included to monitor process. The scrubber is operated under vacuum of 2.0 mbar.

3.9 Distillate Pump P05

The distillate pump circulates distillate from the scrubber via a cooling loop. The pump is equipped with a frequency drive for adjusting of distillate flow. In automatic mode, the pump is will shut down if the lolo limit on flowmeter 27W02FIT01 is met for 1 minute. The operator must ensure adequate flow going to the scrubber when they pump fatty acid out of the system.

3.10 Distillate Cooler W02

The distillate cooler uses hot water(40-60C) to cool distillate to about 80C to recycle over the scrubber. The distillate cooler can be cleaned with steam during maintenance. Cooling is adjusted by automatic valve 27W02AV02 and temperature transmitter 27W02TT01.

Distillate recirculation flow is monitored on flow indicator 27W02FI01.

3.11 Vacuum System Q01

Vacuum is created by a roots vacuum booster pump 27Q01P01 and a rotary vane main vacuum pump 27Q01P02. The main vacuum pump requires DTE extra heavy oil to operate and is equipped with a low level switch that will shut down the pump to prevent damage. Some of this oil along with condensable vapors, steam, must be drained regularly from the exhaust pipe. The booster pump should only be operated when the deaerator pressure is less than 40 mbar.

3.12 Utilities SM03

Steam supply at 30 psig is connected to the deodorizer skid at steam battery SM03, and distributed to feed heater, scrubber, distillate cooler and the sparge steam header. The amount of steam going to sparge steam header is regulated by a 1mm orifice plate.

4. SEQUENCES

4.1 Over view of Sequences of Operation

4.2 Stand Still

Prior to starting the plant it must be ensured that it has been drained down and is isolated, this is stand still.

4.3 Start up Sequence

The system shall only be started up from stand still mode. Prior to starting the operator will check the suitability of the feed oil and that the needed steam, cooling water, tempered water, compressed air and electrical power are available. Because of the high temperatures of the deodorizer and the process piping, leather or other suitable heat resistant gloves must be worn while working on the deodorizer skid.

The operator must:

- Make sure the inlet and outlet filters are in good condition with clean socks .
- Make sure the adequate feed oil and finished product containers are available .
- Check the steam pressure.
- Check that the steam tracing is on.
- Set the operation mode to startup
- Start up the vacuum system.
- Start up distillate system:

The operator has to check if there is oil in the distillate system and if it is fluid. If there is no oil in the system, they will have to fill it up manually. If the fat has solidified they need to heat it up, turning on the steam tracing and heating the scrubber steam coil by slowly opening the valves. When the operator has confirmed the distillate is ok then the distillate pump is turned on and set to 600 lb/hr. The hot water pump should be turned on in manual at 100%. Turn on the make up water to the hot water tank one half turn and turn on the manual steam valve to maintain the temperature of the hot water tank if the oil to be run is not liquid at room temperature. Open the sparge steam to the bottom cooling tray one full turn, shut off the steam trap and open the sparge steam ball valve to the final heater 100%. The vacuum should come down under 4 mbar at the scrubber before proceeding.

- Adjust all manual valves so oil can flow into the system and recycle back to the deaerator. The drain valve on the final heater must be closed.

- Fill up system:

Turn off the sparge steam to the bottom cooling tray. Feed oil is received from the feed container continuously, through the feed pump 27P01P01. The pump controls the level in the deaerator and should be at a nominal low level of 10%. A high level switch is set to turn off the feed pump and close the Deaerator feed valve if the level rises this high. The steam heater 27W01W01, should be set to automatic at 100C. Check to make sure the spray pattern in the nozzle is correct, shut down and clean the nozzle if necessary. When the level in the deaerator is above the lo level or 5%, Reset and start the deodorizer totalizer then start the deaerator pump in automatic around 200 lb/hr.

Oil is now filling the final heater 27W09W09. After the totalizer reaches 90lb, turn on the final heater and put in automatic at the desired temperature, (about 460F). The sparge steam going into the final heater may need to be turned down to avoid oil droplets carrying over into the vacuum system. The oil overflows into the distributor of the stripping column. After the stripping column, the oil flows into the retention section where it is held at deodorization temperature for approximately one hour. The operator must close the 4 retention tray valves in order to have 1 hr at 200 lb/hr. Typically only the lowest valve of the heat retention trays is closed providing about 15 minutes of heat retention. Once a temperature increase is seen in the bottom cooling tray, the operator needs to check the agitation in the retention tray and adjust the sparge steam as needed; typically the lower deodorizer pressure is about 1 millibar above the pressure at the top of the column. At this time the cooling water should be turned on manually to the bottom tray and adjusted to keep the oil in the bottom tray 190-250F. The hot water pump can be put in automatic set at 210F. Sparge steam in the cooling tray keeps the oil agitated. The majority of the sparge steam should be going into the cooling tray so it provides adequate stripping steam for the stripping column. Oil flow from the deodorizer is controlled by pump 27P03P03 which maintains the level within the cooling section. Once the level in the cooling section is above 40%, then the column is ready to go to recirculation mode.

4.4 Recirculation

Heating:

The column is now full of oil, but the temperature is too cold for deodorization, so the oil must be recycled until the temperature in the first tray is correct.

– Set the operation mode to Recirculation and valve the product pump to recycle through the outlet filter into the suction side of the deaerator pump. The product pump will not control the level in the deaerator instead of the level in the deodorizer. When in recycle mode the product pump should be in automatic set at a nominal low level of 10% in the deaerator.

- Stop the feed pump. Put the deaerator feed valve in manual closed.
- Close 27W01AV01, the steam supply for the feed heater.

In recirculation mode there is no intake or output of the system. Once the correct temperature in the first tray is reached, the operator should get a sample of the deodorizer oil verify the color is within specification and then go to production mode.

To get into production the operator must choose to put the plant in Production mode.

4.5 Production

- Set the feed pump and feed heater to automatic.
- Set operation mode to Production. The product pump will now control the level of the deodorizer and the operator must double check that it is an acceptable level.
- Connect the product hose to the appropriate container and switch the valves from recycle to the product container.

If for any reason desired quality is not obtain then, plant can be put in RECIRCULATION mode see above 4.4.

4.6 Shut down Sequence

As shown in the overview diagram the shutdown sequence contains of 5 steps before the plant ready for STANDSTILL.

Cold recycle

In order to make a safe shut down of the plant, it is important to slowly cool it down.

In cold recirculation the program will:

- Stop the feed pump. If the feed oil solidifies at room temperature the the feed hose must be blown back to the feed container using Nitrogen. Set operation mode to Shutdown.
- Close 27W01AV01, steam supply for the heater
- the operator to open the valve to recycle the product back to suction side of the deaerator pump and close the valve to the product hose.
- Set the final heater to manual 0% output.
- Set the cooling water to the bottom tray for maximum cooling. Be careful not to cool the oil below the freezing point of the oil.

The plant will now recycle the oil slowly cooling down the plant.

Once Deodorizer is below 100 C it is ready to empty out

Empty deaerator

- Set up the product hose to finished product container and switch the manual valves to stop recirculating the oil.
- When the deaerator is empty 27P02 will stop.
- Open the drain on the final heater and close the sparge steam going into the final heater.
- Drain the retention trays by opening all the retention tray valves.
- Close the sparge steam.
- Close the cooling water (27C02V09)
- 27P03 should be set to a fixed speed to empty out the column, usually 100%.
- When level in the cooling tray is below 10%, the flow coming out the hose needs to be monitored. When oil stops coming out of the hose, shut off the product pump and blow out the product hose with nitrogen.

Distillate system

The distillate system is left filled to make future start up's easier.

- Disable water supply for distillate cooler (27W02AV02) and the hot water pump.
- Stop distillate pump 27P05.
- Stop vacuum booster pump 27Q01P01 and then stop main vacuum pump 27Q01P02
- Shut off steam and cooling water.
- The system is shut down and can be drained if necessary. It may be necessary to break the residual vacuum in the system.
- The plant is now shut down and the operational mode should be set to STANDSTILL.

Maintenance

Before doing any maintenance, lockout the main electrical breaker and turn off the steam, air and cooling water. Drain valves must be opened to vent any remaining pressure in the utility piping. Allow the system to cool or don the suitable heat resistant clothing. If any oil remains in the system, manual valves must be closed and these lines drained to minimize exposure. Remember ladder safety, keep both hands and feet free when using any ladder. Put tools in your pockets or use a rope.

Deodorizer Software Interlocks

1. If HI HI on the feed heater is reached, the heater is shut off (steam valve closed) until temp < setpoint
2. Final Heater will not turn on unless the deaerator pump is running
3. If bottom tray temp is >130 then product pump shuts off and alarms.
4. If bottom tray fill level >85 then shut off final heater
5. If bottom tray fill level > 95 then shut off deaerator pump P2
6. If high level switch on deaerator is met then turn off feed pump
7. If no flow going to final heater for 1 minutes then shut off deaerator pump and final heater
8. If low level switch in scrubber then fatty acid storage valve closes
9. If lolo on distillate flow for 1 minutes then shut off distillate pump.
10. If hihi on final heater is reached then shut off final heater until temp is < setpoint
11. If either vacuum pump stop for 1 minute then all pumps turn off and heat is shut down.



Continuous Deodorizer

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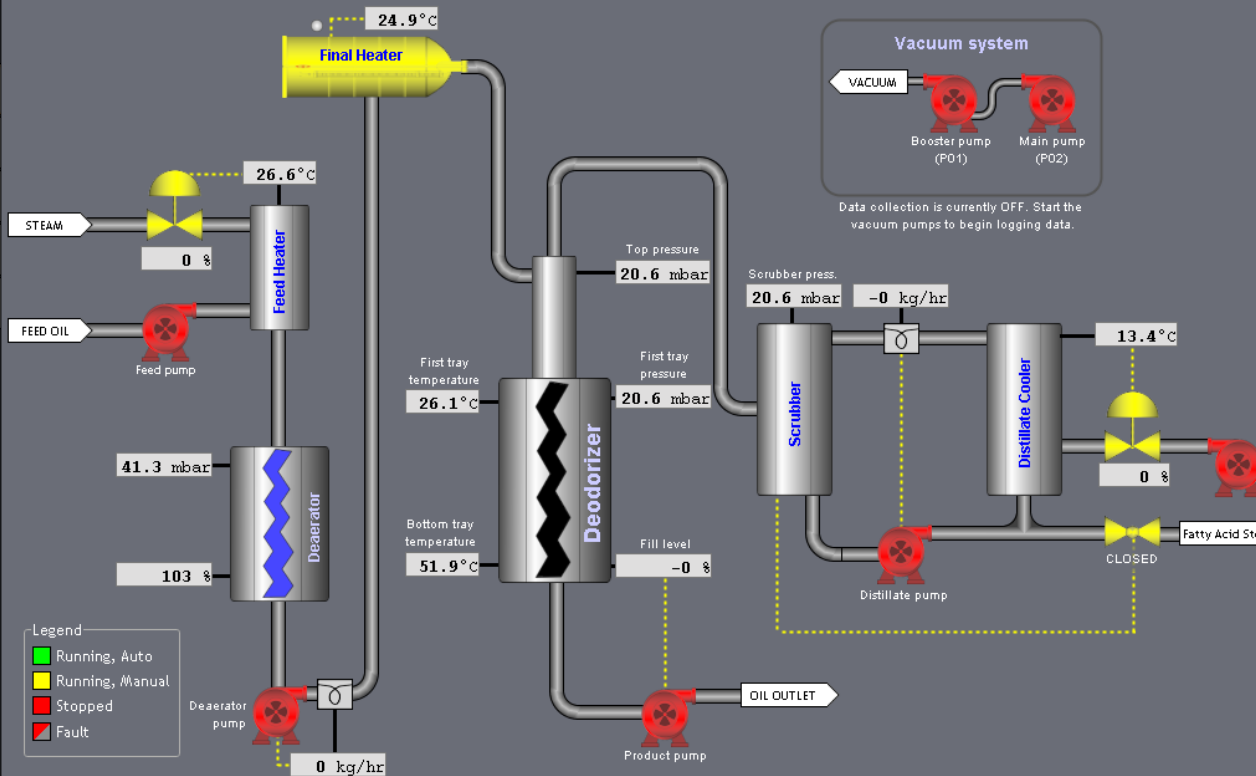
Deodorizer

Trends

Alarms

Alarm Setpts.

Manual



Legend

- Running, Auto
- Running, Manual
- Stopped
- Fault

11 active alerts

Current Operation Mode: <Select Operation Mode>

Maintenance mode is ON