Calculation Sheets (Valve Dia. : 1.3 m)

Torque Calculation of Butterfly Valve

1. Dynamic Torque (Td)

This torque is generated when the valve has different pressure (△P) between former and later of valve during the fluid which has dynamic velocity is flowing .
And this is not occurred when open or close of valve is completely , when an angle of 45 degrees is opened it is max. . And that time this torque effect to closing direction .
This is calculated by following formula .

$$\triangle P = \frac{\xi v \times \gamma \times V2}{2 \times g}$$

$$= 19928.5714 \ (\text{kgf / m2})$$

Loss Coefficient	ξv : 43.4
Weight per unit volume	γ : 1000 (kgf / m2)
Average velocity	V : 3 (m/s)
Gravity	g : 9.8 (m/s)

$$Td = Ct \times Dd3 \times \triangle P$$

$$= 569.1799 \ (\text{kgf . m})$$

Dynamic factor	Ct : 0.01
Diameter	Dd : 1.3 (m)

2. Bearing Friction Torque (Tb)

This torque is generated by friction between stem of valve and bearing .
This is calculated by following formula .

(1) When valve is opened :

$$T_{b\infty} = \frac{\pi}{4} \times Dd2 \times \triangle Pc \times \frac{d \times \mu b}{2}$$

$$= 2415.7277 \ (\text{kgf . m})$$

(2) When valve is opened an angle of 30 deg.

$$T_{b\infty} = \frac{\pi}{4} \times Dd2 \times \triangle Po \times \frac{d \times \mu b}{2}$$

$$= 370.3231 \ (\text{kgf . m})$$

Valve Diameter	Dd : 1.3 (m)
Difference Pre. (Closing)	△Pc: 130000 (kgf / m2)
Difference Pre. (Opening)	△Po: 19928.57 (kgf / m2)
Stem diameter	d : 0.14 (m)
Bearing friction factor	μb : 0.2

3. Seating Torque (Ts)

When the valve is opened or closed , this is generated due to friction between soft and metals .
This is calculated by following formula .

$$Ts = Ps \times \pi \times Dd \times b \times \frac{Dd}{2} \times 0.64 \times \mu s$$

$$= 662.5996 \text{ (kgf . m)}$$

Toutch Pre. Of Seat	Ps : 65000
Dia. Of valve	Dd : 1.3 (m)
Toutch width of valve	b : 0.01 (m)
Seat friction factor	μs : 0.6

4. Hydrostatic Torque (Th)

This is generated when butterfly valve is setted up with horizontal .
This is same as water head .
This is calculated by following formula .

$$Th = \gamma \times Ix$$

Weight per unit volume	γ : 1000 (kgf / m3)
Valve diameter	Dd : 1.3 (m)

$$Th = \gamma \times \frac{\pi \times Dd4}{64}$$

$$= 140.1985 \text{ (kgf . m)}$$

5. Total Torque (Tt)

The total torque of valve according to open or close of valve is different . So , we should select the max. value among two results calculated by following two formula .

(1) When opening , it is added up with two torques , seating and bearing friction torque . namely , when valve is completely closed :

$$Ttc = Tbc + Ts = Th$$

$$= 3218.5257 \text{ (kgf.m)}$$

(2) When the valve is opened some angle , this is calculated by adding up of two torques , dynamic and bearing friction torque .
- An angle of 30 Degrees

$$Ttc = Td + Tbo$$

$$= 939.5030 \text{ (kgf . m)}$$

Accordingly the highest value is No. (1)

$$= 3218.5 \text{ (kgf . m)}$$