國立虎尾科技大學機械設計工程系

113 學年度機械工程實驗(三):熱流力實驗

實驗報告

實驗三 ：伯努利文氏管測驗

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一、儀器與設備

1. 乾溼球溫度計

2. 控制箱與操作面板

3. 測試段與測試件

4. 標準流量產生裝置

5. 標準流量產生器用 AMCA 噴嘴

二、計算出以 CFM 及 CMM 單位表示的流量

需要手動輸入的參數值如下：

1. 環境乾球溫度 Td

2. 環境濕球溫度 Tw

3. 腔室溫度 T5 (T5=T8)

4. 大氣壓力 Pb

5. 噴嘴上下游差壓 P56

6. 腔室靜壓 P5 (P5=P8+P56)

7.標準流量產生裝置腔室內徑 D5 (=150mm)

8. 使用噴嘴直徑 D6 輸入完成後，自動計算出 CFM 及 CMM 單位表示的流量。

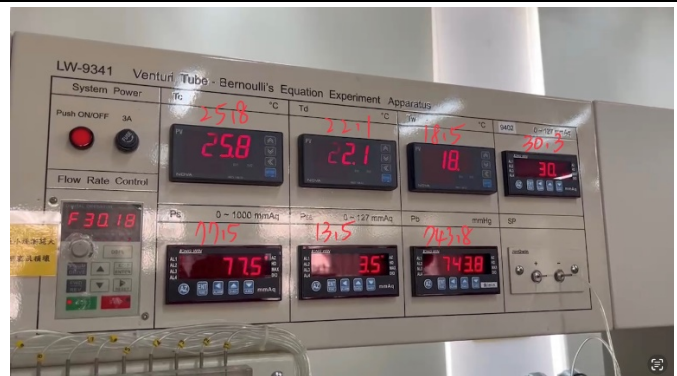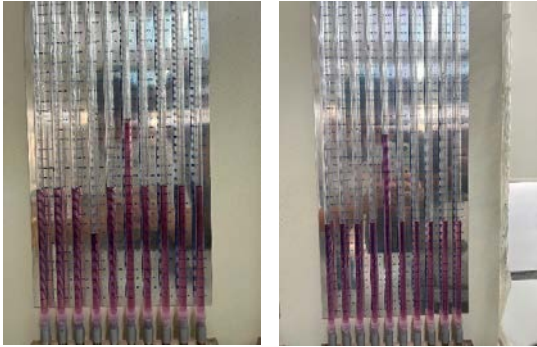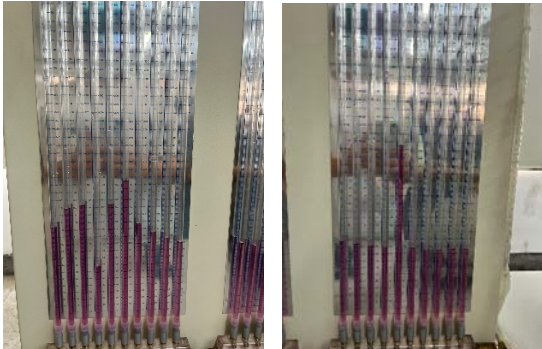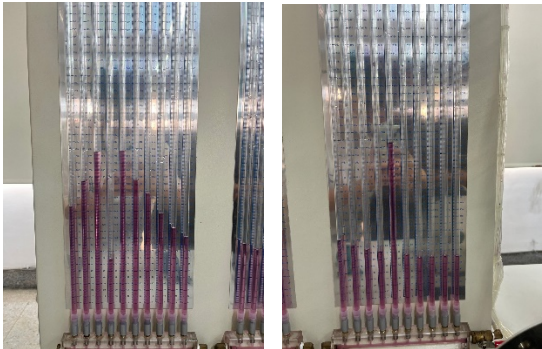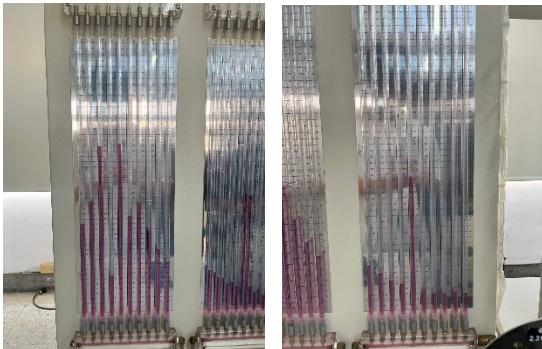|	
Flow : 0Hz	
Flow : 20Hz	
Flow : 30Hz	
Flow : 40Hz	

三、水柱壓力計之壓力分佈數值

Flow : 0Hz	
Flow : 20Hz	
Flow : 30Hz	
Flow : 40Hz	

四、實驗紀錄表

LW-9341 Venturi-TubeTest Data 側邊壓力孔

位置	喉部	漸縮段					入口
Position	4	6	8	10	12	14	18
dP(mmAq)							
Area (cm^2)							
Uc (m/sec)							
P (N/m²)							
$1/2\rho v^2$ (N/m²)							
ρgh (N/m²)							
$P+1/2\rho v^2$ (N/m²)							
Q_{state}= CMM				QSTP= CMM			

五、手動計算

20 Hz

$T_d = 22.2°C \quad T_w = 18.3°C \quad T_5 = T_8 = 25.1°C$

$P_b = 744 mmHg \quad P_{5b} = 5.6 mmAg \quad P_8 = 34.6 mmAg$

$P_5 = P_{5b} + P_8 = 5.6 + 34.6 = 40.2 mmAg$

$D = 150 mm \quad D_n = 24.02 mm$

$P_e = 3.25 × 18.3^2 + 18.6 × 18.3 = 1428.7725$

$P_P = 1428.7725 - 744 × 13.6 × 9.81 × (\frac{22.2 - 18.3}{1500}) = 1170.69259$

$P_0 = \frac{(744 × 13.6 × 9.81) - 0.378 × 1170.69259}{287.1 × (22.2 + 273.15)} = 1.165387$

$P_5 = 1.165387 × (\frac{22.2 + 273.15}{25.1 + 273.15}) × \left[\frac{(40.2 × 9.81) + 744 × 13.6 × 9.81}{744 × 13.6 × 9.81} \right]$

$\quad = 1.004585$

$\mu = (1.723 + 0.048 × 22.2) × 10^{-6} = 1.82956 × 10^{-5}$

$\alpha = 1 - \frac{5.6 × 9.81}{1.004585 × 287.1 × (25.1 + 273.15)} = 0.99361359$

$\beta = \frac{24.02}{150} = 0.16013$

$\gamma = 1 - (0.548 + 0.71 × 0.16013^4) × (1 - 0.99361359)$

$\quad = 0.99964926$

30Hz

$T_d = 22.1°C \quad T_w = 18.5°C \quad T_5 = T_8 = 25.8°C$

$P_b = 743.8mmHg \quad P_{56} = 3.5mmAg \quad P_8 = 77.5mmAg$

$P_5 = P_{56} + P_8 = 81mmAg$

$D = 150mm \quad D_n = 24.02mm$

$P_e = 3.25 \times 18.5^2 + 18.6 \times 18.5 = 1456.4125$

$P_p = 1456.4125 - (743.8 \times 13.6 \times 9.81) \times \left(\frac{22.1 - 18.5}{1500}\right)$

$\qquad = 1218.24893$

$P_o = \dfrac{743.8 \times 13.6 \times 9.81 - 0.378 \times 1218.24893}{287.1 \times (22.1 + 273.15)}$

$\qquad = 1.164061602$

$P_5 = 1.164061602 \times \left(\dfrac{22.1 + 273.15}{25.8 + 273.15}\right) \times \left[\dfrac{81 \times 9.81 + (743.8 \times 13.6 \times 9.81)}{743.8 \times 13.6 \times 9.81}\right]$

$\qquad = 1.158860126$

$\mu = (17.23 + 0.048 \times 22.1) \times 10^{-6} = 1.82908 \times 10^{-5}$

$\alpha = 1 - \dfrac{3.5 \times 9.81}{1.158860126 \times 287.1 \times (25.8 + 273.15)} = 0.999654797$

$\beta = \dfrac{24.02}{150} = 0.16013$

$\gamma = 1 - (0.548 + 0.7 \times 0.16013^4) \times (1 - 0.999654797)$

$\qquad = 0.999810066$

40H ≡

$T_d = 22.1°C \quad T_w = 18.2°C \quad T_5 = T_8 = 26.1°C$

$P_b = 743.8 \, mmHg \quad P_{56} = 4.2 \, mmAg \quad P_8 = 134.2 \, mmAg$

$P_5 = P_{56} + P_8 = 138.4 \, mmAg$

$D = 150mm \quad D_n = 24.02 \, mm$

$P_e = 3.25 \times 18.2^2 + 18.6 \times 18.2 = 1415.05$

$P_p = 1415.05 - (743.8 \times 13.6 \times 9.81) \times \frac{22.1 - 18.2}{1500} = 1157.039466$

$P_o = \frac{743.8 \times 13.6 \times 9.81 - 0.378 \times 1157.039466}{287.1 \times (22.1 + 273.15)} = 1.165527916$

$P_5 = 1.165527916 \times \left(\frac{22.1 + 273.15}{26.1 + 273.15}\right) \times \left(\frac{138.4 \times 9.81 + 743.8 \times 13.6 \times 9.81}{743.8 \times 13.6 \times 9.81}\right)$

$= 1.165681881$

$M = (17.23 + 0.048 \times 22.1) \times 10^{-6} = 1.82908 \times 10^{-5}$

$\alpha = 1 - \frac{4.2 \times 9.81}{1.165681881 \times 287.1 \times (26.1 + 273.15)} = 0.999588593$

$\beta = \frac{24.02}{150} = 0.16013$

$\gamma = 1 - (0.548 + 0.71 \times 0.16013^4) \times (1 - 0.999588593) = 0.999774356$

六、實驗心得與討論

　　透過這次的實驗，了解到是如何用壓力差來計算流量及各管路的損失情形，雖在一開始開水閥時調整水量高度不一致，在上手後順利地做完實驗，我們也利用手算的方式計算出各壓力計算結果，實驗過程中非常有趣，也讓我們學到更多不同儀器的使用。