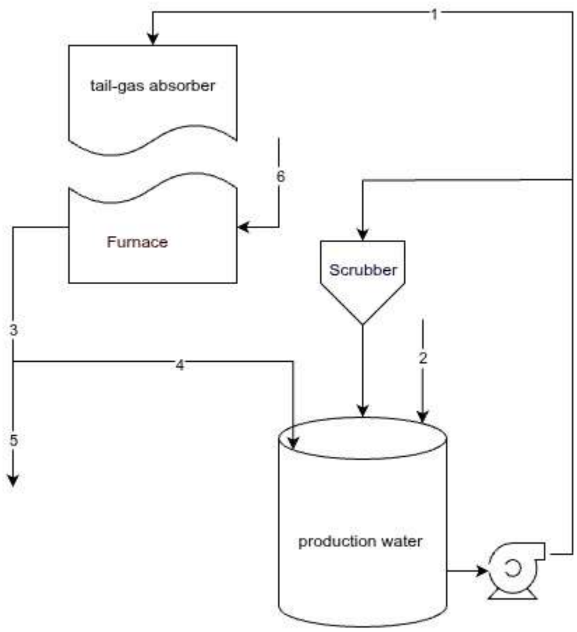
Calculating HCl Recycle Flow

$$Furnace_{Cl2.load} := [550, 600..800] \frac{m^3}{hr} = \begin{bmatrix} 550 \\ 600 \\ 650 \\ 700 \\ 750 \\ 800 \end{bmatrix} \frac{m^3}{hr}$$



$$\rho_{Cl2} := 3.15 \frac{kg}{m^3} \qquad \rho_{H2O} := 1 \frac{tonne}{m^3}$$

$$HCl_{gas.prod} := \frac{36.5}{35.5} \cdot \rho_{Cl2} \cdot Furnace_{Cl2.load} = \begin{bmatrix} 1.7813 \\ 1.9432 \\ 2.1052 \\ 2.2671 \\ 2.429 \\ 2.591 \end{bmatrix} \frac{tonne}{hr}$$

$$HCl_{aq③} := \frac{HCl_{gas.prod}}{0.31} = \begin{bmatrix} 5.7461 \\ 6.2685 \\ 6.7909 \\ 7.3133 \\ 7.8356 \\ 8.358 \end{bmatrix} \frac{tonne}{hr}$$

from DCS observations in comparison with Water.ideal①

$$Leakage_{⑥} := 1.6 \frac{tonne}{hr}$$

$$Water_{ideal①} := \left| \begin{array}{l} \text{for } n \in [1..\text{length}(HCl_{gas.prod})] \\ \quad a_n := \text{solve}\left(\dfrac{HCl_{gas.prod\,n}}{HCl_{gas.prod\,n} + x \dfrac{tonne}{hr}} = 0.31, x \right) \\ a \dfrac{tonne}{hr} \end{array} \right. = \begin{bmatrix} 3.9648 \\ 4.3253 \\ 4.6857 \\ 5.0462 \\ 5.4066 \\ 5.767 \end{bmatrix} \frac{tonne}{hr}$$

w.t% diluted acid maintained in tank because of scrubber & recycle ④. This enters tail-gas absorber

$$DiluteAcid_{real①} := [0, 0.02..0.14] = \begin{bmatrix} 0 \\ 2 \\ 4 \\ 6 \\ 8 \\ 10 \\ 12 \\ 14 \end{bmatrix} \%$$

⊞— Basic Scheme

$$Water_{real①} := \left| \begin{array}{l} a := \mathrm{matrix}(0, 0) \\ \mathrm{for}\ \ m \in [1..\mathrm{length}(DiluteAcid_{real①})] \\ \quad \left| \begin{array}{l} \Sigma H2O_{feed_m} := Leakage_{⑥} + x \dfrac{\mathrm{tonne}}{\mathrm{hr}} \cdot \left(1 - DiluteAcid_{real①_m}\right) \\ \mathrm{for}\ \ n \in [1..\mathrm{length}(HCl_{gas.prod})] \\ \quad \left| \begin{array}{l} \Sigma HCl_{feed_n} := HCl_{gas.prod_n} + x \dfrac{\mathrm{tonne}}{\mathrm{hr}} \cdot DiluteAcid_{real①_m} \\ a_{m\,n} := \mathrm{solve}\left(\dfrac{\Sigma HCl_{feed_n}}{\Sigma HCl_{feed_n} + \Sigma H2O_{feed_m}} = 0.31,\ x \right) \end{array} \right. \end{array} \right. \\ a \dfrac{\mathrm{tonne}}{\mathrm{hr}} \end{array} \right.$$

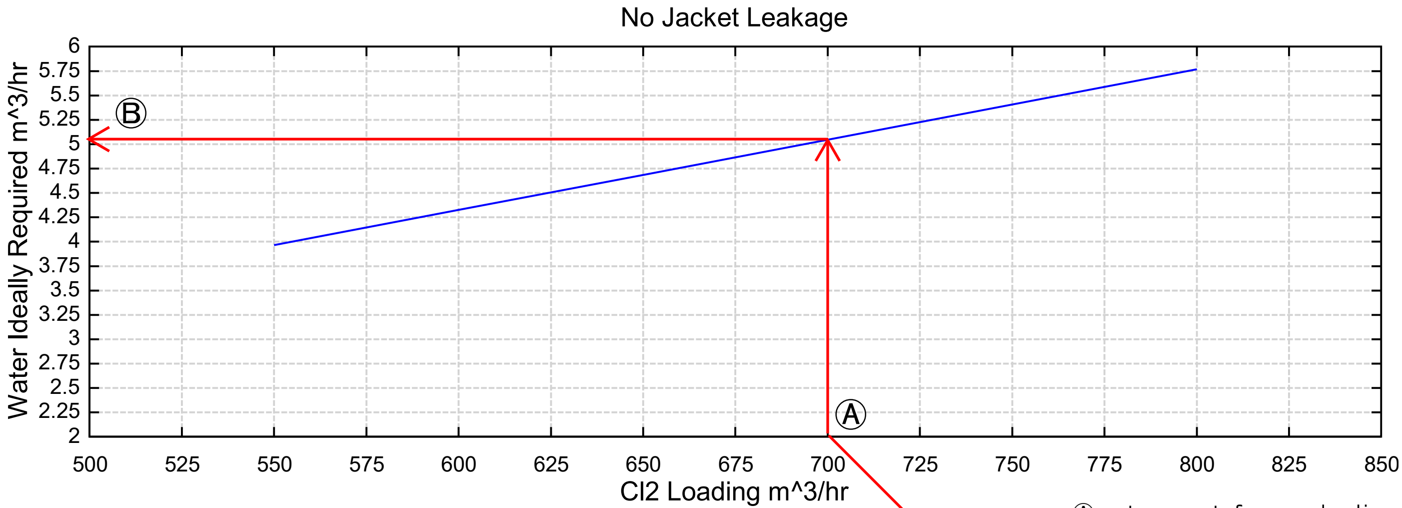
$$Table := \left| \begin{array}{l} horizontal := \mathrm{stack}\left(\text{"Diluted Feed\% ↓ | Cl2 Load m³/h →"},\ DiluteAcid_{real①} \cdot 100\right) \\ vertical := \mathrm{stack}\left(Furnace_{Cl2.load}^{\mathrm{T}} \cdot \dfrac{3600}{1} \dfrac{\mathrm{s}}{\mathrm{m}^3},\ Water_{real①} \cdot \dfrac{3600}{1000} \dfrac{\mathrm{s}}{\mathrm{kg}}\right) \\ \mathrm{augment}(horizontal, vertical) \end{array} \right.$$

$Table =$

"Diluted Feed% ↓ | Cl2 Load m³/h →"	550	600	650	700	750	800
0	2.3648	2.7253	3.0857	3.4462	3.8066	4.167
2	2.5279	2.9132	3.2985	3.6838	4.0691	4.4544
4	2.7152	3.129	3.5429	3.9567	4.3705	4.7844
6	2.9324	3.3793	3.8263	4.2732	4.7202	5.1671
8	3.1874	3.6732	4.159	4.6448	5.1306	5.6164
10	3.4909	4.023	4.5551	5.0872	5.6193	6.1513
12	3.8584	4.4465	5.0346	5.6227	6.2108	6.7988
14	4.3123	4.9696	5.6269	6.2842	6.9414	7.5987

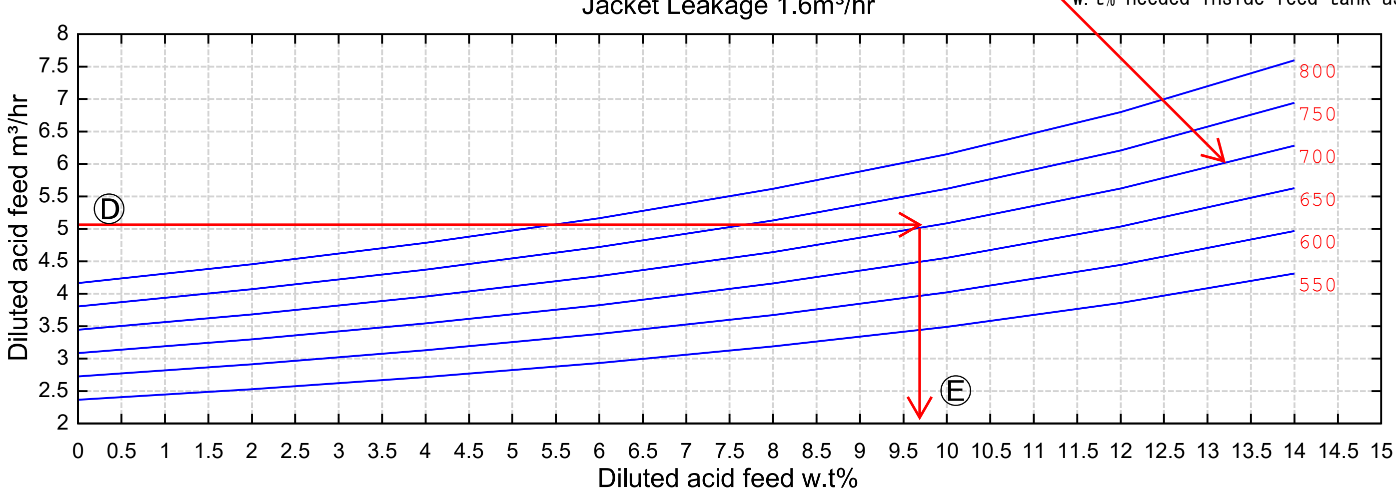
Plotting curves for various furnace Cl2 loading

$$\left| \begin{array}{l} \mathrm{for}\ \ n \in [1..\mathrm{cols}(Water_{real①})] \\ \quad \left| \begin{array}{l} y_n := \mathrm{col}\left(Water_{real①} \cdot \dfrac{3600}{1000} \dfrac{\mathrm{s}}{\mathrm{kg}},\ n\right) \\ plot_n := \mathrm{augment}\left(DiluteAcid_{real①} \cdot 100,\ y_n\right) \\ label_n := \mathrm{augment}\left(14,\ y_{n_8},\ \mathrm{var2str}\left(Furnace_{Cl2.load_n} \cdot 3600 \dfrac{\mathrm{s}}{\mathrm{m}^3}\right),\ 8\right) \end{array} \right. \end{array} \right.$$



$$\left\{ \text{augment}\left(\text{Furnace}_{\text{Cl2.load}} \cdot \frac{3600}{1} \frac{\text{s}}{\text{m}^3}, \text{Water}_{\text{ideal①}} \cdot \frac{3600}{1000} \frac{\text{s}}{\text{kg}} \right) \right.$$

Ⓐ get current furnace loading
Ⓑ get ideal water feed flow
Ⓒ match the loading curve
Ⓓ navigate the curve until feed flow is almost same as Ⓑ
Ⓔ finally read the diluted acid w.t% needed inside feed tank using recycle



$$\left\{ \begin{array}{l} \text{plot} \\ \text{deNest}(\text{label}) \end{array} \right.$$