Lesson-16

Solving Numerical

16.1 PROBLEM:

Calculate the power consumption of a homogenizer having capacity 10,000 lph, operated at 250 bar pressure.

1. Power Consumption = Pressure. Volumetric rate

E = P . V

V = 10,000lph =10/3600(m^3/s). m^3/s

1m^3 = 1000lt

P = 250 bar =250 x 10^5 kg/s^2m

$$E = \frac{10}{3600} \times 250 \times 10^5$$

=0.69444 x 10^5

≈70kw

16.1.2 In case the inlet pressure, efficiency of pump & motor are considered.

Calculate the power consumption of a homogenizer if the feed rate is 1800 lph and the operating pressure is 200 bar. The inlet pressure of milk is 2 bar, and efficiency of homogenizer is 95%.

Soln:

Electrical Power: $$\frac{Q_{in} \times (P_1 - P_{in})}{3600 \times \eta_p \times \eta_{motor}} \text{ KW}$$

When Q_m = feeding rate l/h

P_h = Homogenisation pressure (bar)

P_{in} = Pressure at which milk enters Homogenizer (bar)

n_{pump} =Efficiency of pump

$$= \frac{1800 \times (200-2)}{3600 \times 0.85 \times 0.95}$$

= 122.6 K.W

16.1.3 Find out the increase in temperature after homogenization for the given data below:

C milk = 3900J/kg K

ρ milk=1030kg/m^3

P=250 x 10^5kg/s^2.m

Soln:

Increase in temperature of homogenized liquid is proportional to

E = P.V = V. ρ .C. Δθ

Or $\Delta\theta = \frac{P}{C.\rho}$ $\Delta\theta = P/C.\rho$

$$\Delta\theta = \frac{250 \times 10^5}{3900 \times 1030} = 6.2^0\ C$$

16.1.4 Calculate the final outlet temperature of milk from the homogeniser if the inlet pressure is 2 bar, homogenising pressure 175 bar and milk inlet temperature is 50°C.

Soln:

Another assumption is that for every 40 bar pressure drop, the temperature of milk rises by 1°C,

$$T_{out} = \frac{P_h - P_{out}}{40} + T_{in}$$

$T_{in} = 55\ ^{o}C$

$P_h = 175$ bar

$P_{out} = 2$ bar

$$T_{out} = \frac{175 - 2}{40} + 55$$

$= 59.325^{o}C$

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