CALCULATION FEED PUMP FOR BOILER 65 TONS

Data Input

- Steam: 65 tons/hour (Q_{boiler})
- Pressure max: 34 bar (P_{boiler} operation)
- Temperature max: 105 degree Celsius
- Height of feed tank: 4m
- Available pressure in tank: 2 bar
- Suction pipe: 150 mm

Require

- Calculate feed pump?
- Check pump's cavitation at temperature 110 degree Celsius.

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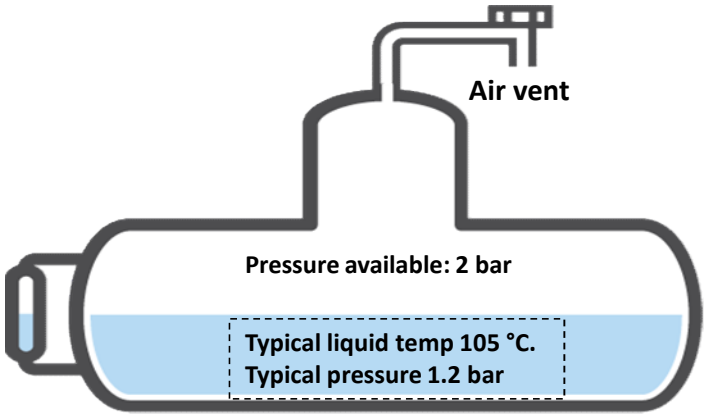
Deaerator/Condenser tank



Vapour pressure p and density ρ of water

t[°C]	T[K]	P[bar]	ρ[kg/m³]
100	373.15	1.0133	958.1
102	375.15	1.0878	956.7
104	377.15	1.1668	955.2
106	379.15	1.2504	953.7
108	381.15	1.3390	952.2
110	383.15	1.4327	950.7
112	385.15	1.5316	949.1
114	387.15	1.6362	947.6
116	389.15	1.7465	946.0
118	391.15	1.8628	944.5
120	393.15	1.9854	942.9

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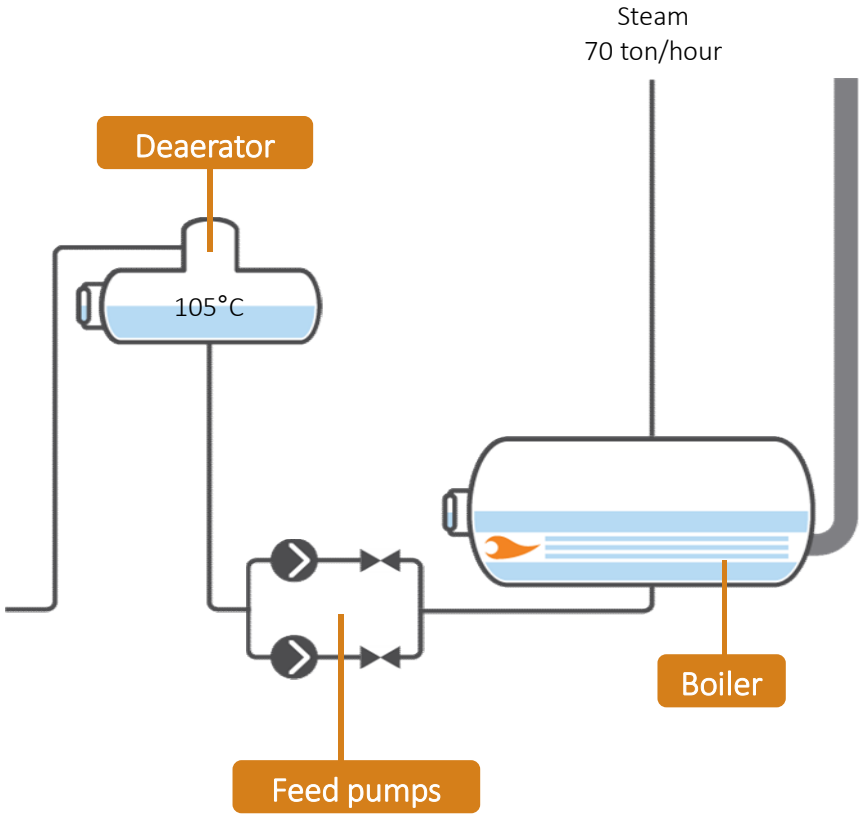
<u>Example for calculating flow and head.</u>

From the boiler required we have the following information:

Q_{Boiler}	=	65 tons/hour
P_{Boiler} max	=	34 bar
Temp max.	=	105° C

From the vapour table we have the following data on water with a **temp. of 105°C**.

Density (rho)	=	954,4 kg/m3
Vapour pressure	=	1,2 bar



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Pump sizing

$$Q_{Boiler} = \frac{Q_{Boiler}}{\rho} = \frac{65 \cdot 10^3}{954{,}4} = 68{,}1\ m^3 / h$$

$$h_{Boiler} = \frac{p_{Boiler}}{\rho \cdot g} = \frac{34 \cdot 10^5}{954{,}4 \cdot 9{,}81} = 363{,}18\ mH2O$$

European rules according to EN 12952-7

Flow: The pump has to be able to do a flow 1.15 times the max. flow on the boiler operation required.

Pressure: The pump has to be able to do a pressure 1.10 times the max. pressure on the boiler pressure max required.

$Q_{Pump\ operation}$ = 1,15 x Q_{Boiler}=1,15 x 68,1 = 78,31 m^3/h

Say: Q pump = 80 m3/h

h_{Pump} = 1,1 x h_{boiler} = 1,1 x 363,18 = 399,49 m H2O

Say: H pump = 400 m H2O

Then we have FEED PUMP data is Q= 80m3/h @ H=400m

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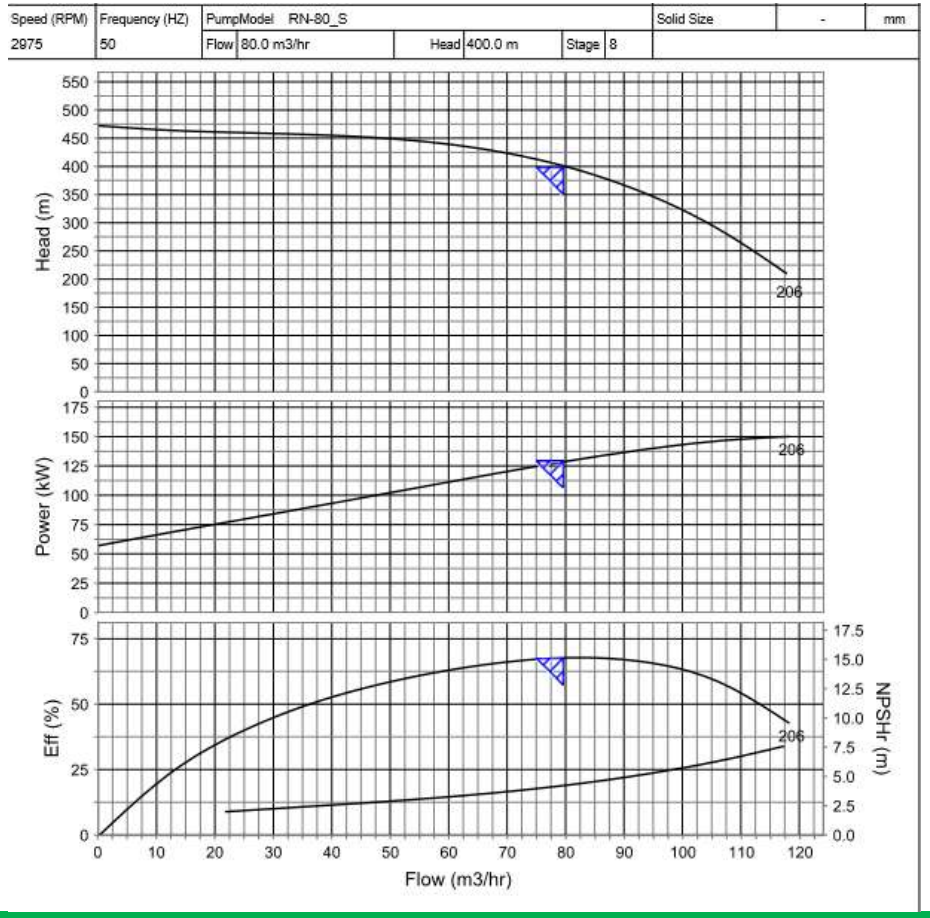
Pump selection

After we have pump spec, I select FEED pump below:

- Pump model: RN-80_S
- Pump flow: 80m3/h
- Pump head: 400m
- Pump speed: 2975rpm
- NPSHreq: 4.24m



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Check pump cavitation at 110 degree C

We have to calculate NPSH available at temperature 110 degree Celsius.

Follow formula: $$H_{sv} = 10\frac{P_a - P_v}{\gamma} + hs - hl$$

Where as:

Pa: Pressure on the suction water surface (kgf/cm2) = 2 bar = 2 kgf/cm2

Pv: Pump water saturated vapour pressure (kgf/cm2) = 1,43 bar = 1,43 kgf/cm2 (at 110 degree Celsius)

y: Pump liquid specific gravity [density] (kg/l) = 0,9507 kg/l (at 110 degree Celsius)

hs: Suction actual head = 4m

hl: Suction pipe loss head: Follow Darcy Weisbach formula

$$h_l = \lambda\frac{L}{D}.\frac{v^2}{2g} = 0{,}0349\frac{4}{0{,}15}\frac{1{,}258^2}{2x9{,}81} = 0{,}075m$$

Vậy ***Hsv= 9,92m > NPSHreq= 4.24m***

Conclusion: Pump operate well at liquid temperature 110 degree Celsius.