

## Economic evaluation of antiscalants

➤ Cost needed for PASP synthesis:

- 1- Electric energy (240 °C 4 h) and (80 °C for 48 h)
- 2- NaOH
- 3- Ethanol
- 4- L-aspartic acid 1kg = 800 L.E

➤ CMC purchased 1kg = 175 L.E

➤ CA-SC composed of 1kg CA = 90 and 1kg SC = 105

➤ PASP purchased commercially

From the market (importing) =  $2\$ * 100/40 * 40 = 200 \text{ L.E}$

Adding  $200 + 200*200\% = 600 \text{ L.E}$  (200% is the expected company profit plus charging fees).

**1Kg taurine = 200 L.E approx.**

**PASP-SEA =  $1556.6 + 200 = 1756.6 \text{ L.E}$**

• The process of PASP lab production needs thermal energy

a-  $Q = mc\Delta T = 1000 * 155.18 * ((240 - 25) + 273) = 1000/133.1 * 155.18 * 488 = 569 \text{ KJ}$

P for 4 h =  $569 / 4 * 3600 = 39.5 \text{ watt}$  assuming efficiency 90% to transfer from electric to thermal ----  $39.5 / 0.9 = 43.9 \text{ watt} = 0.0439 \text{ kw}$

KWH =  $0.0439 * 4 = 0.17$

Cost =  $(1.6 \text{ L. E /kwh}) * 0.17 = 28 \text{ piasters.}$

b- Ethanol –wet PASP (every 2 mol aspartic acid released 1 mol water)

$$\text{PSI weight} = 1000 - 67.6 \text{ g} = 932.4 \text{ g}$$

$$C (\text{ethanol}) = 2.46 \text{ J/g } ^\circ\text{C}$$

$$Q = mc\Delta T = 932.4 \times 2.46 \times (25 - 60) = 80.3 \text{ KJ} \text{ ----- power} = 80.3 / (48 \times 3600) \\ = 0.46 \text{ watt}$$

$$\text{Cost} = 160 \times 0.000465 \times 48 = \mathbf{3.57 \text{ piasters}}$$

$$\mathbf{\text{Electric} = 28 + 3.57 = 31.57 \text{ L.E}}$$

$$5.5 \text{ L ethanol} = 150 \times 5.5 = \mathbf{825 \text{ L.E}}$$

$$0.5 \text{ Kg NaOH} = 400 \times 0.5 = \mathbf{200 \text{ L.E}}$$

$$1 \text{ Kg aspartic acid} = \mathbf{600 \text{ L.E}}$$

$$\mathbf{\text{TOTAL} = 600 + 100 + 825 + 31.57 = 1556.6 \text{ L.E} \text{ (Synthetic)}}$$

Comparison between the prices for different used antiscalants

| Antiscalant         | CMC        | CA-SC     | PASP<br>(market) | PASP (Lab)    | PASP-SEA<br>(lab) |
|---------------------|------------|-----------|------------------|---------------|-------------------|
| Price of 1 kg (L.E) | <b>175</b> | <b>95</b> | <b>600</b>       | <b>1556.6</b> | <b>1756.6</b>     |