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黏滞系数的测定

小球距离 $l = 150\text{mm}$

零点修正值 $d_0 = 0.00\text{mm}$

油样温度 $T = 24^\circ\text{C}$

小球 数量	d/mm	\bar{d}/mm	t/s	\bar{t}/s	$\eta/\text{Pa}\cdot\text{s}$
小球 1	1.028		21.93		
	1.025	1.025	21.75	21.70	0.546
	1.022		21.43		
小球 2	1.021		21.91		
	1.020	1.021	21.94	21.88	0.557
	1.021		21.79	21.8	
小球 3	1.002		22.22		
	1.003	1.002	22.06	22.24	0.538
	1.002		22.43		
小球 4	1.028		21.47		
	1.028	1.029	21.37	21.49	0.544
	1.031		21.62		
小球 5	1.009		21.59		
	1.010	1.010	21.66	21.63	0.536
	1.012		21.63		

张亮

六、数据处理(要有详细过程,包括不确定度计算等)

已知 $\Delta d = 0.004 \text{ mm}$, $\Delta l = 2 \text{ mm}$ $\Delta t = 0.01 \text{ s}$

选取小球1实验数据做数据处理

$$\bar{d} = \frac{\sum_{i=1}^n d_i}{n} = \frac{1.028 + 1.025 + 1.022}{3} = 1.025 \text{ mm}$$

$$6d_A = t_p \sqrt{\frac{\sum_{i=1}^n (d_i - \bar{d})^2}{n(n-1)}} = 1.32 \times \sqrt{\frac{(0.003)^2 \times 2}{3 \times 2}} = 2.28 \times 10^{-3} \text{ mm}$$

$$6d_B = \frac{\Delta l}{\sqrt{3}} = \frac{0.004}{\sqrt{3}} \approx 2.31 \times 10^{-3} \text{ mm}$$

$$6d = \sqrt{6d_A^2 + 6d_B^2} = \sqrt{1.73 \times 10^{-3} + 2.31 \times 10^{-3}} \approx 2.829 \times 10^{-3} \text{ mm}$$

$$\begin{cases} d = (\bar{d} \pm 6d) = (1.025 \pm 0.002) \text{ mm} \\ E_d = \frac{6d}{\bar{d}} \times 100\% \approx \cancel{0.28\%} 0.23\% \end{cases}$$

$$\bar{t} = \frac{\sum_{i=1}^3 t_i}{3} = \frac{21.93 + 21.75 + 21.43}{3} = 21.70 \text{ s}$$

$$\delta t_B = \sqrt{\frac{\sum_{i=1}^3 (t_i - \bar{t})^2}{n(n-1)}} \approx 0.168 \text{ s}$$

$$\delta t_B = \frac{\Delta t}{\sqrt{3}} = \frac{0.01}{\sqrt{3}} \approx 0.00577 \text{ s}$$

$$\delta t = \sqrt{\delta t_A^2 + \delta t_B^2} \approx 0.168 \text{ s}$$

$$\begin{cases} t = \bar{t} \pm \delta t = (21.70 \pm 0.17) \text{ s} \\ E = \frac{\delta t}{\bar{t}} \times 100\% \approx 0.77\% \end{cases}$$

$$L = 150 \text{ mm} \quad \delta L = \frac{\Delta L}{\sqrt{3}} \approx 1.15 \text{ mm}$$

$$\begin{cases} L = (150 \pm 1.15) \text{ mm} \\ E = \frac{\delta L}{L} \times 100\% \approx 0.77\% \end{cases}$$

$$\eta = \frac{(p-p_0) g d^2 \bar{t}}{18 L (1 + 2.4 \frac{\delta d}{d})} \approx 0.546 \text{ Pa} \cdot \text{s}$$

$$\delta \eta = \sqrt{\left(\frac{\delta t}{\bar{t}}\right)^2 + \left(2.4 \frac{\delta d}{d}\right)^2 + \left(\frac{\delta L}{L}\right)^2} \approx 0.012 \text{ (Pa} \cdot \text{s)}$$

$$E\eta = \frac{\delta \eta}{\eta} \times 100\% \approx 2.2\%$$

$$\begin{cases} \eta = \eta \pm \delta \eta = (0.546 \pm 0.012) \text{ Pa} \cdot \text{s} \\ E\eta = \frac{\delta \eta}{\eta} \times 100\% = 2.2\% \end{cases}$$