

#2. Adequacy study: Condenser capacity check for the rated vapour load

The organic product is dried in a vacuum dryer using Acrylonitrile as the synthesis solvent. During drying, the solvent is recovered through a series of condensers before venting to the vacuum pump. Nitrogen is used as a pressurizing medium in the upstream filtration process and in the downstream bag filter, aiding the condensation of Acrylonitrile in the vapor line.

The condenser system consists of two stages: the first uses chilled water, and the second uses chilled brine. Vapor enters the first condenser at 45 °C and must be cooled to 0 °C to maximize solvent recovery. Current condensers are inadequate for the calculated heat load under these conditions.

Simulation results indicate that effective condenser operation minimizes the solvent load to the recovery plant, maximizing in-situ solvent recovery. Inadequate condensation increases solvent load to the recovery plant, raising operating costs and overall plant expenses.

Process Flow Summary (Vapor and Solvent Recovery):

1. **Vacuum Dryer:** Organic product dried; Acrylonitrile vapor generated.
 2. **Nitrogen Injection:** Nitrogen used for pressurization and vapor flow control.
 3. **Bag Filter (Downstream):** Nitrogen assists in vapor handling.
 4. **Condenser Stage 1 (Chilled Water):** Cools vapor from 45 °C toward 0 °C; partial solvent recovery.
 5. **Condenser Stage 2 (Chilled Brine):** Further cooling to maximize solvent recovery.
 6. **Vacuum Pump / Solvent Recovery Plant:** Residual vapor collected; solvent load depends on condenser efficiency.
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Condenser 1 (HE 2807 A)						
S.No	Description	UOM	Option 1	Option 2	Option 3	Option 4
1	Detail of scenario considered		Heat load & Nitrogen flow Specified in the datasheet provided by Client. Temp not match with datasheet	Gas inlet & out and Nitrogen flow specified in the datasheet. Heat load not match with datasheet	Heat load specified in the datasheet. Nitrogen flow specified in the mail communication	Gas inlet and outlet temp maintain as per datasheet. Nitrogen flow specified in the mail communication
2	LOD	%	10	10	10	10
3	Gas inlet composition					
	Nitrogen	kg/hr	12	12	52.467	52.467
	Acrylonitrile	kg/hr	194	194	194	194
4	Gas outlet composition					
	Nitrogen	kg/hr	12	12	52.467	52.467
	Acrylonitrile	kg/hr	18.19	13.92	28.54	60.84
5	Liquid outlet composition					
	Nitrogen	kg/hr	0	0	0	0
	Acrylonitrile	kg/hr	175.81	180.08	165.46	133.16
6	Gas inlet temperature	deg.C	42	42	42	42
7	Gas outlet temperature	deg.C	23.28	20	9.54	20
8	Heat load	Kcal/hr	27955	28919	27955	21946

Condenser 2 (HE 2807 B)						
S.No	Description	UOM	Option 1	Option 2	Option 3	Option 4
1	Detail of scenario considered		Heat load & Nitrogen flow Specified in the datasheet provided by client. Temp not match with datasheet	Gas inlet & out and Nitrogen flow specified in the datasheet. Heat load not match with datasheet	Heat load specified in the datasheet. Nitrogen flow specified in the mail communication	Gas inlet and outlet temp maintain as per datasheet. Nitrogen flow specified in the mail communication
2	LOD	%	10	10	10	10
3	Gas inlet composition					
	Nitrogen	kg/hr	12	12	52.467	52.467
	Acrylonitrile	kg/hr	18.19	13.92	28.54	60.84
4	Gas outlet composition					
	Nitrogen	kg/hr	12	12	52.467	52.467
	Acrylonitrile	kg/hr	9.46	3.45	20.17	15.07
5	Liquid outlet composition					
	Nitrogen	kg/hr	0	0	0	0
	Acrylonitrile	kg/hr	8.73	10.47	8.36	45.77
6	Gas inlet temperature	deg.C	23.28	20	9.54	20
7	Gas outlet temperature	deg.C	14.85	0	4.39	0
8	Heat load	Kcal/hr	1416	1784	1416	7802
9	Gas load to Solvent recovery plant					
	Nitrogen	kg/hr	12	12	52.467	52.467
	Acrylonitrile	kg/hr	9.46	3.45	20.17	15.07
	Acrylonitrile	kg/day	227.04	82.8	484.08	361.68