4.3. Valve sizing problem

Sizing is required for a **globe valve** under the following conditions:

piping line

nominal diameter of the line: DN = 65 mm

liquid stream

olive oil, with a density ρ = 920 kg/m^3
upstream pressure of the valve: P_1 = 4.5 atm
downstream pressure of the circuit in which the valve is inserted: P_3 = 1.6 atm
downstream pressure of the valve P_2 as given from the formula $\Delta P=(P_1 - P_2)= 35\%(P_1 - P_3)$
vapor pressure: P_v = 0.003 atm
nominal flow rate in the range: $\dot{V}$ = 4.5 ÷ 6.5 L/s
liquid critical pressure ratio factor: F_F = 0.956

valve

The manufacturer provided the following Table for a **Burkert 2013 globe valve**:

DN (mm)	K_{vn} ($m^3(H_2O)$ / h bar$^{1/2}$)
10	2.7
15	4.0
20	7.1
25	12.0
32	18.0
40	34.0
50	48.0
65	64.0

C_{vn}=1.16 K_{vn}

The intrinsic characteristic can be:
VA1: **equal percentage**
VA2: **linear**
VA3: **quadratic**

The **rangeability** is always r = 30.

Questions

1. Calculate the **flow coefficient C_v** for the above conditions
2. **Size the valve** for the problem, choosing the one with the most appropriate DN and intrinsic characteristic
3. Plot the **intrinsic characteristic**

Next, you are prompted to enter the sized valve in a circuit, taking ΔP_n equal to the original value (P_1 - P_2) and considering an user's equipment pressure drop:

$\Delta P_0 = 2.9$ atm

4. How much is the authority V?
5. Discuss if the calculated value for the authority V is consistent or not with the inherent characteristic previously chosen under the point 2)
6. Calculate $\dot{V}_n$
7. How much is the flow rate $\dot{V}_1(h)$ which passes the valve for $h_1 = 0.4$?
8. How much is the actual pressure drop across the valve ΔP_{v1} for $h_1 = 0.4$?
9. What is the **relative stroke** h_2 that allows a flow rate $\dot{V}_2 = 155$ gal(US)/min passing through the valve?
10. Calculate and plot the **flow curve**, and then check the occurrence of **cavitation**