Design of SINGLE EFFECT EVAPORATOR

Available data

Liquid to be concentrated	Naoh Solution	Conc. Of solid in Feed **(Xf)**	0.1
Flow rate of feed, **(F)** (in Kg/hr)	35000	Conc. Of solid in Product **(XL)**	0.3
Flow rate of feed, **(F)** (in Kg/seconds)	9.722222222	Temp of feed **(Tf)** (in °C)	30
Vacuum pressure (in mm hg)	650	Sat. temp at evaporator pressure (in °C)	53.33
Pressure inside evaporator (in mm hg)	110	**T1** (Sat. temp at evaporator pressure (in °C))	57.33
Pressure inside evaporator (in bar)	0.146647114	**(λS)** Latent heat of vapour at steam chest pressure (in Kj/Kg)	2199.3
Boiling point elevation (in °C)	4	**(Hv)** Latent heat of vapour of steam at evaporator pressure (in Kj/Kg)	2370.89
Pressure of steam **(Psteam)** (in atm)	2	specific heat capacity of feed **(Cpf)** (in kJ/kg °C)	3.9
(Ts) Temp of water at steam chest pressure (in °C)	127	specific heat capacity of product (Cpp) (in kJ/kg °C)	3.2
The overall heat transfer coefficient (in W/m2K)	1400	The overall heat transfer coefficient (in Kj/m2 K sec)	1.4

Mass and solid balance

Flow rate of Product, **(L)** (in Kg/seconds)	3.240740741
Flow rate of Vapour, **(V)** (in Kg/seconds)	6.481481481
Flow rate of Steam, **(S)** (in Kg/seconds)	7.458346806

Tube specifications (14 BWG)

(do) Tube outside diameter, in m	0.0254
(di) Tube inside diameter, in m	0.02118
(Lt) Length of tube, in m	4.88
Pitch (triangular) **(Pt)**, in m	0.03175

Area and no. of tube calculations

Calculated Area (in m2)	168.1718113	**(Ds)** Diamter of shell (in m)	0.980334355
Number of tube **(N)**	432.085821	**(Dc)** Diamter of Downcome(in m)	0.524010755
Actual Area (in m2)	0.538877519	**(H)** Height of Evaporator Column (in m)	6.350501533
Downcome area **(Ad)** (in m2)	0.215551008		
Total Area **(A)** (in m2)	0.754428527		