$$J=\frac{1}{3}v\frac{d}{h}(c-c_0)$$

$$J\cdot S'=-\frac{dc}{dt}\cdot V_{container} \qquad V_{container}=\pi r^2 \ell$$

Sensor measures $C=\frac{cV}{(c+c_{air})V}$ $c \ll c_{air}$ - net concentration of air that doesn't include CO_2 which doesn't make a difference considering $c_{CO_2} \ll c_{air}$

$$C = c/c_{air} \Rightarrow \frac{dc}{dt}=\frac{dC}{dt}\cdot c_{air}$$

$$J\cdot S'=-\frac{dC}{dt}c_{air}V_{container} \qquad c/c_{air}\equiv C \quad c_0/c_{air}\equiv C_0$$ → these will be used hereon.

$$S'\frac{vd}{3h}(C-C_0)=-\frac{dC}{dt}V_{container}$$

$S'=\frac{\pi d_w^2}{4}p$ → net area that CO_2 can flow through

p → porosity

$$v_{rms}=\sqrt{\frac{3RT}{\mu}}$$

T - temperature
$R=N_A\cdot k_B$
μ - molar mass of CO_2

$$p\frac{v\pi}{3}\frac{d d_w^2}{4h}(C_0-C)=+\frac{dC}{dt}V_{container}$$

$$C_0-C=Ae^{-\alpha t}$$

$$-A=C_{(t=0)}-C_0$$

$$\alpha=\sqrt{\frac{RT}{3\mu}}\frac{\pi d d_w^2 p}{4h\cdot V_{container}}$$

→ If we draw a graph of $-\ln(C_0-C)$ vs t the slope would give us α, we find C_0 from the data ~~using the saturation~~ by finding the point where particle flow stops. $C_0\approx 1/0.15$

$-\ln(C_0-C)$ vs t graph gives α and we can find $V_{container}$ the volume of the container by measuring. $V=\pi(6\pm0.2)(4\pm0.2)^2 (cm^3)$

$V=301\pm5\ (cm^3)$

$$\frac{dp}{h}=\frac{4\alpha\sqrt{\frac{3\mu}{RT}}}{\pi d_w^2}V_{container}$$

$\alpha=9.1\pm0.3\times10^{-4}\ (\frac{1}{s}) \Rightarrow \frac{d\cdot P}{h}=$ ~~[illegible]~~ $=14.8\pm0.4\times10^{-6}$

$[\Delta ab=a\Delta b+b\Delta a]$ → used here to get error

C → concentration ratio , t - time

t (s)	C (%)	t (s)	C (%)
0	% 0.0805	1200	0.141
20	% 0.0813	1300	0.146
		1340	0.146
40	% 0.0828		
		1380	0.1470
60	% 0.0832	1400	0.1481
80	% 0.0840	1560	0.1500
100	% 0.0849	1580	0.1500
200	0.09	1600	0.1501
300	0.095	1640	0.1505
400	0.101	1700	0.1490
500	0.106	1760	0.1477
		1800	0.1471
600	0.112	1840	0.1461
800	0.122	1920	0.1440
		2000	0.1431
1000	0.134	2040	0.1419
1100	0.137	2100	0.1419

→ Only some of the data is written to avoid a cluster.

It is seen that first the ratio increases, therefore $C_{(t=0)} < C_0$ then it reaches a stable value which means $C_{(t\to\infty)} = C_0$

$dP/h = 14.8 \times 10^{-6}$ [$\pm 0.4 \times 10^{-6}$] → the error is calculated using standart deviation method.

→ ~~The setup we~~ In this setup there were two fans at both ends of the channel to prevent inhomogenity. ~~Fans distributed air the~~

Student's code (e.g. RUS 1) TUR 5

Problem number (e.g. ☑) **Experiment**

Page number/Total (e.g. 5/8) 8/8