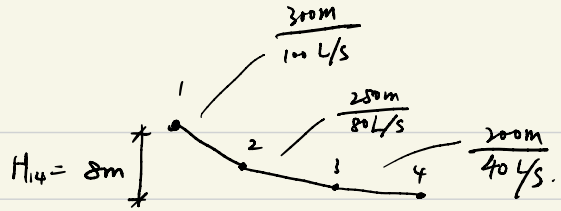
10.



$n=1.852$. $m=4.87$. $\alpha=1.7$

由 $\frac{q^{\frac{n\alpha}{\alpha+m}}}{i_{ij}}$ = constant 和 $\sum i_{ij} l_{ij} = H$

得 $\frac{n\alpha}{\alpha+m} = \frac{1.852\times 1.7}{1.7+4.87} = 0.479$

$\therefore \frac{q_{1-2}^{0.479}}{i_{1-2}} = \frac{q_{2-3}^{0.479}}{i_{2-3}} = \frac{q_{3-4}^{0.479}}{i_{3-4}}$; $i_{1-2} l_{1-2} + i_{2-3} l_{2-3} + i_{3-4} l_{3-4} = 8m$

$$\Rightarrow \begin{cases} \frac{i_{1-2}}{0.1^{0.479}} = \frac{i_{2-3}}{0.08^{0.479}} = \frac{i_{3-4}}{0.04^{0.479}} \\ 300\, i_{1-2} + 250\, i_{2-3} + 200\, i_{3-4} = 8m \end{cases} \Rightarrow \begin{cases} i_{1-2} = 0.0122 \\ i_{2-3} = 0.0110 \\ i_{3-4} = 0.079 \end{cases}$$

即求得各段的最大水力坡降.

取水头损失公式 $h_{ij} = \frac{10.67\, q_{ij}^{1.852}}{C^{1.852} \cdot D^{4.87}} l_{ij}$ 、取 $C=130$

$$\Rightarrow i_{ij} = \frac{10.67\times q_{ij}^{1.852}}{130^{1.852} \cdot D^{4.87}} \le (i_{ij})_{max}$$

$$\Rightarrow D \ge \left(\frac{10.67\times q^{1.852}}{130^{1.852} \cdot (i_{ij})_{max}} \right)^{\frac{1}{4.87}}$$

计算得 $D_{1-2} \ge 260mm$. $D_{2-3} \ge 247mm$. $D_{3-4} \ge 202mm$

考虑经济管径. 取 $D_{1-2}=300mm$ $D_{2-3}=250mm$ $D_{3-4}=200mm$.

总水头损失 $\Delta h = 1.93 + 2.58 + 1.70 = 6.21m < 8m$ 合理

11. 限界流量 $q_1 = \left(\frac{m}{f\alpha}\right)^{\frac{1}{3}} \cdot \left(\frac{D_n^{\alpha} - D_{n-1}^{\alpha}}{D_{n-1}^{-m} - D_n^{-m}}\right)^{\frac{1}{3}} = 1.49 \left(\frac{D_n^{\alpha} - D_{n-1}^{\alpha}}{D_{n-1}^{-m} - D_n^{-m}}\right)^{\frac{1}{3}}$

300mm 管道的上界流量 $q_{300}^{上界} = 1.49 \left(\frac{0.35^{\alpha} - 0.3^{\alpha}}{0.3^{-m} - 0.35^{-m}}\right)^{\frac{1}{3}}$

$= 0.0883\ m^3/s = 88.3\ L/s$

300mm 管道的下界流量 $q_{300}^{下界} = 1.49 \left(\frac{0.3^{\alpha} - 0.25^{\alpha}}{0.25^{-m} - 0.3^{-m}}\right)^{\frac{1}{3}}$

$= 0.0609\ m^3/s = 60.9\ L/s$

400mm 管道的上界流量 $q_{400}^{上界} = 1.49 \left(\frac{0.45^{\alpha} - 0.4^{\alpha}}{0.4^{-m} - 0.45^{-m}}\right)^{\frac{1}{3}}$

$= 0.1598\ m^3/s = 159.8\ L/s$

400mm 管道的下界流量 $q_{400}^{下界} = 1.49 \left(\frac{0.4^{\alpha} - 0.35^{\alpha}}{0.35^{-m} - 0.4^{-m}}\right)^{\frac{1}{3}}$

$= 0.1212\ m^3/s = 121.2\ L/s$