Chapter 1. Definitions and Principles

Industrial chemical process – very complex

→ can be broken down into a series of steps

↓

unit operation

(based on the same scientific principles)

Ex) 1. Manufacturing of salt (no chemical reaction appears)

transportation of solids and liquids

transfer of heat, evaporation, crystallization

drying, screening

2. Cracking of petroleum (chemical reaction involves)

transportation of fluids and solids

distillation, mechanical separations

cracking reaction

Unit Systems

SI units ←→ FPS units

↓ ↓

kg, m, s ft, lb, s

Standards

(kg) Platinum cylinder (France 표준국)

(s) ^{133}Cs의 진동수 9,192,631,770 회

(K) T_3 of pure water (물의 삼중점) 273.16 K

(m) length of light path during 1/299,792,458 s

(mol) ^{12}C의 12 g에 해당하는 atom 수

* SI Units

N, J, K, Pa

↓ ↓ ↓

$kg \cdot m/s^2$ $N \cdot m$ N/m^2

$T(^oC) = T(K) - 273.15$

g(중력가속도) = 9.8 m/s^2

1 bar = 1×10^5 Pa = 10^5 N/m^2

1 atm = 1.013 bar

* CGS Units

g, cm, s

1 dyn = 1 $g \cdot cm/s^2$

1 erg = 1 dyn·cm = 1×10^{-7} J

1 cal = 4.184 J (물 1 g을 1 °C 올리는데 필요한 열량)

R(기체상수) = 8.314 J/mol·K (정의: $\lim_{p \to 0} \frac{pV}{nT} = R$)

= 1.987 cal/mol·K

= 0.082 l·atm/mol·K

* FPS Units

1 lb = 0.4536 kg

1 ft = 0.3048 m

1 ^{o}R = 1/1.8 K

$T(^{o}\mathrm{F}) = 32 + 1.8T(^{o}\mathrm{C})$ $\quad$ $T(^{o}\mathrm{R}) = 459.67 + T(^{o}\mathrm{F})$

물의 어는 점: 0 ^{o}C = 273.15 K = 491.67 ^{o}R = 32 ^{o}F

1 lb_f (pound force)= 32.174 lb·ft/s^2

$$\leftarrow \quad 1\mathrm{lb}_f = 1\mathrm{lb}_m \times \frac{9.80665\,\mathrm{m/s^2}}{0.3048\,\mathrm{m/ft}}$$

cf.) 1 kg_f = 1 kg· (9.8 m/s^2) = 9.8 N

1 hp (horse power) = 550 ft·lb_f/s

1 BTU (British thermal unit) = 778.17 ft·lb_f

= 252 cal

(물 1 lb를 1 ^{o}F 올리는데 필요한 열량)

→ 1 BTU/lb·^{o}F ≡ 1 cal/g·^{o}C

* Conversion factor

→ Appendix 1 (p. 1085 – 1087) 참고

Related Problems

(Example 1.1) Calculating factors for converting

(a) N → lb_f (b) BTU → cal

(c) atm → lb_f/in^2 (psi) (d) hp → kW

(Probs.) 1.1, 1.2, 1.10, 1.11 and 1.16