PQI 3203: FENÔMENOS DE TRANSPORTE I

ESCOAMENTO ATRAVÉS DE LEITO DE PARTÍCULAS –PARTE2

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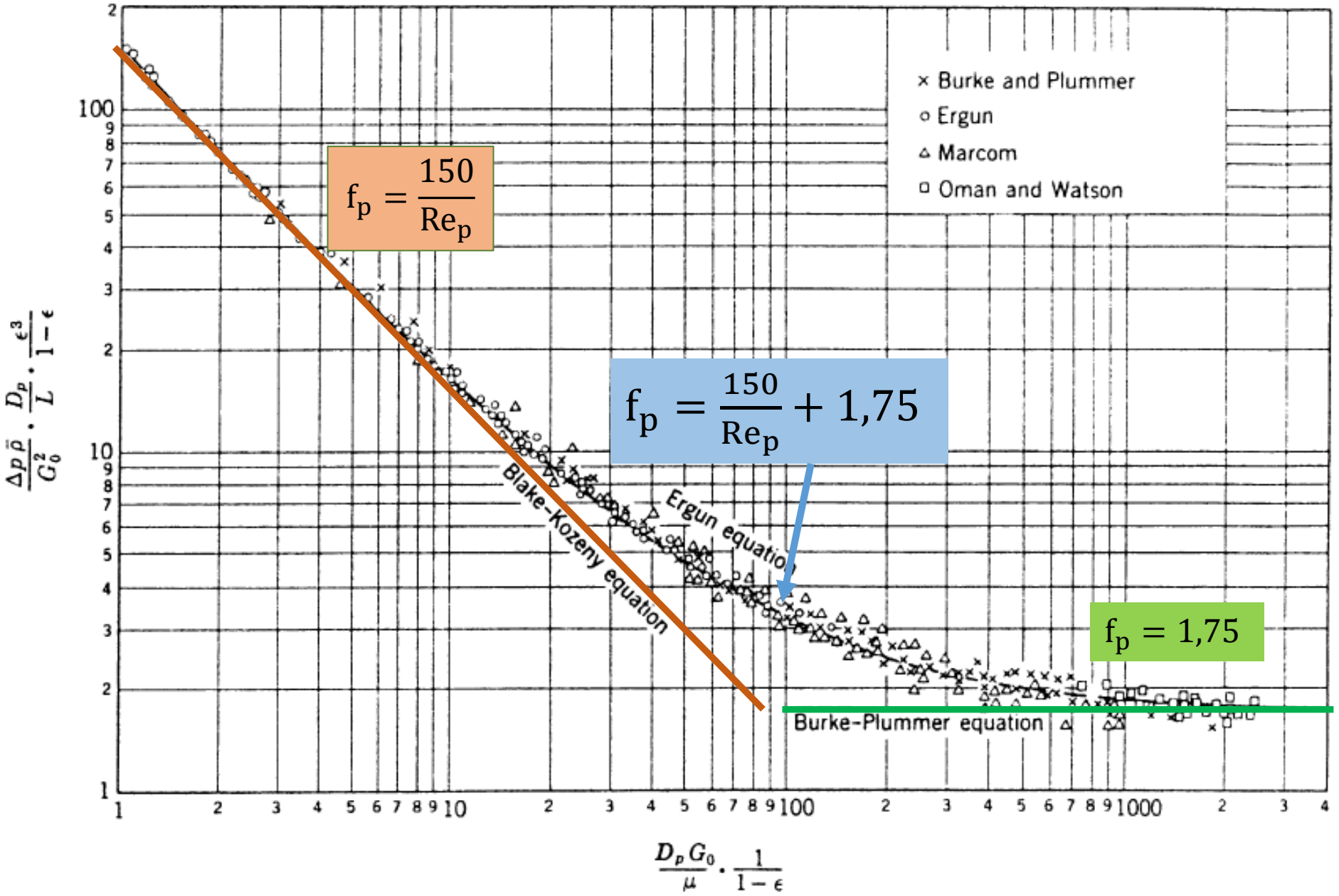

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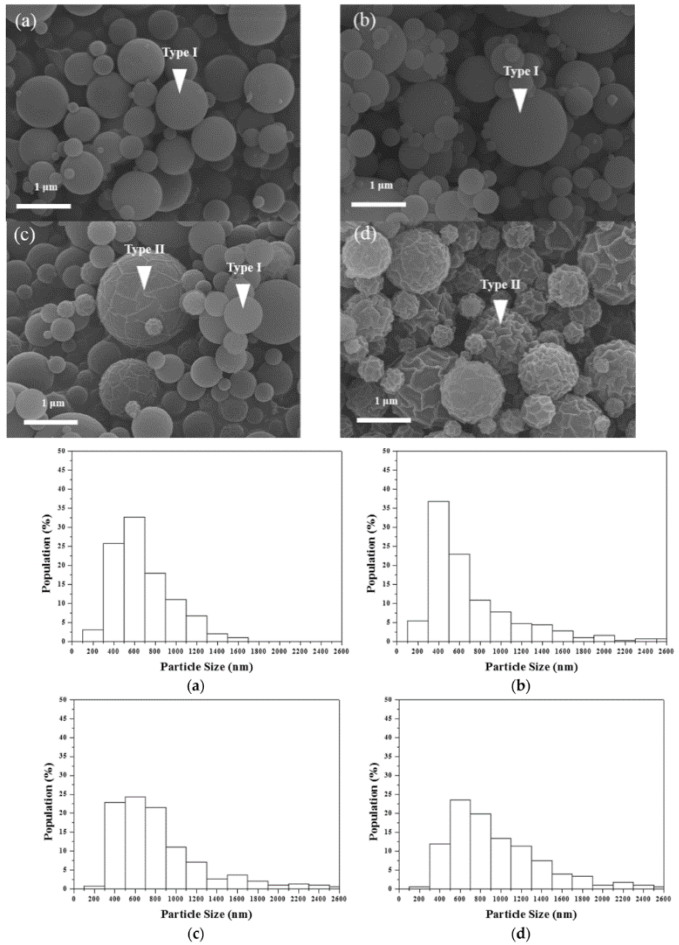
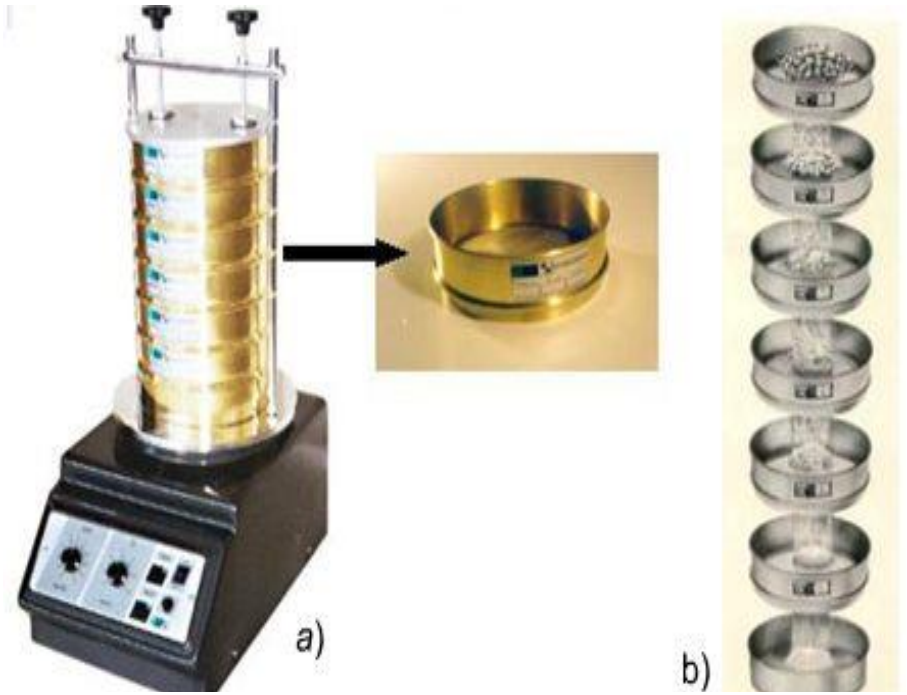
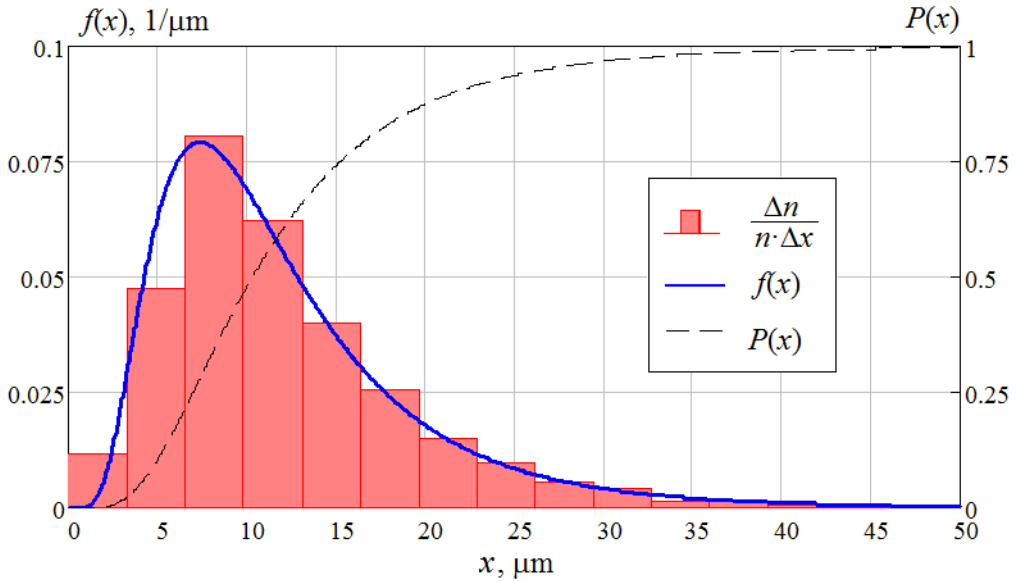
Distribuição granulométrica:

Partículas do tipo i com fração volumétrica x_i







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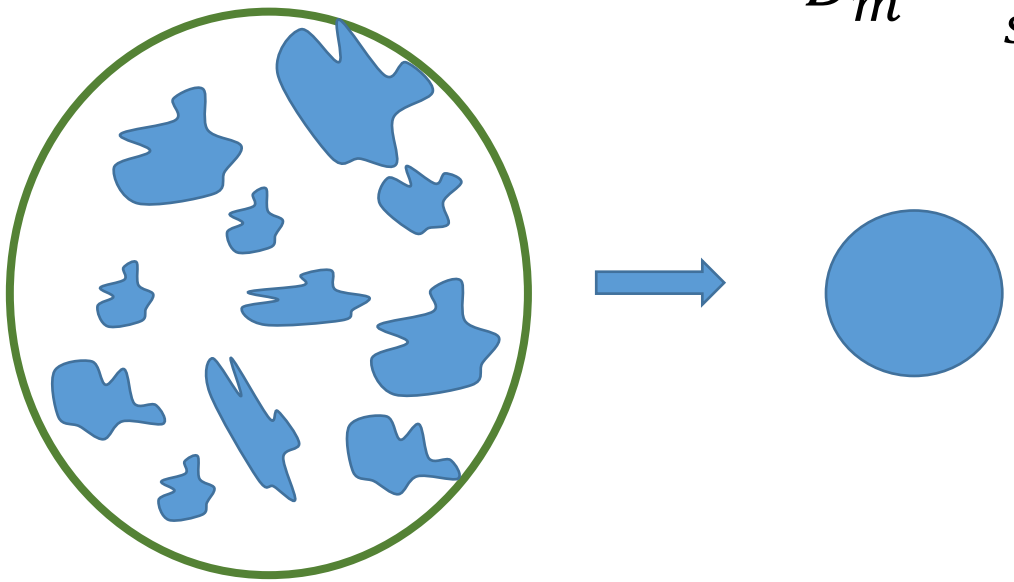
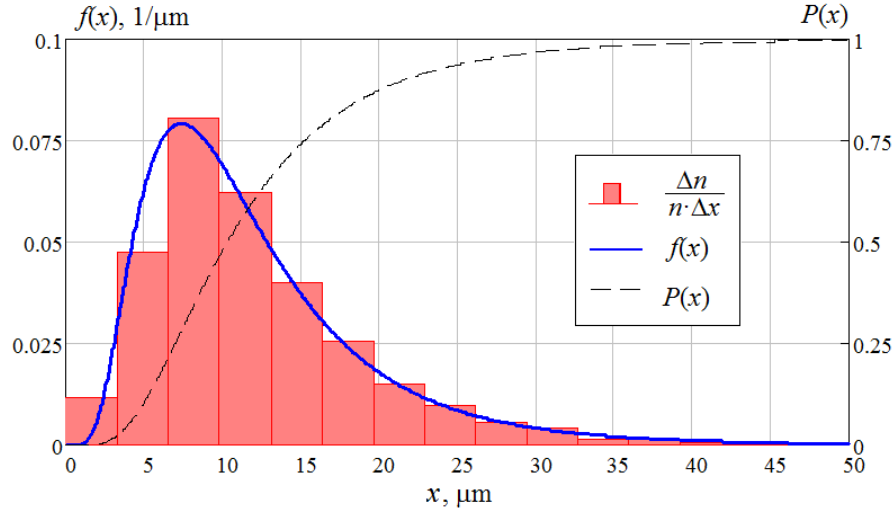
Distribuição granulométrica:

Cálculo da área específica s_{Vm} para partículas do tipo i com fração volumétrica x_i e s_{Vi} :

$$s_{vm} = \sum_i x_i s_{vi} = \sum_i x_i \frac{6}{D_i}$$

$$D_m = \frac{6}{s_{vm}} = \frac{6}{\sum_i x_i \frac{6}{D_i}} = \frac{1}{\sum_i \frac{x_i}{D_i}}$$





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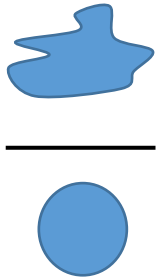
Esfericidade

Diâmetro da esfera de mesmo volume (diâmetro volumar), D_{pv} :

$$D_{pv} = \left(\frac{6v_p}{\pi}\right)^{1/3}$$

Esfericidade: ϕ_S = superfície da esfera de mesmo volume/superfície da partícula

$$\phi_S = \frac{\pi}{s_p}\left(D_{pv}\right)^2 = \frac{\text{}}{\text{}}$$



Substituir no equacionamento D_p por $\phi_S D_p$.

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Exercício 1 :

Estimar s_v , diâmetro efetivo, diâmetro volumar e esfericidade de:

- um cubo de aresta L
- um cilindro com D = H

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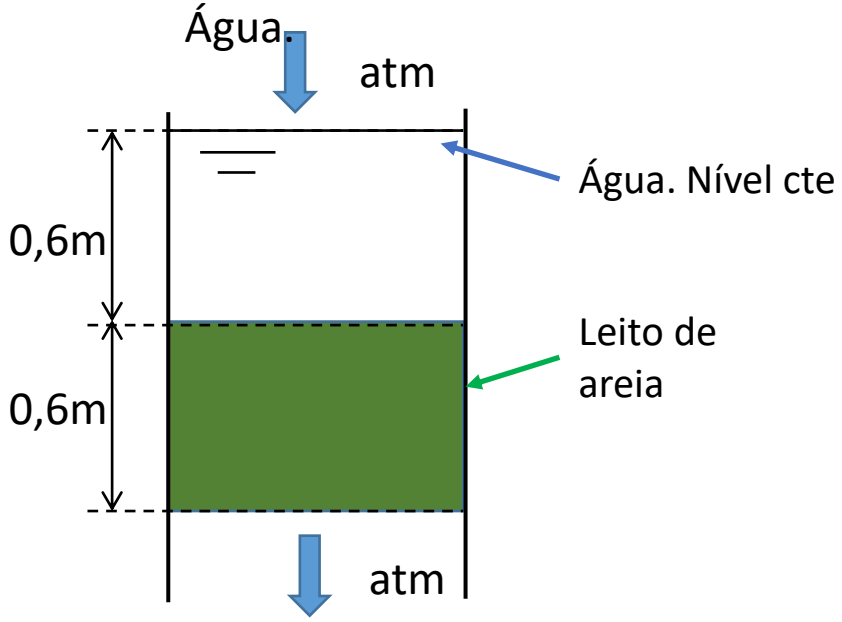
Exercício 2 – (Massarani):

Estimar a capacidade ($m^3/(m^2.h)$) do filtro de areia, com porosidade 0,43, operando com água a 20 ºC. Dados da areia :

Esfericidade: $\phi_S = 0,70$

Dp (mm)	% massa
1,168 – 0,833	20
0,833 – 0,589	60
0,580 – 0,417	20



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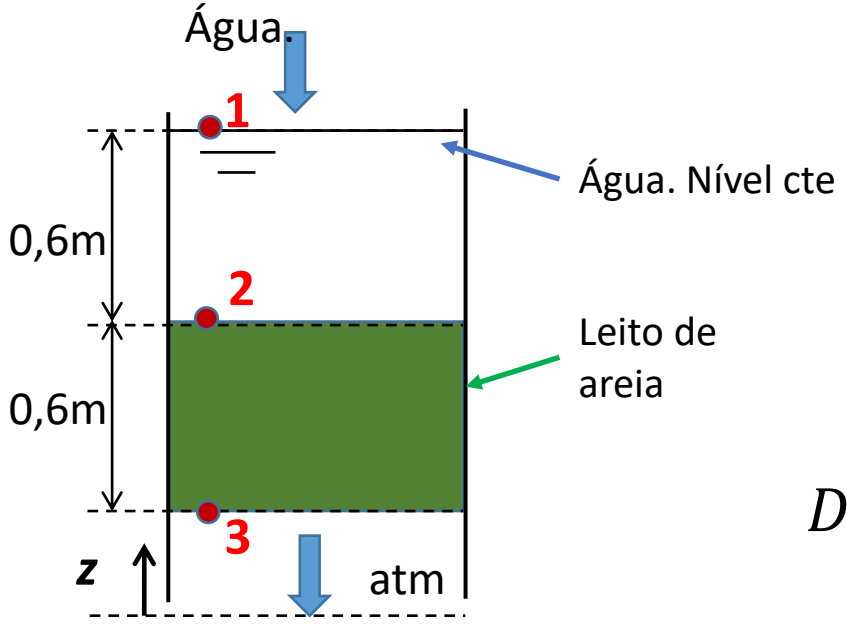

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$$D_m = \frac{6}{s_{vm}} = \frac{6}{\sum_i x_i \frac{6}{D_i}} = \frac{1}{\sum_i \frac{x_i}{D_i}}$$

$$D_m = \frac{1}{\sum_i \frac{x_i}{D_i}} = \frac{1}{\left(\frac{0,2}{1,0} + \frac{0,6}{0,711} + \frac{0,2}{0,503}\right)} = 0{,}694 \text{ mm}$$

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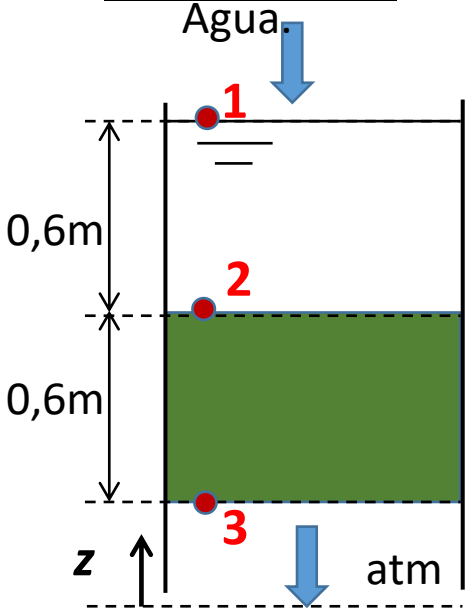
Exercício 2



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$$\frac{P_1}{\rho} + gh_1 = \frac{P_2}{\rho} + gh_2 + lw_{f12} \quad (=0)$$

$$\frac{P_2}{\rho} + gh_2 = \frac{P_3}{\rho} + gh_3 + lw_{f23}$$

$P_1 = atm$, $P_3 = atm$

$$\frac{P_1}{\rho} + gh_1 = \frac{P_3}{\rho} + gh_3 + lw_{f23}$$

$$lw_{f23} = \frac{P_1 - P_3}{\rho} = g(h_1 - h_3)$$

$9,8 \times 1,2$

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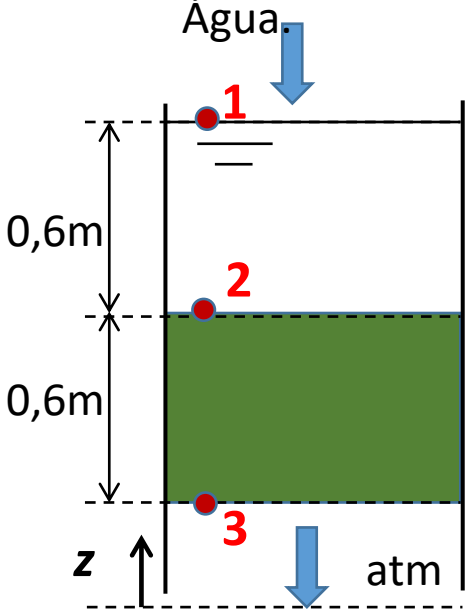
Exercício 2



$$\sum h_{f23} = \frac{P_2 - P_3}{\rho} = \underbrace{g(h_1 - h_3)}_{9,8 \times 1,2}$$

$$\sum h_f = \left[\frac{150}{Re_p} + 1,75\right] u_{bs}^2 \left(\frac{1-\epsilon}{\epsilon^3}\right)\frac{L}{\phi_s D_p} = \left[\frac{150}{\frac{\rho u_{bs}\phi_s D_p}{(1-\epsilon)\mu}} + 1,75\right] u_{bs}^2 \left(\frac{1-\epsilon}{\epsilon^3}\right)\frac{L}{\phi_s D_p}$$

$$\sum h_f = \left[\frac{150 \times (1-0,43).10^{-3}}{10^3 \times u_{bs} \times 0,7 \times 9,694.10^{-3}} + 1,75\right] u_{bs}^2 \left(\frac{1-0,43}{0,43^3}\right)\frac{0,6}{0,7 \times 9,694.10^{-3}}$$

$$\sum h_f = \left[\frac{0,176}{u_{bs}} + 1,75\right] u_{bs}^2 \times 8854 = 1558\, u_{bs} + 15495\, u_{bs}^2 = 9,8 \times 1,2 = 11,76$$

$$u_{bs} = 0,00705 m/s = 25,4\ m^3/m^2 h \Rightarrow Re = \frac{1000 \times 0,00705 \times 9,694.10^{-3} \times 9,7}{10^{-3}(1-0,43)} = 6,0$$