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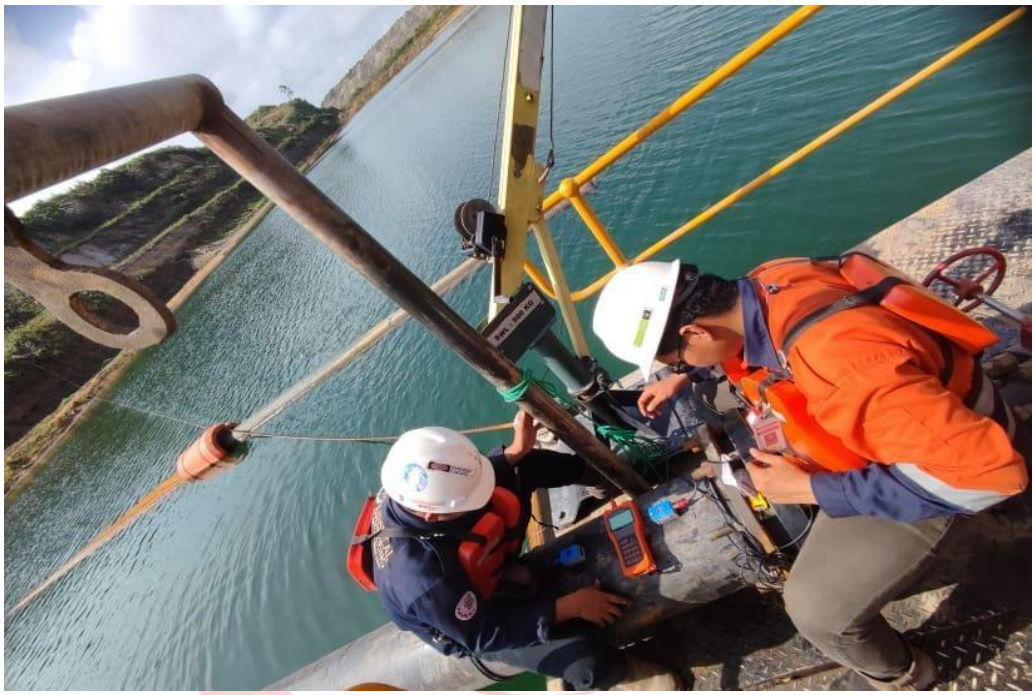
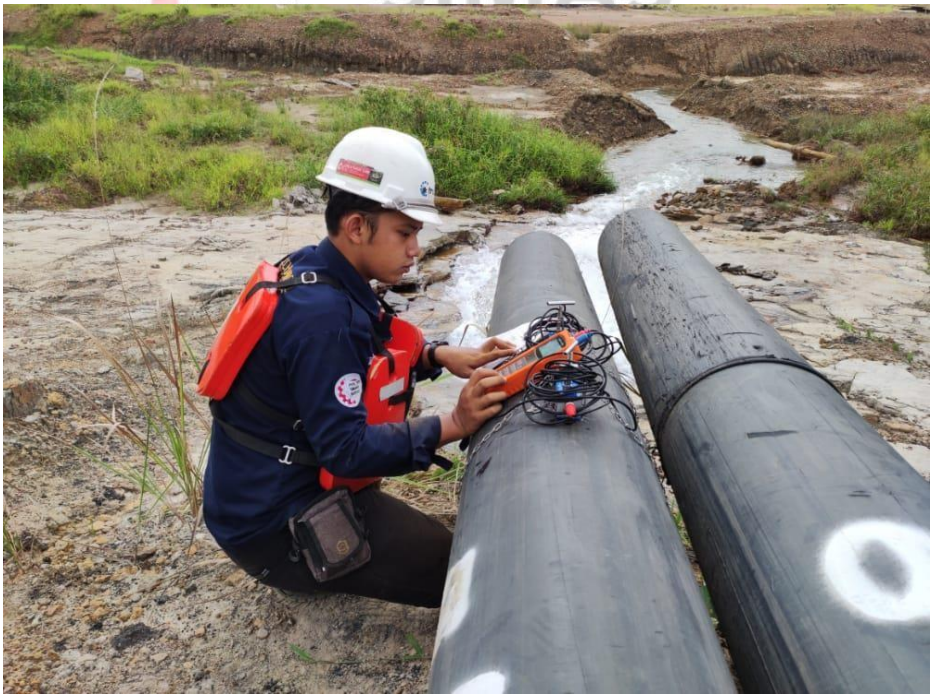
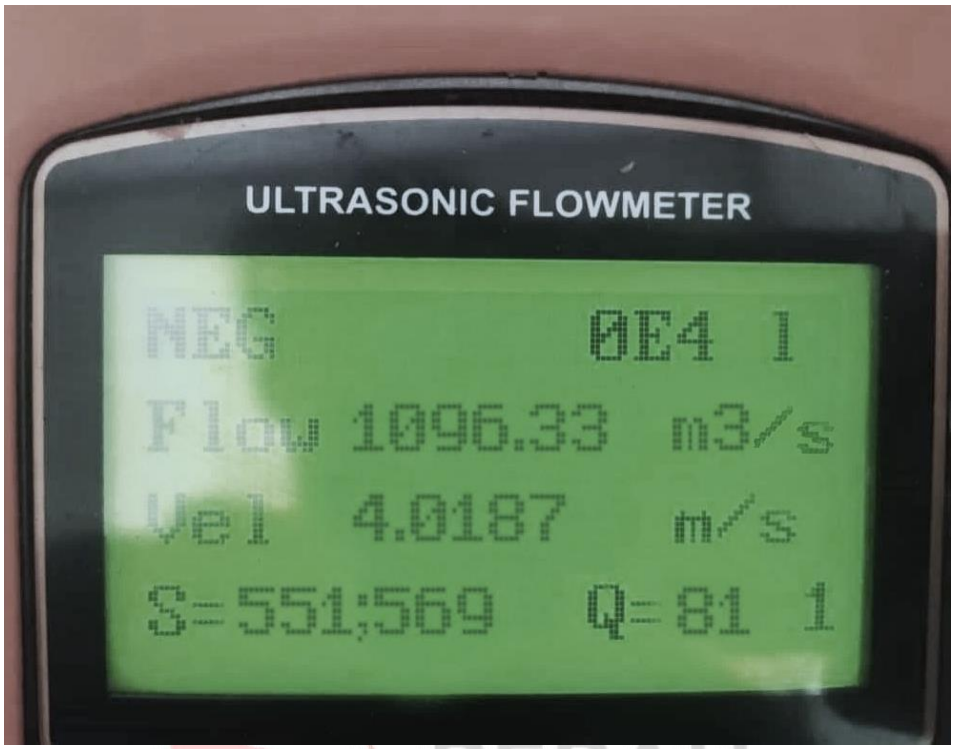
LAMPIRAN

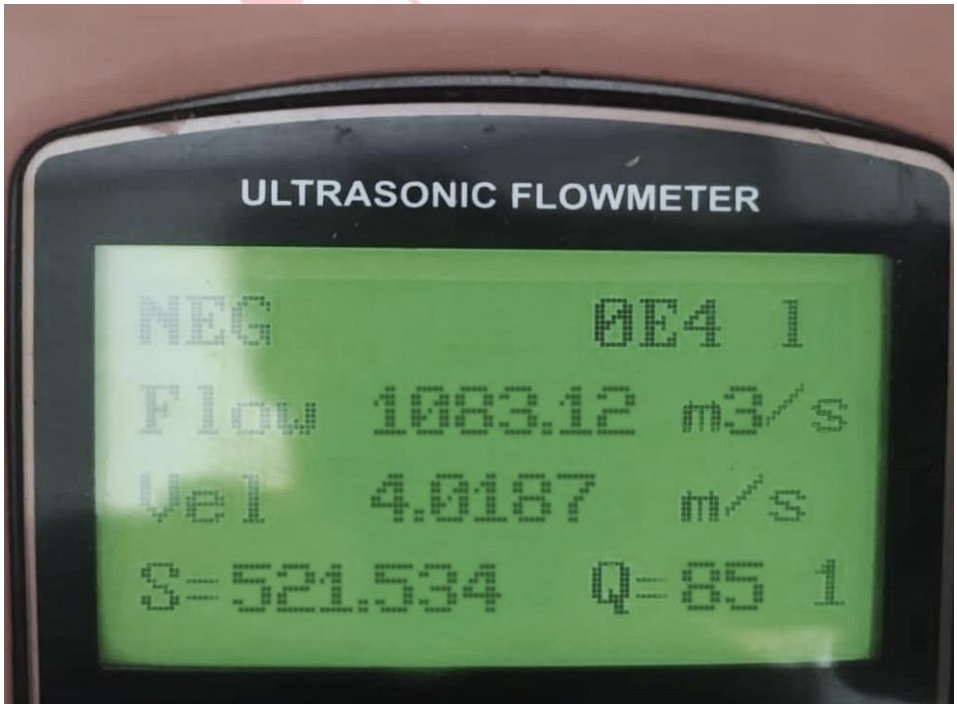
Lampiran 1. Instalasi Pemasangan Alat Ukur

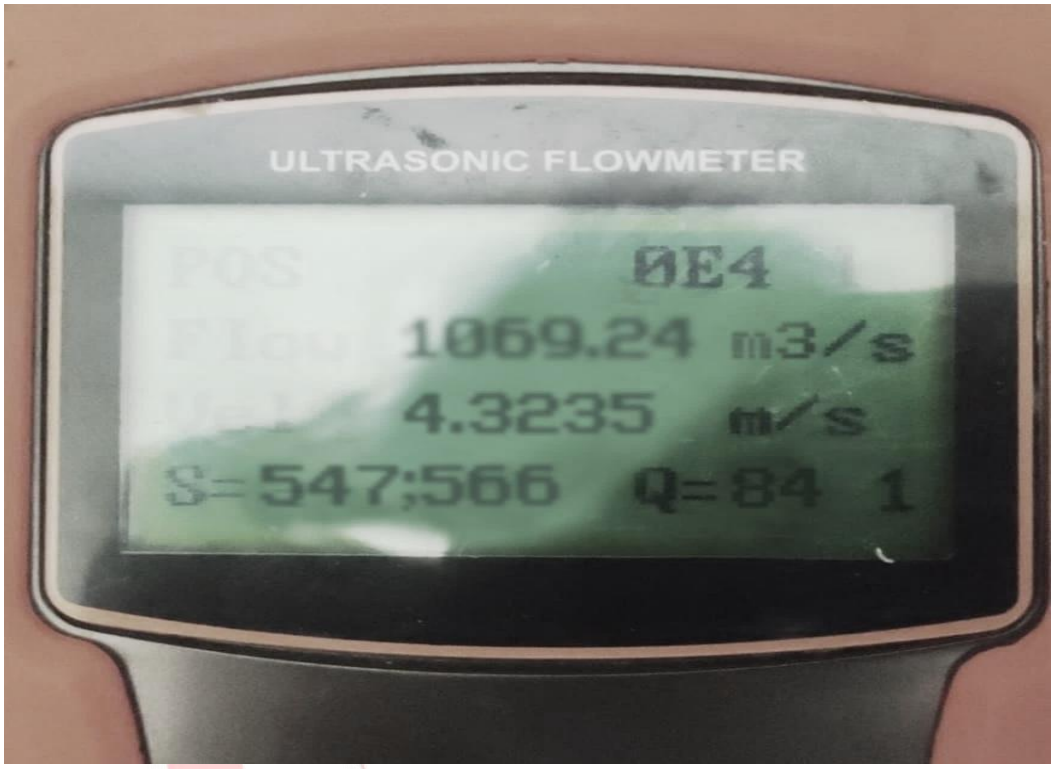


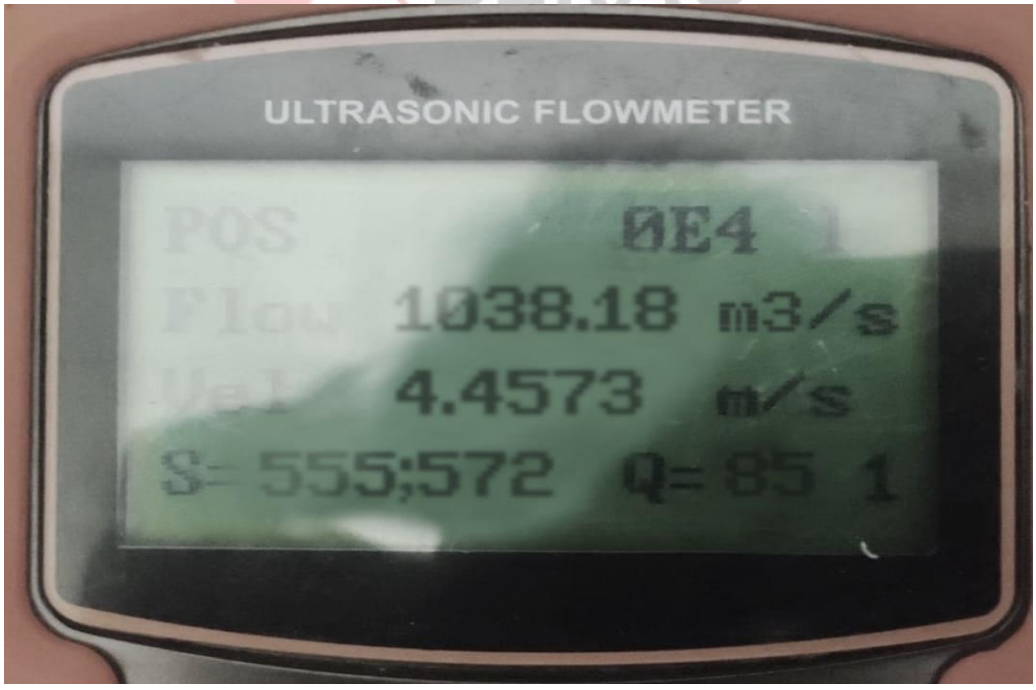


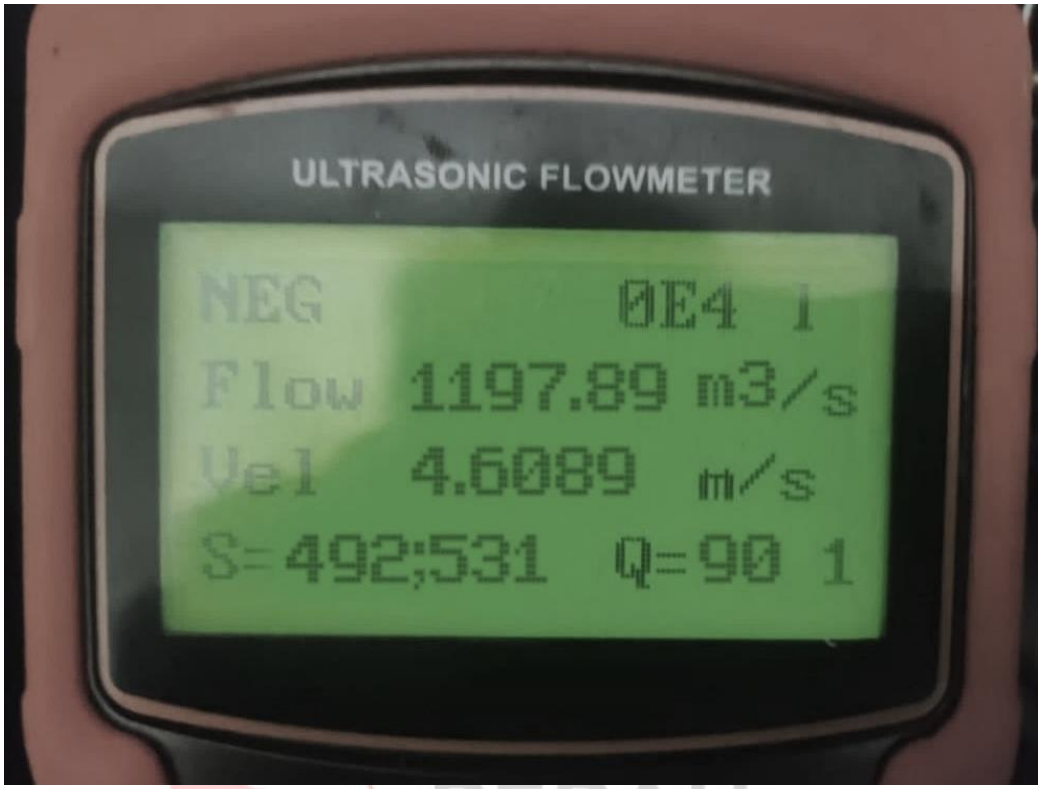
Lampiran 2 Hasil Pengukuran Flow dan Velocity

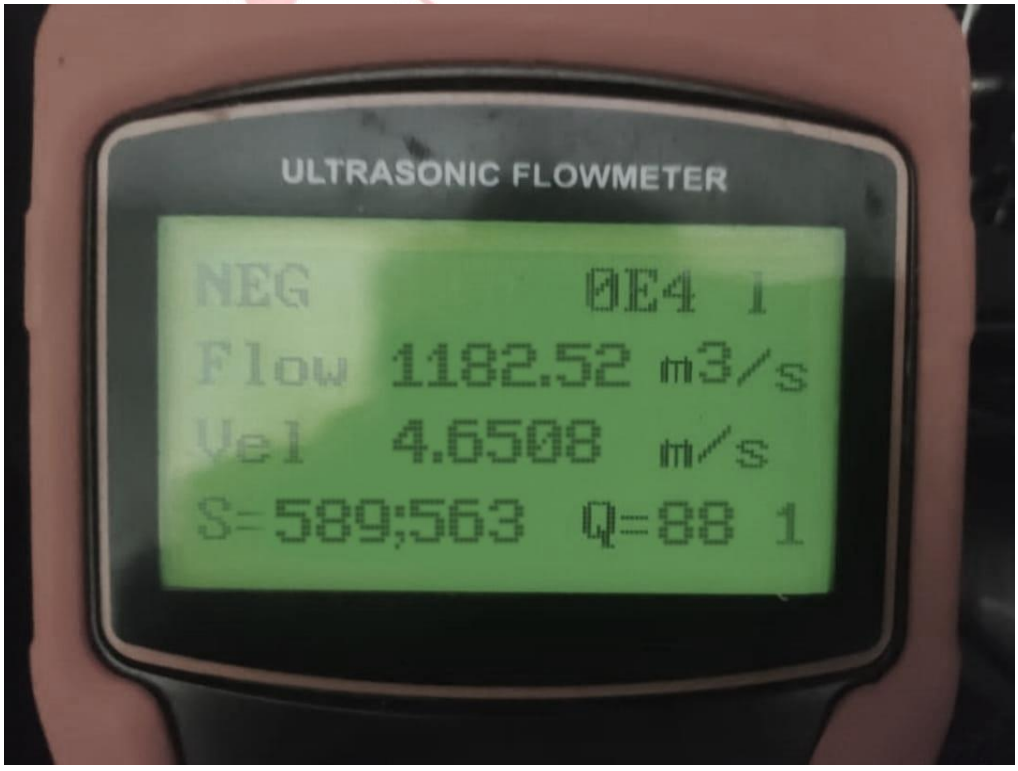


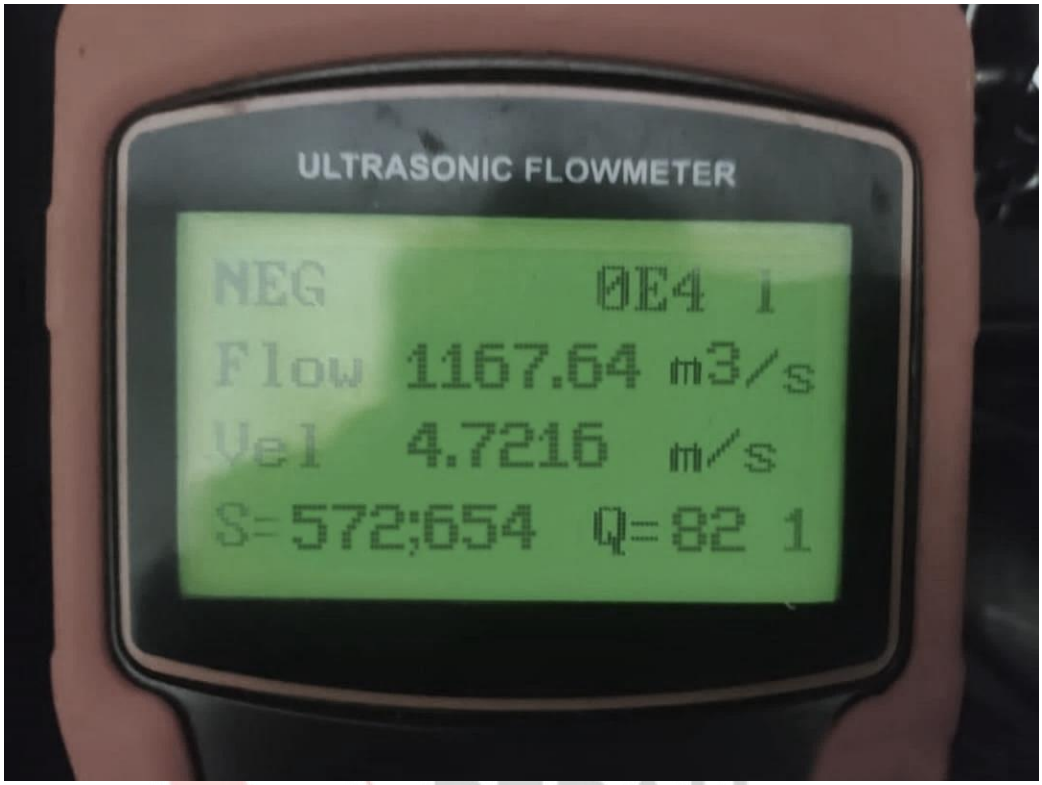


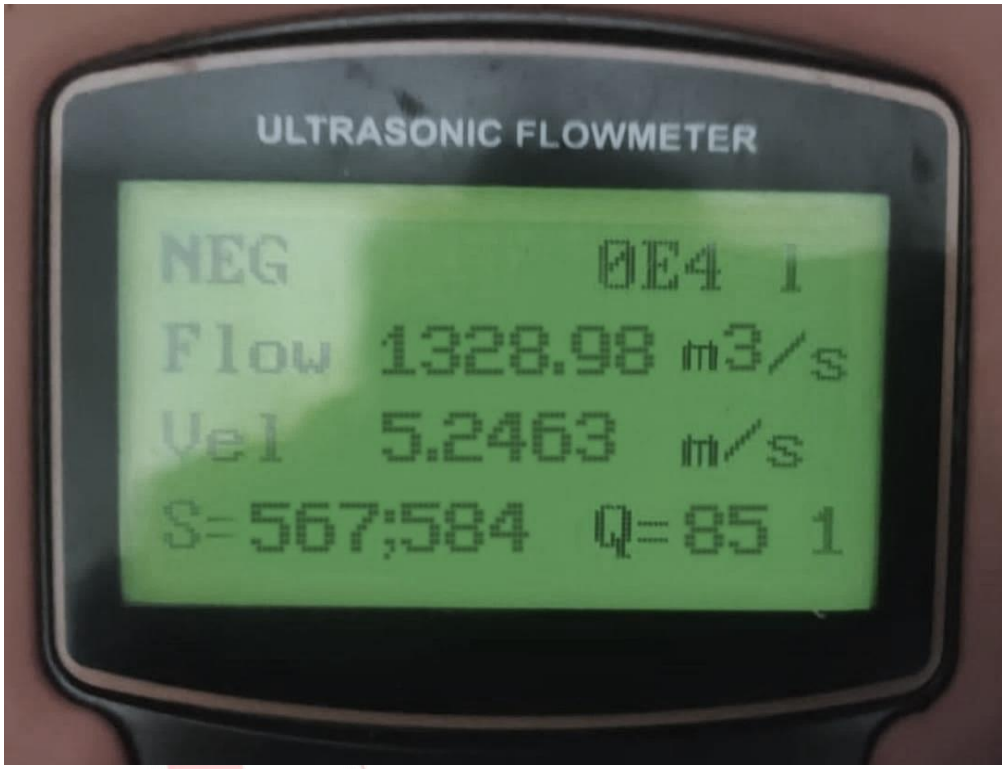


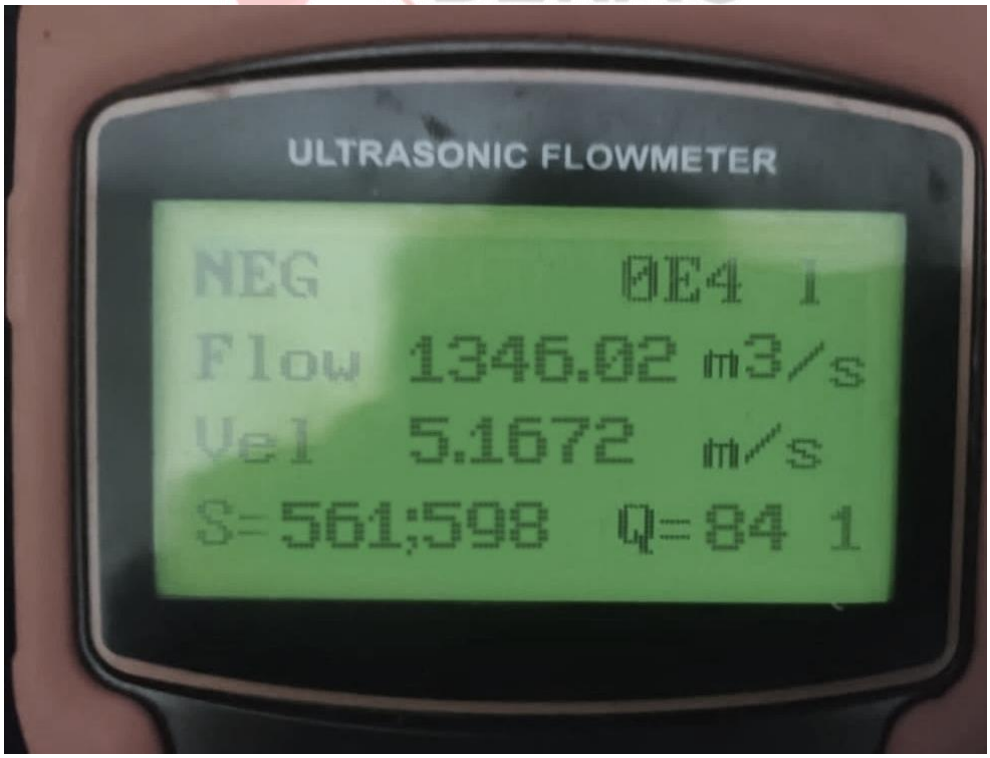


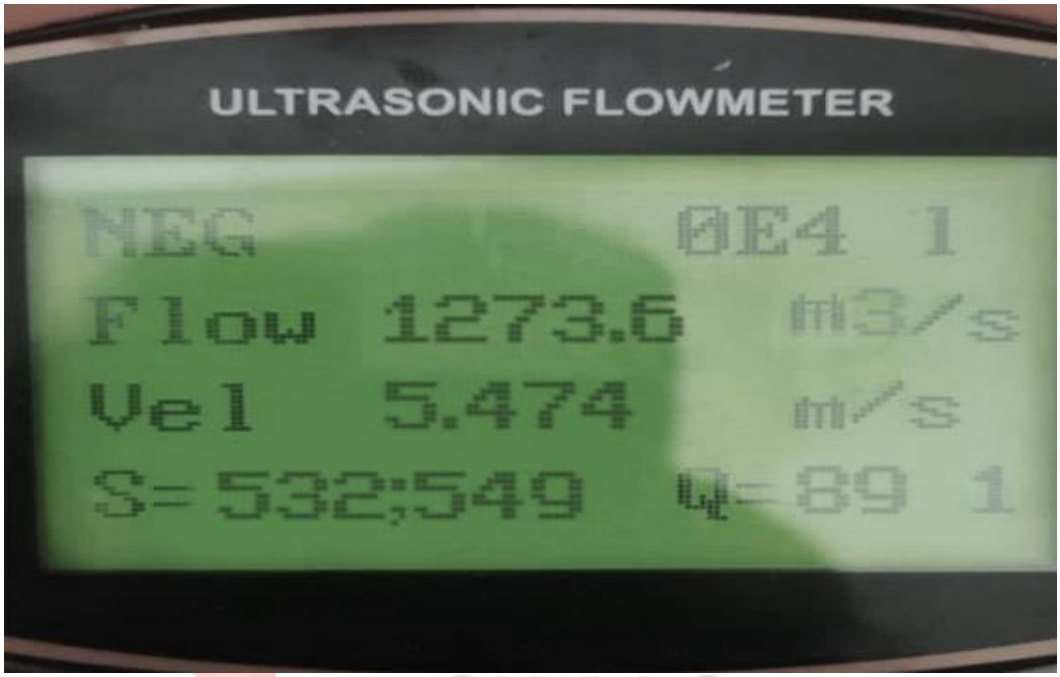


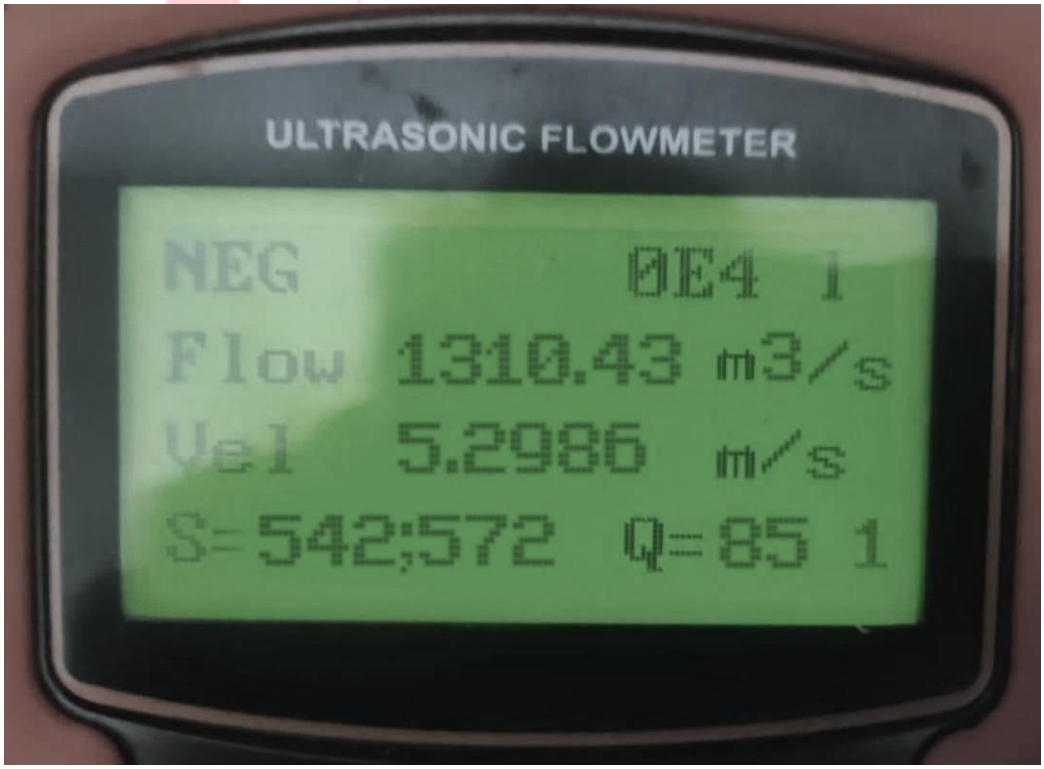


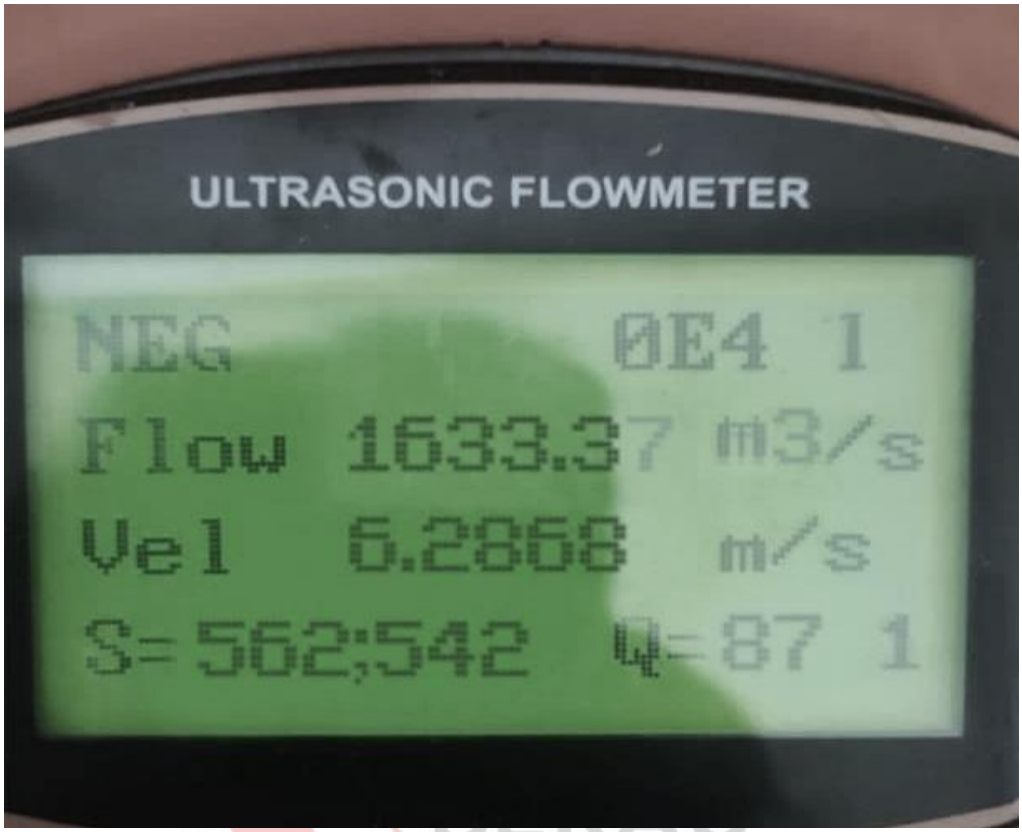


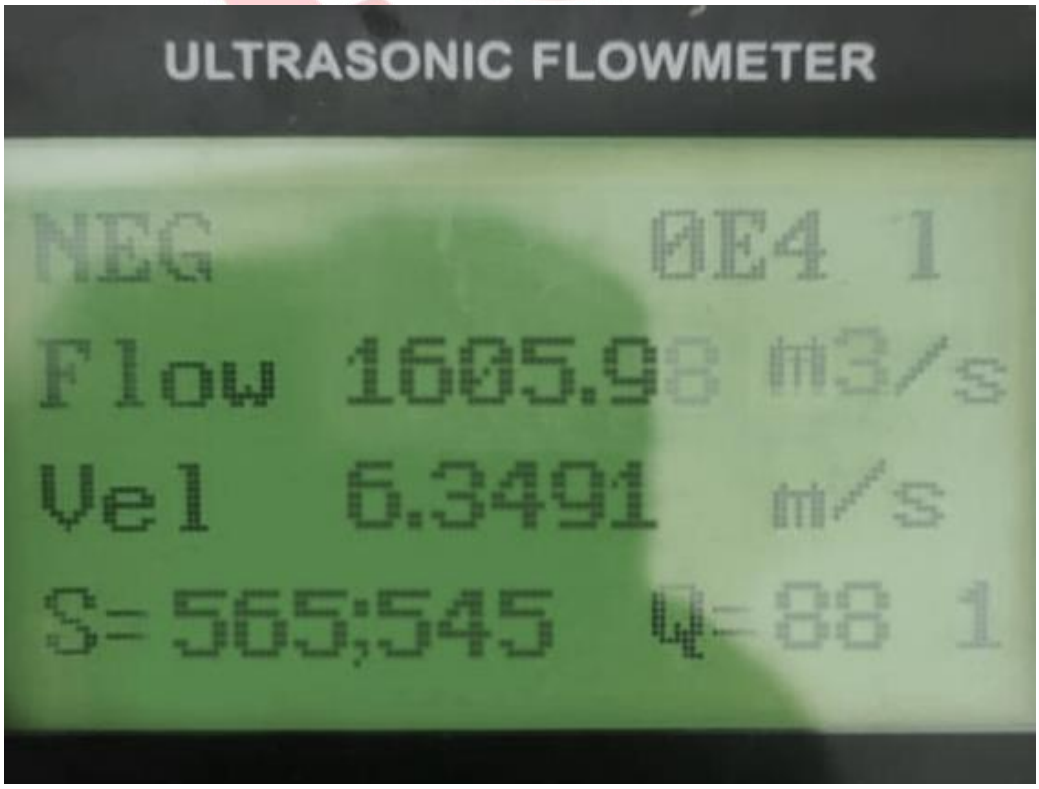


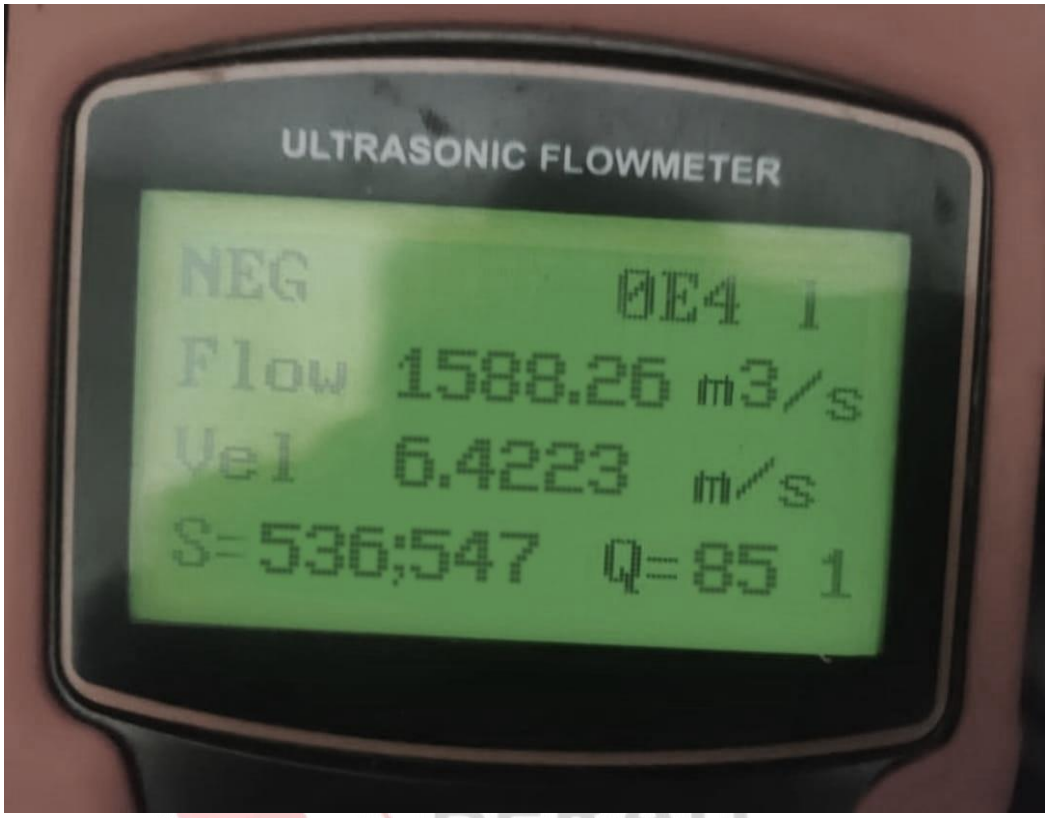


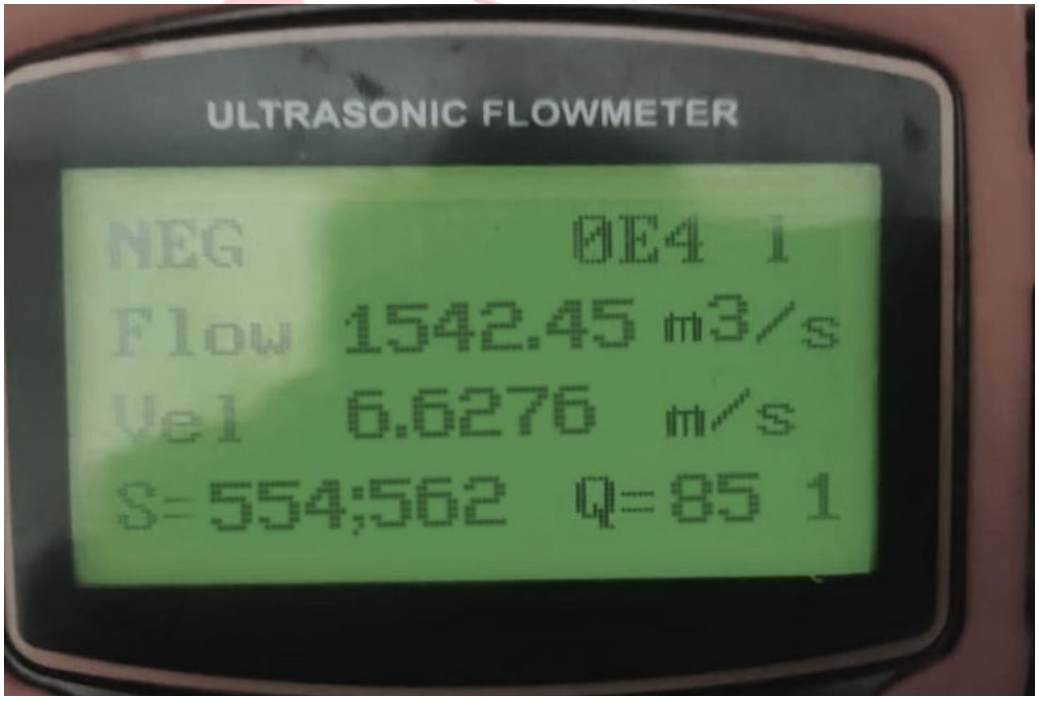












Lampiran 3 APD Yang Digunakan Pada Penelitian

Lampiran 4 Perhitungan *head losses*, *pressure drop*, Persamaan Bernoulli

Mencari nilai viskositas dinamik air dengan menggunakan rumus interpolarsi

Dik :

$X_1 = 25^oC$ $\mu_1 (25^oC) = 0{,}891\times10^{-3}$

$X = ….?$

$X_2 = 30^oC$ $\mu_2 (30^oC) = 0{,}798\times10^{-3}$

Penyelesaian

$$\mu = \frac{X_2 - X}{X_2 - X_1} \cdot \mu_1 + \frac{X - X_1}{X_2 - X_1}\mu_2$$

$$\mu = \frac{30^oC - 29{,}4^oC}{30^oC - 25^oC} \cdot 0{,}891\times10^{-3} + \frac{29{,}4^oC - 25^oC}{30^oC - 25^oC} \cdot 0{,}798\times10^{-3}$$

$\mu = 0{,}809\times10^{-3}$ kg m/s

Langkah 2

Mencari nilai *density* cairan dengan menggunakan rumus interpolarsi

Diketahui :

$X_1 = 25^oC$ $\rho_1 (25^oC) = 997{,}0$

$X = ….?$

$X_2 = 30^oC$ $\rho_2 (30^oC) = 996{,}0$

Penyelesaian

$$\rho = \frac{X_2 - X}{X_2 - X_1} \cdot \rho_1 + \frac{X - X_1}{X_2 - X_1}\rho_2$$

$$\rho = \frac{30^oC - 29{,}4^oC}{30\ ^oC - 25^oC} \cdot 997{,}0 + \frac{29{,}4^oC - 25^oC}{30^oC - 25^oC} \cdot 996{,}0$$

$\rho = 996{,}12$ kg/m³

Langkah 3

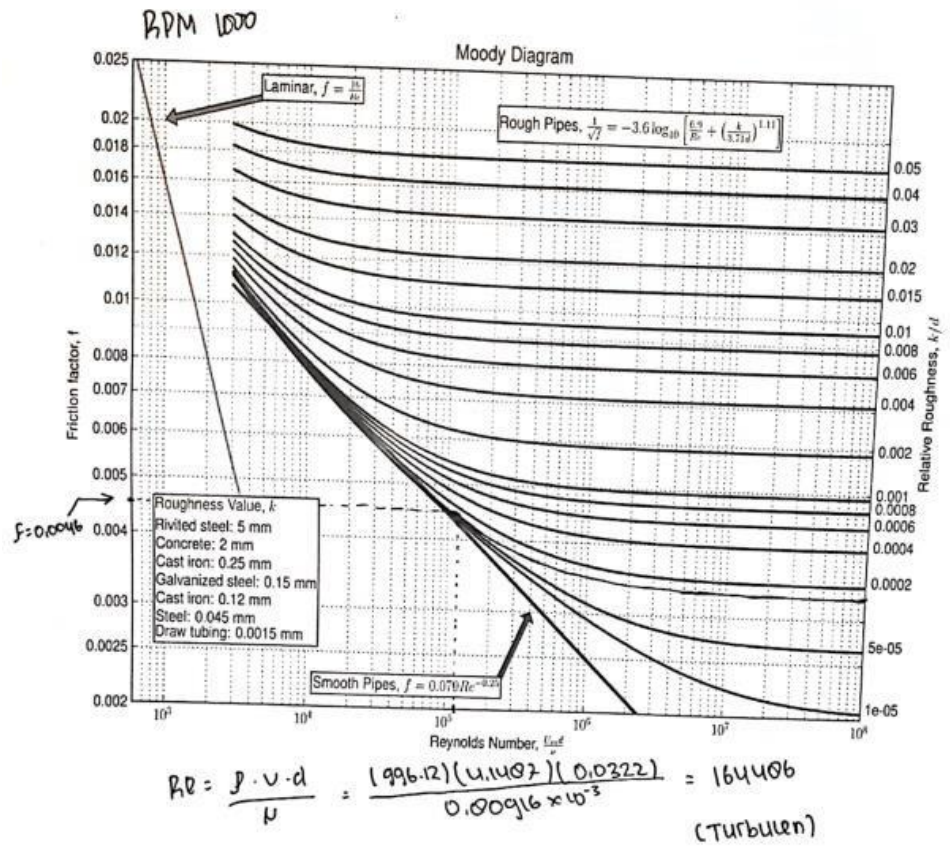
Mencari bilangan Reynold pada rpm 1000

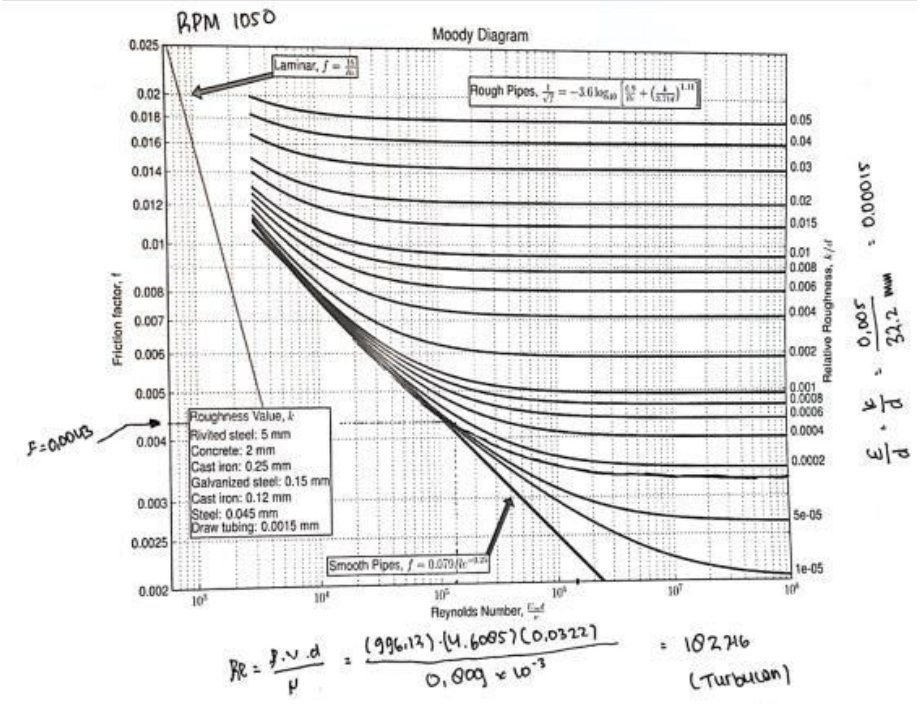
$$Re = \frac{\rho . V . d}{\mu} = \frac{(996{,}12) \cdot (4{,}1487\ m/s) \cdot (0{,}0322\ m)}{0{,}809\times10^{-3}}$$

= 164486 (Turbulen karena Re > 4000)

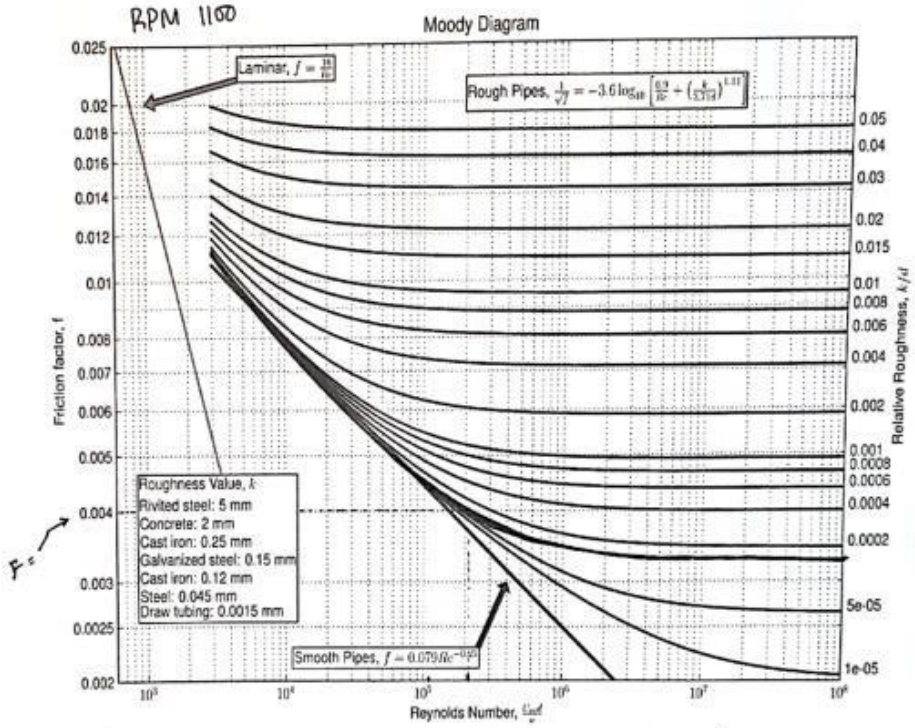
Karena turbulen, maka nilai f dapat dicari dengan diagram moody (lampiran 4 perhitungan)

Langkah 4 mencari nilai f dengan diagram moody





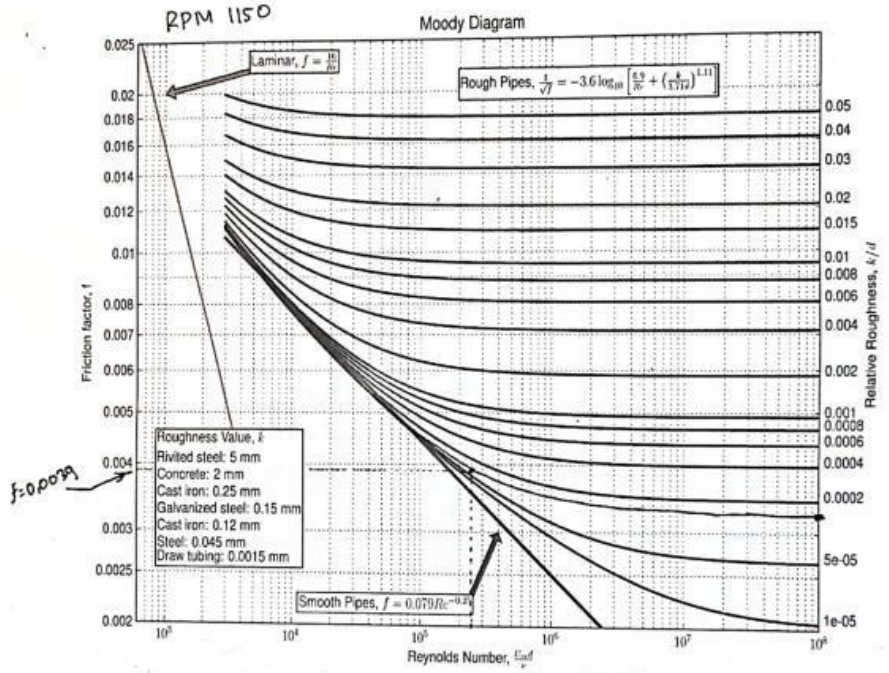
RPM 1100



$\frac{\varepsilon}{d} = \frac{k}{d} = \frac{0,005}{32,2} = 0,00015$

$Re = \frac{\rho \cdot v \cdot d}{\mu} = \frac{(996,12)(5,1027)(0,0322)}{0,809 \times 10^{-3}} = 205482$

RPM 1150



$\frac{\varepsilon}{d} = \frac{k}{d} = \frac{0,005}{32,2} = 0,00015$

$Re = \frac{\rho \cdot v \cdot d}{\mu} = \frac{(996,12)(6,26777)(0,0322)}{0,809 \times 10^{-3}} = 248500$

Langkah 5 memasukkan ke pers. Darcy-Weisbach untuk mendapatkan *head loss major*.

1. Masukkan ke persamaan Darcy-Weisbach untuk mendapatkan nilai *head loss major* pada rpm 1000.

$$Hlp = f.\frac{L}{d}.\frac{V^2}{2g}$$

$$Hlp = 0.0046 \cdot \frac{900\ m}{0.0322\ m} \cdot \frac{4.1487^2\ m/s}{2(9{,}81)\ m/s^2}$$

$$Hlp = 112.789\ m$$

2. Masukkan ke persamaan Darcy-Weisbach untuk mendapatkan nilai *head loss major* pada rpm 1050.

$$Re = \frac{\rho .V.\ d}{\mu} = \frac{(996{,}12) \cdot (4.6085\ m/s) \cdot (0{,}0322\ m)}{0{,}809\times10^{-3}\ kg\ m/s}$$

$$= 182716 \text{ (Turbulen karena Re > 4000)}$$

$$Hlp = f.\frac{L}{d}.\frac{V^2}{2g}$$

$$Hlp = 0.0043 \cdot \frac{900\ m}{0.0322\ m} \cdot \frac{4.6085^2\ m/s}{2(9{,}81)\ m/s^2}$$

$$Hlp = 130.099\ m$$

3. Masukkan ke persamaan Darcy-Weisbach untuk mendapatkan nilai *head loss major* pada rpm 1100.

$$Re = \frac{\rho .V.\ d}{\mu} = \frac{(996{,}12) \cdot (4.6085\ m/s) \cdot (0{,}0322\ m)}{0{,}809\times10^{-3}\ kg\ m/s}$$

$$= 205482 \text{ (Turbulen karena Re > 4000)}$$

$$Hlp = f.\frac{L}{d}.\frac{V^2}{2g}$$

$$Hlp = 0.004 \cdot \frac{900\ m}{0.0322\ m} \cdot \frac{5.1827^2\ m/s}{2(9{,}81)\ m/s^2}$$

$$Hlp = 153.059\ m$$

4. Masukkan ke persamaan Darcy-Weisbach untuk mendapatkan nilai *head loss major* pada rpm 1150.

$$Re = \frac{\rho . V. d}{\mu} = \frac{(996{,}12) \cdot (6.2677\ m/s) \cdot (0{,}0322\ m)}{0{,}809 \times 10^{-3}\ kg\ m/s}$$

= 248500 (Turbulen karena Re > 4000)

$$Hlp = f. \frac{L}{d} . \frac{V^2}{2g}$$

$$Hlp = 0.0039 \cdot \frac{900\ m}{0.0322\ m} \cdot \frac{6.2677^2\ m/s}{2(9{,}81)\ m/s^2}$$

Hlp = 218.257 m

Langkah 5 Memasukkan kepersamaan *head loss minor*

1. Perhitungan *head loss minor* rpm 1000

A. pada *elbow* pertama

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 4.2063 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{4.2063^2\ m/s}{19.62\ m/s^2} = 0{,}126\ m$$

B. pada *elbow* kedua

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 4.2573 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{4.2573^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}129 \text{ m}$$

2. Perhitungan *head loss minor* rpm 1050

A. Pada *elbow* pertama

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 4.6551 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{4.6551^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}154 \text{ m}$$

B. Pada *elbow* kedua

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 4.7181 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{4.6551^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}158 \text{ m}$$

3. Perhitungan *head loss minor* rpm 1100

A. Pada *elbow* pertama

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 5.2441 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{5.2441^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}0196 \text{ m}$$

B. Pada *elbow* kedua

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 5.3043 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{5.3043^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}200 \text{ m}$$

4. Perhitungan *head loss minor* rpm 1100

A. Pada *elbow* pertama

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 6.3486 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{6.3486^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}280 \text{ m}$$

B. Pada *elbow* kedua

$$Hf = k \frac{V^2}{2g}$$

Diketahui :

k = 0,14

V^2 = 6.4257 m/s

g = 9,81 m/s²

Penyelesaian :

$$0{,}14 \cdot \frac{6.4257^2 \text{ m/s}}{19.62 \text{ m/s}^2} = 0{,}294 \text{ m}$$