HYDRAULIC FORMULAE

PUMPS AND MOTORS

Fluid Flow

$$Q^2 \alpha \Delta p$$

Q is flow in litres/min and Δp is the pressure drop

Hydraulic Torque

$$T = (D \times p) / 62.8$$

Torque values are in Newton meter; D is the displacement in cc per revolution and p is the pressure in bar.

Hydraulic (fluid power) Horse-power

$$P = (p \times Q) / 600$$

Horsepower is in kilowatt; Q is the flow in litres per minute and p is the pressure in bar.

Torque and horsepower rela-tions

$$HP = (T \times p)/9554$$

Horsepower is in kilowatt, Torque is in Newton meter and p is in bar.

Side load on pump or motor shaft

$$F = (HP \times 63024) \div (RPM \times R)$$

F is the side load, in pounds, against shaft; R is the pitch radius, in inches, of sheave on pump shaft; HP is driving power applied to shaft

Horsepower for driving a pump

For every 1 HP of drive, the equivalent approximately of 3.5 lpm @ 100 bar can be produced.

Horsepower for idling a pump

To idle a pump when it is un-loaded will require about 5% of its full rated horsepower.

CYLINDERS

Cylinder Pressure

$$P = F / A$$

P is pressure in the cylinder in Newtons per square meter; F is the force in Newtons and A is the area in square meter.

Force Developed by Cylinder

$$N = A \times p \times 10$$

N is the force developed by the cylinder in Newtons; A is the cross section area in square millimeters and p is the force in bar.

Flow Rate of a cylinder

$$Q = 60 \times A \times v$$

Q is flow rate of the cylinder in litres per minute; A is the area in square centimeter and v is velocity of the rod in meters per second.

Cylinder piston travel speed

$$S = Q \div 60A$$

S is piston travel speed, me-ters per second; Q is oil flow rate into cylinder, litres per minute; A is piston area in centimeter square

Force or thrust of any cylin-der

$$F = A \times p$$

F is force or thrust, in Kg; A is piston net area in square centimeters; p is gauge pres-sure in bar

HYDRAULIC PIPING

Burst pressure of pipe/tubing

$$P = 2x10^5 x\ t\ x\ S \div 0.D$$

P is burst pressure in bar; t is wall thickness, in mm; S is tensile strength of material in bar; 0.D is outside diameter, in mm

Compressibility of hydraulic oil

Volume reduction is approxi-mately 1% for every 70 bar of fluid pressure in a non-rigid system

Wattage for heating hydraulic oil

Each Watt will raise the tem-perature of 1 gallon of oil by 1°F per hour.

Velocity of oil flow in pipe

$$V = Q \div 60A$$

V is oil velocity in meter per second;
Q is flow in litres per minute; A is inside area of pipe in square centimeters

Heating Effects

$$\Delta T = \Delta p \div 14$$

ΔT is the temperature rise in the cylinder in degrees Celcius; Δp is the pressure drop increase in bar

Flow Velocity in Hydraulic Lines

Pump suction lines - 0.6 to 1.2 m/s
Pres lines up to 35 bar: 3.0 to 4.5 m/s
Pres lines up to 200 bar: 4.5 to 6.0 m/s
Pres. lines over 200 bar: 7.5 m/s

CIB 246/5, G.I.D.C. Indl. Estate
Umbergaon, Gujarat
tucson@vsnl.com