SHUBHAM GUPTA
180749
Q -2

| μm. | % wt less than |
|---|---|
| 50 | 90 |
| 40 | 80 |
| 30 | 65 |
| 20 | 55 |
| 10 | 50 |
| 5 | 10 |
| 2 | 5 |

flow rate $(Q_2)$ = $282\ m^3/h$

$= 0.0078\ m^3/s$

minimum gas velocity = 10 m/s

area of duct at 10 m/s $= \frac{0.078}{10}\ m^2$

$= 0.0078\ m^2$

duct area $= 0.5 D \times 0.2 D = 0.0078\ m^2$

$= 0.1 D = 0.0078\ m^2$

$\boxed{D^2 = 0.078\ m^2}$

$\boxed{D = 0.28\ m}$

The standard design diameter is 0.203 m and here we are getting 0.28 m, both of them are comparable so we use a single high efficiency cyclone separator density of gas at 100°C $\longrightarrow$ MM of $N_2$

$$= \frac{28}{22.4} \times \frac{273}{373}$$

$$= 0.915 \ kg/m^3$$

viscosity of $N_2$ at 150°C =

$2.1 \times 10^{-5} \ N.s/m^2$

now we will calculate the scaling factor

$$\text{scaling factor} = \left[\left(\frac{0.28}{0.203}\right)^3 \times \left(\frac{223}{282}\right) \times \left(\frac{2000}{2050}\right) \times \frac{2.1}{1.81}\right]$$

$$= 1.533$$

| | | | | collected. |
|---|---|---|---|---|
| >50 | 10 | 32.6 | 99 | 9.9 |
| 50-40 | 10 | 29.35 | 97 | 9.7 |
| 40-30 | 15 | 22.83 | 95 | 14.25 |
| 30-20 | 10 | 16.31 | 94 | 9.4 |
| 20-10 | 25 | 9.78 | 92 | 23 |
| 10-5 | 20 | 4.89 | 86 | 17.2 |
| 5-2 | 5 | 2.28 | 70 | 3.5 |
| 2-0 | 5 | 0.65 | 10 | 0.5 |

overall collection efficiency 87.45

classmate

Date ______

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Pressure drop

area of inlet duct $A_1 = 0.1D^2 =$

cyclone surface area $A_s = \pi D L$

$= \pi 4 D^2.$

$f_c = 0.005$

$\psi = \frac{0.005 \times 4\pi \cancel{D^2}}{0.1 \cancel{D^2}} = 0.628.$

$\frac{r_1}{r_2} = \frac{D - \left(\frac{0.2}{2}\right)D}{0.5 D.}$

$= \frac{0.9.}{0.5} = 1.8$

$\therefore \phi = 0.9$ from pressure drop figure.

$u_1 = \frac{282}{3600} \times \frac{1}{0.1D^2}$

$= \frac{282}{3600} \times \frac{1}{0.1 \times (0.28)^2}$

$= 10 \, m/s.$

area of exit pipe $= \frac{\pi (0.5D)^2}{4.}$

$= \frac{\pi (0.14)^2}{4}$

$= 0.015 \, m^2$

$u_2 = \frac{282}{3600} \times \frac{1}{0.015} = 5.22 \, m/s$

$$\Delta P = \frac{\rho_f}{2 g_c} \left\{ u_1^2 \left[ 1 + 2\phi^2 \left( \frac{2 r_2}{r_c} - 1 \right) \right] + 2 u_2^2 \right\}$$

$$\Delta P = \frac{0.91}{203} \left\{ 10^2 \left[ 1 + 2(0.9)^2 \left( 2 \times 1.8 - 1 \right) \right] + 2 \times (5.22)^2 \right\}$$

$\boxed{\Delta P = 2.58}$ millibar

This pressure drop looks reasonable