EX 10

1 TRANSFERT CHALEUR ETABLI

$$\frac{\partial}{\partial x}\left[\frac{T(x)-T_w(x)}{T_m(x)-T_w(x)}\right]=0$$

DEFINITION GENERALE DES NOTES

- ici $T_w = cst$

$$\frac{\partial T}{\partial x} = 0 \quad :-)$$

OUI C'EST COMPLIQUÉ !

SUIS PAS VRAIMENT CERTAIN QUE C'EST UTILE !

MAIS WINCKY UTILISE CELA POUR LES ECHANGEURS ..... :-)

2

$$v(r) = 2v_m\left(1-\left(\frac{r}{R}\right)^2\right)$$

3

$$-\mu\left[\frac{dv}{dr}\right]^2 = k\,\frac{1}{r}\,\frac{d}{dr}\left(r\,\frac{dT}{dr}\right)$$

$$\left[\frac{dv}{dr}\right] = \left(-4v_m\frac{r}{R^2}\right)$$

NOTE $\mu = \mu_m$:-)

$$-16\frac{\mu v_m^2}{k}\,\frac{r^3}{R^4} = \frac{d}{dr}\left(r\,\frac{dT}{dr}\right)$$

$$-4\frac{\mu v_m^2}{k}\,\frac{r^4}{R^4} = r\,\frac{dT}{dr} + A$$

$$-4\frac{\mu v_m^2}{k}\,\frac{r^3}{R^4} = \frac{dT}{dr} + \frac{A}{r}$$

$$T(r)-T_w = \left[\frac{\mu v_m^2}{k}\right]\left(1-\frac{r^4}{R^4}\right)$$

ON INTEGRE SUR UN DISQUE !

4

$$v_m(T_m-T_w)\,\Pi R^2 = 4\Pi\left[\frac{\mu v_m^3}{k}\right]\int_0^1 (1-\eta^2)(1-\eta^4)\,\eta\,d\eta\;R^2$$

DEFINITION DE T_m "CUP MIXING TEMPERATURE"

$$= \int(\eta-\eta^3)(1-\eta^4)$$

$$\eta = \frac{r}{R}$$

$$= \int \eta-\eta^3-\eta^5+\eta^7$$

$$= \left[\frac{\eta^2}{2}-\frac{\eta^4}{4}-\frac{\eta^6}{6}+\frac{\eta^8}{8}\right]_0^1$$

$$= \frac{24-12-8+6}{48} = \frac{10}{48} = \frac{5}{24}$$

$$T_m - T_w = \frac{\mu v_m^2}{k}\,\frac{5}{6}$$

5

$$\mu = \frac{6}{5}\,\frac{k}{v_m^2}\,(T_m-T_w)$$

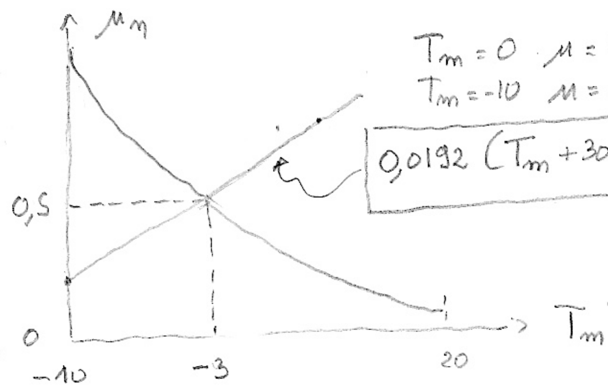
v_m^2 : $\frac{0.1}{(2,5)^2}$; T_w : -30

APPROXIMATIVEMENT $T_m = -3$, $\mu_m = 0.5$

$T_m = 0$ $\mu = 0,576$

$T_m = -10$ $\mu = 0,384$

$0,0192\,(T_m+30)$



6

$$Nu = \frac{2R\, q_w}{k\,(T_m - T_w)}$$

- $q_w = -k \left.\frac{dT}{dr}\right|_{r=R} = \frac{4 \mu v_m^2}{R}$
- $T_m - T_w = \frac{\mu v_m^2}{k} \frac{5}{6}$

$$Nu = \frac{2R}{k} \frac{4 \mu v_m^2}{R} \frac{k}{\mu v_m^2} \frac{6}{5} = \frac{48}{5}$$

7

$$P = \underbrace{q_w}\ \underbrace{2\pi R} = 8 \mu v_m^2 \pi$$

PUISSANCE EVACUEE PAR q_w

OU

$$P = \frac{16 \mu v_m^2}{R^4}\, 2\pi \underbrace{\int_0^R r^3\, dr}_{\frac{R^4}{4}}$$

$$= 8 \mu v_m^2 \pi$$

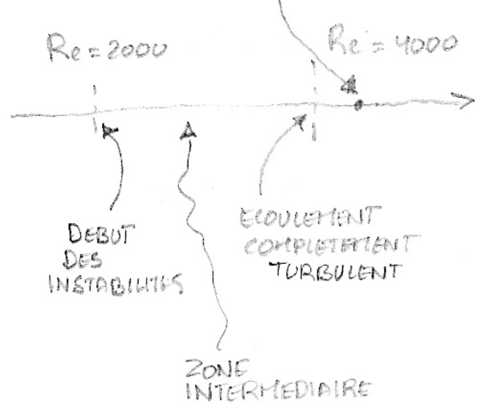
PUISSANCE DISSIPEE

LES 2 TERMES DOIVENT ETRE EGAUX !

8

$$Re = \frac{900 \times 2{,}5 \times 1}{0{,}5} = \underbrace{4500}$$

ECOUL DANS UN TUYAU $\mu = cst$



TOUTEFOIS μ PRES DE LA PAROI EST BEAUCOUP PLUS IMPORTANT...

EN PRATIQUE ON A UN ECOULEMENT DE PETROLE LAMINAIRE POUR

$Re < 6000$!

9

$$\frac{dp}{dx} = \frac{8 \mu v_m}{R^2} \quad (\mu = 0{,}5,\ v_m = 2{,}5,\ R^2 = 0{,}5^2)$$

$= 40$ [Pa/m]

$= 40 \underbrace{\frac{10^5}{10^3}}_{0{,}4}$ [bar/Km]