An 'Old Timer's' Tips for Approximate Plant Calculations

Cullen Langford, a self-described "Old Timer", who provided considerable help with the *Head Type Flowmeter Elements*, portion of this chapter, has generously agreed to share with *ISA Handbook* readers the "approximate plant calculations, for preliminary design and checking" shown below. Dr. Langford advises that readers use them with care, however, because "these are valid only for normal situations."

Units, definitions

W, pph	P, psi	h inwc
ρ, Lb/cuft	R=19.316	g=grav, 32.16 ft/s^2
m, mol wt	D or d, inches	v, ft/s

Valve not corrected for fittings, choking, etc.

$$C_v = W/(63.2 \bullet \sqrt{\Delta P \bullet \rho}) \qquad W = 63.2 \bullet C_v \bullet \sqrt{\Delta P \bullet \rho}$$

Orifice, approximate discharge coefficient C_d,=0.61 for 0.2<β<0.55 and 10,000<Rd 100.000

$$W = 360 \bullet d^2 \bullet C_d \bullet \sqrt{h \bullet \rho}$$

$$d^2 = W/(360 \bullet C_d \bullet \sqrt{h \bullet \rho})$$

$$\sqrt{h} = W/(360 \bullet C_d \bullet d^2 \bullet \sqrt{\rho})$$

Pitot tube, C_d =0.65, approx, coefficients vary

$$W = 360 \bullet D^2 \bullet C_d \bullet \sqrt{h \bullet \rho}$$

Wedge, C_d = 0.46 for h/D = 0.5

$$W = 360 \bullet D^2 \bullet C_d \bullet \sqrt{h \bullet \rho}.$$

Rd

$$Rd = 6.32 \bullet W/(d \bullet cP)$$

Fluid Velocity

$$v = 0.48 \bullet gpm/D^2$$

Hydraulic Horse Power, the power to pump, or the power lost to turbulence.

$$HP = W \bullet psid / (946 \bullet \rho)$$

Hydraulic Head: in feet of fluid head

$$H = v^2 / 2g$$

$$K^0 = C^0 + 273.16 \qquad R^0 = F^0 + 459.69$$

Absolute temperature
Gas Density, T in K, p in psia

$$\rho = mP / R \bullet T$$