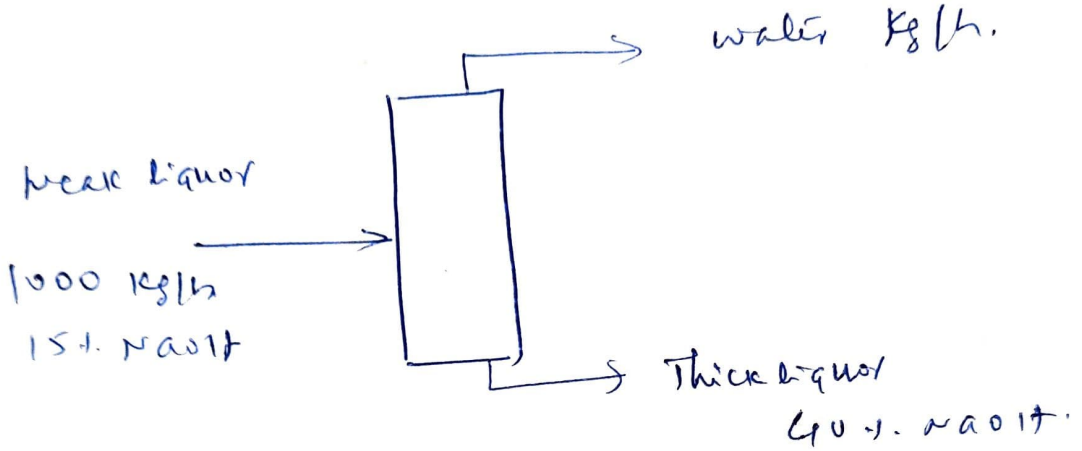
(3.1) A single effect evaporator is fed with 1000 kg/h of weak liquor containing 15% caustic by weight and is concentrated to get thick liquor containing 40% by weight caustic (NaOH). Calculate

(a) kg/hr of water evaporated and

(b) kg/h of thick liquor obtained



Basis: 1000 kg/hr of weak liquor.

Let x and y be the kg of water vaporised and thick liquor obtained

Overall balance

$$1000 = x + y$$

NaOH balance

$$1000 \times 0.15 = (0)x + 0.4y.$$

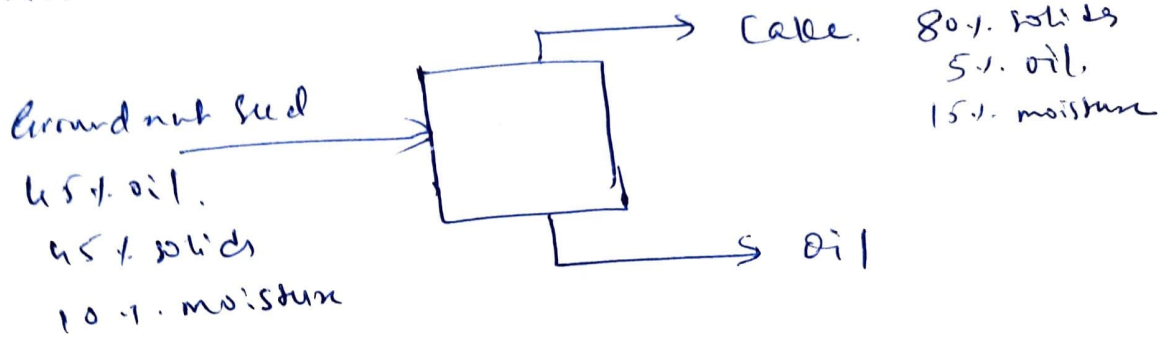
$$y = 375 \text{ kg/hr}$$

$$x + y = 1000$$

$$x = 1000 - 375$$

$$x = 625 \text{ kg/hr.}$$ water vaporised.

(2) The groundnut seeds containing 45% oil and 45% solids are fed to Expeller, the cake coming out of expeller is found to contain 80% solids and 5% oil. Find the percentage recovery of oil.



Let x and y be the kg of cake and oil respectively

For 100 kg groundnut seeds.

Solids balance

$100 \times 0.45 = x \times 0.8$

$x = 56.25$ kg

$x + y = 100$

$y = 100 - 56.25$

$y = 43.75$ kg

100.00
56.25
43.75

Oil balance

~~$100 \times 0.45 = 56.25 \times 0.05 + 43.75$~~

∴ Oil in the cake = 56.25×0.05

$= 2.8125$ kg

Oil in feed = $100 \times 0.45 = 45$ kg.

Oil recovered = ~~43.75 kg.~~

$45.00 - 2.8125$

$= 42.1875$ kg

45 kg — 42.1875 kg

100 kg — $\frac{100 \times 42.1875}{45}$

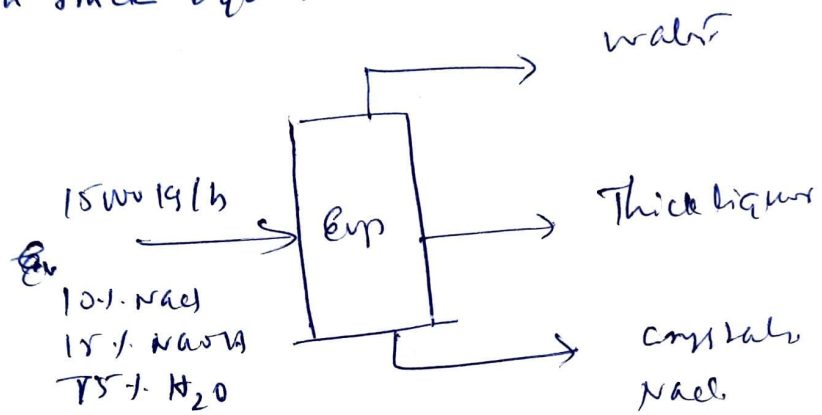
$= 93.75\%$

(3) An Evaporator is fed with 15000 kg/h of a sol^{n} containing 10 % NaCl, 15 % NaOH and rest water. In Operation water is Evaporated and NaCl is precipitated as crystals. The thick liquor leaving the Evaporator contain 45 % NaOH, 2 % NaCl and rest water. Calculate

a) kg/h of water Evaporated

b) kg/h salt precipitated

c) kg/h thick liquor



Basis. 15000 kg/h of soln.

~~Total balance~~

Let x, y, z be the kg/h of water, thick liqu and crystal resp.

NaCl balance

$0.1 \times 15000 = (0)x + 0.02 \times y + (0)z$

$0.02y = 1500$

$y = 5000$ kg/h.

$0.02y + z = 1500$

$0.02 \times 5000 + z = 1500$

$100 + z = 1500$

$z = 1400$ kg/hr.

~~$x + y + z = 15000$ kg/h~~

Total balance

$15000 \times 0.15 = (0)x + 0.45y + (0)z$

$2250 = 0.45y$

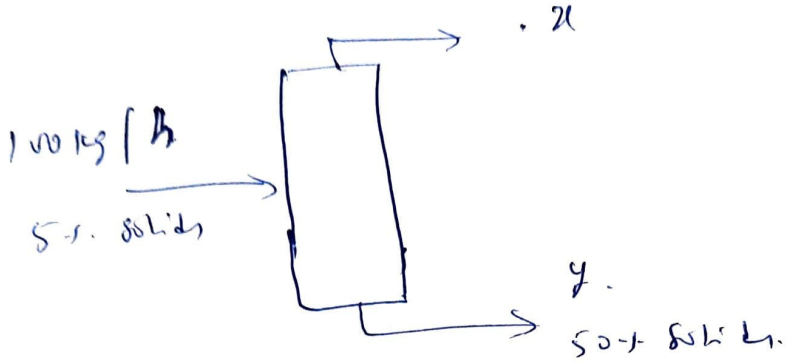
$y = 5000$ kg/h.

$x + y + z = 15000$

$x = 8000$ kg/hr

~~$x + y + z = 15000$~~ $z = 15000$ -

(4) An evaporator system concentrating a weak liquor from 5% to 50% solids handles 100 kg of solids per hour. If the same system is to concentrate a weak liquor from 4% to 35%. find the capacity of the system in terms of solids that can be handled per hour assuming water evaporation capacity to be same in both the cases.



Let x, y be the kg/hr of water evaporated and thick liquor.

Solids balance

100 kg solids

$0.05 \times 2000 = (0)x + 0.5y$

$0.05x = 100$

$x = 2000$ kg/hr

$y = \frac{100}{0.5}$

$y = 200$ kg/hr thick liquor.

$x + y = 2000$

$x = 1000 - 10$

$= 90$ kg/hr

$x = 2000 - 200$

$x = 1800$ kg/h water evaporated

Case: II

If water evaporation capacity is the same

Let x_1 and y_1 be the quantities of ~~thick liquor~~ thin liquor entering and thick liquor leaving