LAMPIRAN

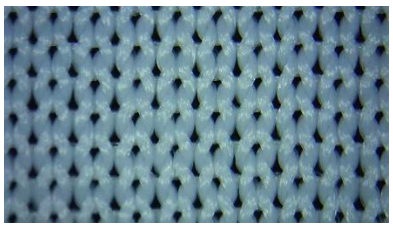
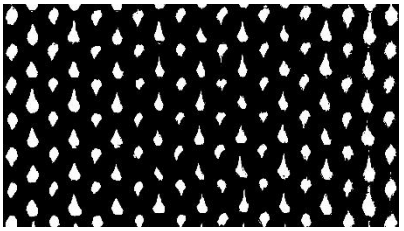
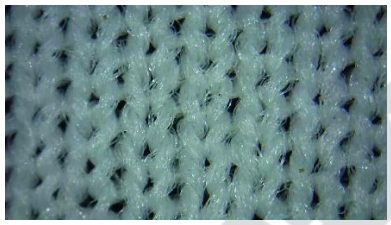
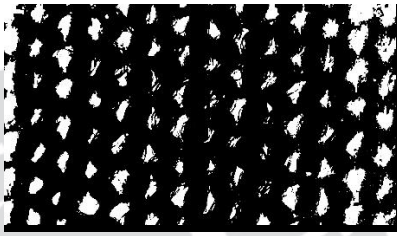
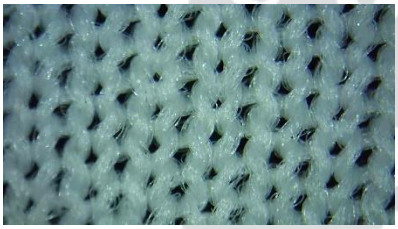
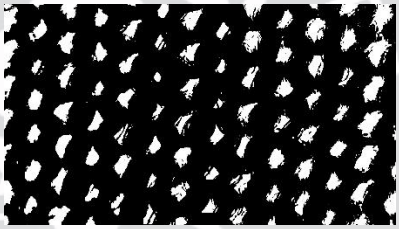
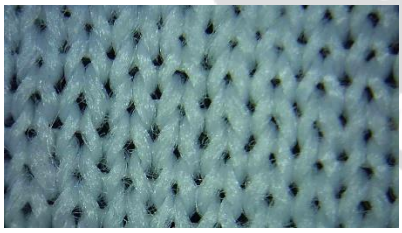
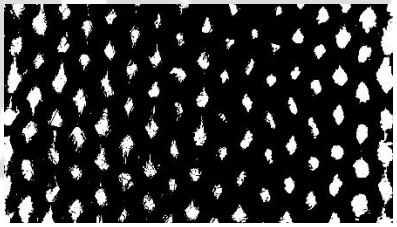
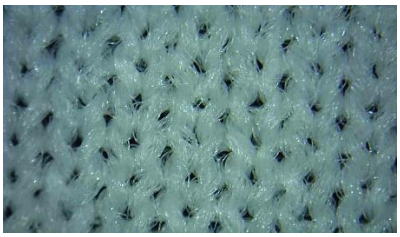
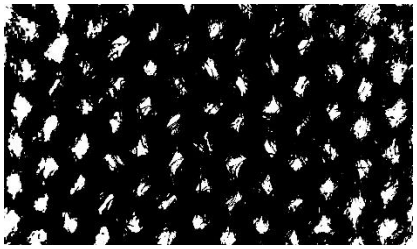
LAMPIRAN A

Lampiran A Pengujian sifat kain

Lampiran A. 1 Pengujian ketebalan kain

No	Gambar Pengujian	Suhu ± 2^0C	RH ± 4 (%)	KETEBALAN (MM)				
				NFOF	NDTF	NTTF	NATF	PSPF
1		27	65	0.424	0.487	0.440	0.442	0.500
2				0.415	0.492	0.451	0.422	0.511
3				0.419	0.480	0.450	0.427	0.492
4				0.419	0.490	0.460	0.431	0.502
5				0.411	0.495	0.450	0.419	0.540
Rata-rata				0.418	0.489	0.450	0.428	0.509
Standar Deviasi				0.00	0.01	0.01	0.01	0.02
cv (%)				1.17	1.17	1.57	2.10	3.65

Lampiran A. 2 Gambar langkah pengujian porositas optik

Sampel	Gambar Mentah	Gambar Binary	Gambar Histogram
NFOF			
NDTF			
NTTF			
NATF			
PSPF			

Porositas optik ditentukan berdasarkan formula di bawah ini:+$Porositas\ optik = \frac{piksel\ putih}{piksel\ putih + piksel\ hitam} \times 100\%$

Lampiran A. 3 Data pengujian porositas optik *nylon fully oriented fabric*

Pegujian ke	piksel hitam	piksel putih	porositas optik (%)
1	1742012	334288	16.10
2	1720477	355823	17.14
3	1710862	365438	17.60
4	1761615	314685	15.16
5	1722470	353830	17.04
6	1692184	384116	18.50
7	1714157	362143	17.44
8	1761959	314341	15.14
9	1724095	352205	16.96
10	1752760	323540	15.58
11	1713662	362638	17.47
12	1769026	307274	14.80
13	1716866	359434	17.31
14	1715664	360636	17.37
15	1729671	346629	16.69
16	1727489	348811	16.80
17	1756893	319407	15.38
18	1711123	365177	17.59
19	1738011	338289	16.29
20	1746425	329875	15.89
Rata-rata			**16.61**

Lampiran A. 4 Data pengujian porositas optik *nylon drawn textured fabric*

Pegujian ke	piksel hitam	piksel putih	porositas optik (%)
1	1704498	371802	17.91
2	1718929	357371	17.21
3	1751939	324361	15.62
4	1743402	332898	16.03
5	1740391	335909	16.18
6	1740823	335477	16.16
7	1706126	370174	17.83
8	1693756	382544	18.42
9	1708014	368286	17.74
10	1702473	373827	18.00
11	1730721	345579	16.64
12	1726324	349976	16.86
13	1711428	364872	17.57
14	1738480	337820	16.27
15	1696681	379619	18.28
16	1759103	317197	15.28
17	1695015	381285	18.36
18	1742104	334196	16.10
19	1748868	327432	15.77
20	1738230	338070	16.28
Rata-rata			**16.93**

Lampiran A. 5 Data pengujian porositas optik *nylon textured twisted fabric*

Pegujian ke	piksel hitam	piksel putih	porositas optik (%)
1	1720331	355969	17.14
2	1722917	353383	17.02
3	1742339	333961	16.08
4	1707844	368456	17.75
5	1705391	370909	17.86
6	1721298	355002	17.10
7	1749362	326938	15.75
8	1728253	348047	16.76
9	1788623	287677	13.86
10	1766057	310243	14.94
11	1767412	308888	14.88
12	1749958	326342	15.72
13	1692184	384116	18.50
14	1761002	315298	15.19
15	1741645	334655	16.12
16	1692184	384116	18.50
17	1760026	316274	15.23
18	1747733	328567	15.82
19	1766428	309872	14.92
20	1749076	327224	15.76
Rata-rata			**16.25**

Lampiran A. 6 Data pengujian porositas optik *nylon air jet textured yarn*

Pegujian ke	piksel hitam	piksel putih	porositas optik (%)
1	1733718	342582	16.50
2	1728567	347733	16.75
3	1734912	341388	16.44
4	1757210	319090	15.37
5	1739968	336332	16.20
6	1729421	346879	16.71
7	1678584	397716	19.16
8	1794314	281986	13.58
9	1709665	366635	17.66
10	1710413	365887	17.62
11	1717762	358538	17.27
12	1756639	319661	15.40
13	1732283	344017	16.57
14	1692184	384116	18.50
15	1739850	336450	16.20
16	1646823	429477	20.68
17	1655314	420986	20.28
18	1681387	394913	19.02
19	1762083	314217	15.13
20	1691540	384760	18.53
Rata-rata			**17.18**

Lampiran A. 7 Data pengujian porositas optik *polyester spun fabric*

Pegujian ke	piksel hitam	piksel putih	porositas optik (%)
1	1760002	316298	15.23
2	1741645	334655	16.12
3	1730721	345579	16.64
4	1726324	349976	16.86
5	1711428	364872	17.57
6	1692184	384116	18.50
7	1646823	429477	20.68
8	1655314	420986	20.28
9	1678584	397716	19.16
10	1692184	384116	18.50
11	1709665	366635	17.66
12	1710413	365887	17.62
13	1717762	358538	17.27
14	1756639	319661	15.40
15	1732283	344017	16.57
16	1646823	429477	20.68
17	1655314	420986	20.28
18	1740391	335909	16.18
19	1740823	335477	16.16
20	1706126	370174	17.83
Rata-rata			**17.29**

Lampiran A. 8 Uji normalitas dan homogenitas porositas optik pada 5 sampel uji

Tests of Normality

	JenisBenang	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Porositas	NFO1	.134	20	.200*	.947	20	.320
	NDT1	.188	20	.063	.921	20	.104
	NTT1	.139	20	.200*	.958	20	.503
	NAT1	.145	20	.200*	.974	20	.835
	PSP1	.115	20	.200*	.937	20	.214

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

Dasar pengambilan keputusan :

Jika nilai sig. > 0.05 maka data berdistribusi normal

Jika nilai sig. < 0.05 maka data berdistribusi tidak nornal

Dapat dilihat bahwa dari ke lima sampel kain uji, nilai sig. pada Kolmogorov smirnov dan Saphiro wilk lebih dari 0.05, maka distribusi data porositas optik kesemua sampel berdistribusi normal.

Lampiran A.8 Uji normalitas dan homogenitas porositas optik pada 5 sampel uji

Test of Homogeneity of Variances

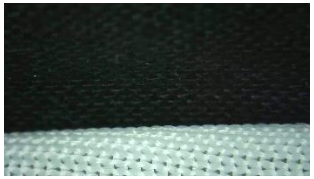
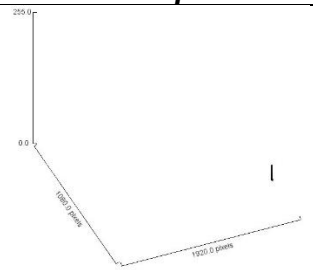
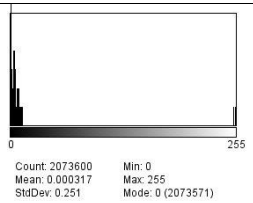
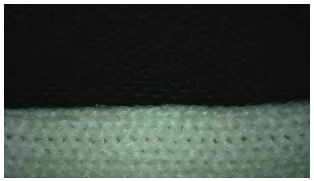
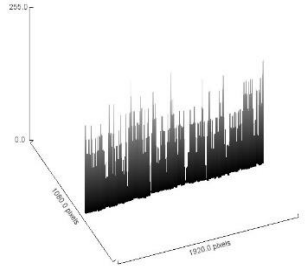
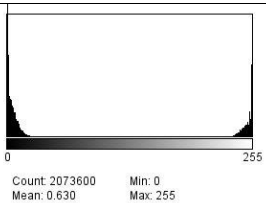
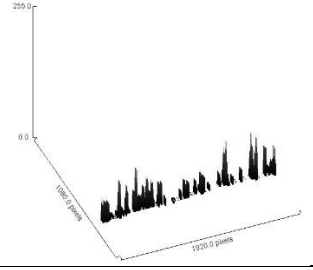
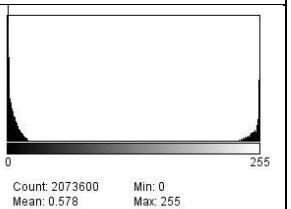
Porositas

Levene Statistic	df1	df2	Sig.
1.893	4	95	.118

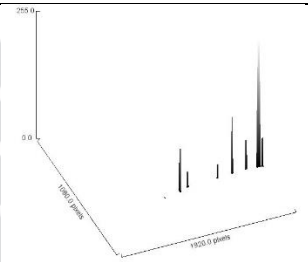
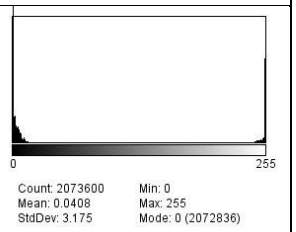
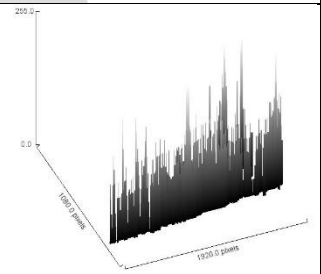
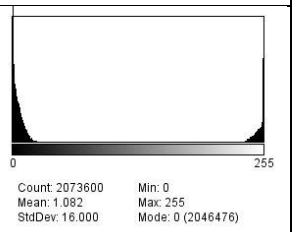
Dasar pengambilan keputusan :
Jika nilai sig. > 0.05 maka data homogen
Jika nilai sig. < 0.05 maka data tidak homogen

Dapat dilihat bahwa nilai sig. dari tabel **Test of Homogeneity of Variances** bernilai lebih dari 0.05, maka diasumsikan varians data homogen.

Lampiran A. 9 Gambar langkah pengujian *fuzzy level* dan tinggi relatif *fuzzy*

Sampel	Gambar Mentah	Gambar Binary	Gambar Fuzziness	Gambar 3D Permukaan *fuzziness*	Gambar Histogram
NFOF					
NDTF					
NTTF					

Lampiran A.9 Gambar langkah pengujian *fuzzy level* dan tinggi relatif *fuzzy* (lanjutan)

Sampel	**Gambar Mentah**	**Gambar Binary**	**Gambar Fuzziness**	**Gambar 3D Permukaan *fuzziness***	**Gambar Histogram**
NATF					
PSPF					

Lampiran A. 10 Data pengujian *fuzzy level* dan tinggi relatif *fuzzy*

Sampel	Piksel Hitam	Piksel Putih	Rata-Rata Piksel Putih	Standar Deviasi	Koefisien Variasi %)	*Fuzzy* Level	Tinggi Relatif *Fuzzy* (piksel)	Tinggi Relatif *Fuzzy* (mm)
NFOF	2073571.00	29.00	74.00	45.00	0.61	0.36	0.07	0.00
	2073481.00	119.00						
	2073526.00	74.00						
NDTF	2059899.00	13701.00	13423.50	277.50	0.02	64.60	12.43	0.06
	2060454.00	13146.00						
	2060176.50	13423.50						
NTTF	2059786.00	13814.00	8440.00	5374.00	0.64	40.62	7.81	0.04
	2070534.00	3066.00						
	2065160.00	8440.00						
NATF	2072836.00	764.00	6393.00	5629.00	0.88	30.77	5.92	0.03
	2061578.00	12022.00						
	2067207.00	6393.00						
PSPF	2046046.00	27554.00	26516.00	1038.00	0.04	127.60	24.55	0.12
	2048122.00	25478.00						
	2047084.00	26516.00						

Diketahui : 1 mm = 207.8 piksel

lebar gambar = 1080 piksel

Perhitugan *fuzzy level* : $fuzzy\ level = \frac{piksel\ putih}{piksel/mm}$

Perhitungan tinggi relatif *fuzzy* tinggi relatif $fuzzy = \frac{piksel\ putih}{piksel\ lebar\ gambar/207.8}$

LAMPIRAN B

Lampiran B Aerodinamika

Lampiran B. 1 Tabel nilai viskositas dinamik dan kinematik

Temperature	**Dynamic Viscosity**				**Kinematic Viscosity**	
[°C]	**[µPa s], [N s/m^2 *10^{-6}]**	**[cP], [mPa s]**	**[lb$_f$ s/ft^2 *10-6]**	**[lb$_m$ /ft h]**	**[cSt], [m^2/s *10^{-6}]**	**[ft^2/s*10^{-4}]**
-75	13.18	0.01318	0.2753	0.03188	7.40	0.796
-50	14.56	0.01456	0.3041	0.03523	9.22	0.992
-25	15.88	0.01588	0.3317	0.03842	11.18	1.203
-15	16.40	0.01640	0.3425	0.03966	12.01	1.292
-10	16.65	0.01665	0.3477	0.04028	12.43	1.338
-5	16.90	0.01690	0.3530	0.04089	12.85	1.383
0	17.15	0.01715	0.3582	0.04149	13.28	1.430
5	17.40	0.01740	0.3633	0.04209	13.72	1.477
10	17.64	0.01764	0.3685	0.04268	14.16	1.524
15	17.89	0.01789	0.3735	0.04327	14.61	1.573
20	18.13	0.01813	0.3786	0.04385	15.06	1.621

Lampiran B. 2 Tabel nilai viskositas dinamik dan kinematik (lanjutan)

Temperature	**Dynamic Viscosity**				**Kinematic Viscosity**	
[°C]	**[µPa s], [N s/m^2 *10^{-6}]**	**[cP], [mPa s]**	**[lb$_f$ s/ft^2 *10 -6]**	**[lb$_m$ /ft h]**	**[cSt], [m^2/s *10^{-6}]**	**[ft^2/s*10^{-4}]**
25	18.37	0.01837	0.3836	0.04443	15.52	1.671
30	18.60	0.01860	0.3885	0.04500	15.98	1.7s\x20
40	19.07	0.01907	0.3983	0.04614	16.92	1.822
50	19.53	0.01953	0.4080	0.04725	17.88	1.925
60	19.99	0.01999	0.4175	0.04835	18.86	2.030
80	20.88	0.02088	0.4361	0.05051	20.88	2.248
100	21.74	0.02174	0.4541	0.05260	22.97	2.473
125	22.79	0.02279	0.4760	0.05513	25.69	2.765
150	23.80	0.02380	0.4971	0.05758	28.51	3.069

Lampiran B. 3 Tabel nilai viskositas dinamik dan kinematik (lanjutan

Temperature	**Dynamic Viscosity**				**Kinematic Viscosity**	
[°C]	**[µPa s], [N s/m^2 *10^{-6}]**	**[cP], [mPa s]**	**[lb$_f$ s/ft^2 * 10-6]**	**[lb$_m$ /ft h]**	**[cSt], [m^2/s *10^{-6}]**	**[ft^2/s*10^{-4}]**
175	24.78	0.02478	0.5176	0.05995	31.44	3.384
200	25.73	0.02573	0.5374	0.06225	34.47	3.710
300	29.28	0.02928	0.6115	0.07083	47.54	5.117
412	32.87	0.03287	0.6865	0.07952	63.82	6.869
500	35.47	0.03547	0.7409	0.08581	77.72	8.366
600	38.25	0.03825	0.7988	0.09252	94.62	10.19
700	40.85	0.04085	0.8532	0.09883	112.6	12.12
800	43.32	0.04332	0.9047	0.1048	131.7	14.17
900	45.66	0.04566	0.9535	0.1104	151.7	16.33
1000	47.88	0.04788	1.000	0.1158	172.7	18.59

- 1 kg/(m s) = 1 (N s)/m^2 = 1 Pa s = 10 P = 1000 cP = 0.672197 lb/(ft s) = 2419.09 lb/(ft h)

Lampiran B. 4 Pemodelan nilai $C_{d\ min}$ sebagai fungsi dari parameter nilai *fuzzy* level dan tinggi relatif *fuzzy*

Pada pemodelan ini telah diuraikan hubungan $C_{d\ min}$ Sebagai Fungsi Dari Parameter Nilai *Fuzzy* Level & Tingkat Tinggi Relatif *Fuzzy* pada bahan tekstil menggunakan metode fitting data sesuai dengan model pada persamaan (B.1).

$$Cd_{min} = a\ l_{fuzzy\ level}{}^{b}\ l_{fuzzy\ relative}{}^{c} \tag{B.1}$$

Nilai a, b dan c adalah suatu konstanta tertentu yang didapatkan melalui metode optimasi. Parameter yang digunakan yaitu $l_{fuzzy\ level}$, $l_{fuzzy\ relative}$ dan Cd_{min} . Untuk mendapatkan hasil persamaan (A.1) dimodelkan dalam perhitungan sesuai pada persamaan (B.4):

$$\sum_{i=1}^{n} \hat{y}_i = a_o + a_1 \sum x_{i1} + a_2 \sum x_{i2} + a_3 \sum x_{i3}$$

$$\begin{aligned} \hat{y}_1 &= a_o + a_1 x_{11} + a_2 x_{12} + a_3 x_{13} \\ \hat{y}_2 &= a_o + a_1 x_{21} + a_2 x_{22} + a_3 x_{23} \\ \hat{y}_n &= a_o + a_1 x_{n1} + a_2 x_{n2} + a_3 x_{n3} \end{aligned} \tag{B.2}$$

$$\begin{pmatrix} \hat{y}_1 \\ \vdots \\ \hat{y}_n \end{pmatrix} = \begin{pmatrix} 1 & \dots & x_{1k} \\ 1 & \ddots & \vdots \\ 1 & \dots & x_{nk} \end{pmatrix} \begin{pmatrix} a_0 \\ \vdots \\ a_k \end{pmatrix} \tag{B.3}$$

$$\hat{y}_i = x_{ik}\ a_k$$

$$\hat{\boldsymbol{y}} = \boldsymbol{Xa} \tag{B.4}$$

Selisih antara data eksperimen dengan data prediksi pemodelan disebut sebagai error ϵ dan memiliki nilai sebesar berikut:

$$\sum_{i=1}^{n} (y_i - \hat{y}_i) = \epsilon \tag{B.5}$$

Jika persamaan (A.5) dikuadratkan, maka akan menghasilkan persamaan (A.6).

$$\epsilon^T \epsilon = \epsilon^2 = L \tag{B.6}$$

Untuk mencari nilai a maka dapat dilakukan optimasi melalui diferensial persamaan (A.7) terhadap a.

$$L = \epsilon^T \epsilon = \sum (y_i - \hat{y}_i)^T (y_i - \hat{y}_i) \tag{B.7}$$

$$\begin{aligned} L = \epsilon^T \epsilon &= (y - Xa)^T (y - Xa) = (y^T - a^T X^T)(y - Xa) \\ &= y^T y - y^T Xa - a^T X^T y + a^T X^T Xa \\ &= y^T y - y^T Xa - (y^T Xa)^T + a^T X^T Xa \end{aligned} \tag{B.8}$$

$$\begin{aligned} \frac{dL}{da} &= \frac{d}{da}(y^T y - y^T Xa - (y^T Xa)^T + a^T X^T Xa) \\ &= -2y^T X + 2a^T X^T X = 0 \end{aligned} \tag{B.9}$$

$$2y^T X = 2a^T X^T X$$

$$a^T X^T X = y^T X \text{ dengan } a^T = (X^T X)^{-1} y^T X \tag{B.10}$$

$$(a^T X^T X)^T = (y^T X)^T \tag{B.11}$$

$$(X^T X)a = X^T y \tag{B.12}$$

$$a = (X^T X)^{-1} X^T y \tag{B.13}$$

$$\begin{aligned} \hat{y} &= Xa \\ &= X(X^T X)^{-1} X^T y \end{aligned} \tag{B.14}$$

Persamaan (A.14) digunakan untuk menyelesaikan persamaan eksponensial tersebut serta mengacu pada persamaan (A.3) maka dapat dituliskan seperti pada persamaan (A.15) dan (A.16) di bawah ini.

$$Cd_{min} = a \, l_{fuzzy\ level}{}^{b} \, l_{fuzzy\ relative}{}^{c} \tag{B.15}$$

$$\ln Cd_{min} = \ln a + b \ln l_{fuzzy\ level} + c \ ln \ l_{fuzzy\ relative} \tag{B.16}$$

$$Y = A + BX_1 + CX_2 \tag{B.17}$$

$$\begin{pmatrix} \hat{y}_1 \\ \hat{y}_2 \\ \hat{y}_3 \end{pmatrix} = \begin{pmatrix} 1 & \ln(64.6) & \ln(0.06) \\ 1 & \ln(40.62) & \ln(0.04) \\ 1 & \ln(30.77) & ln(0.03) \end{pmatrix} \begin{pmatrix} a \\ b \\ c \end{pmatrix} \tag{B.18}$$

Dengan menggunakan pemrograman MATLAB maka didapatkan persamaan (A.19) dengan $a = e^A$ dan seterusnya.

$$Cd_{min} = 1.07239\ l_{fuzzy\ level}{}^{0.07272}\ l_{fuzzy\ relative}{}^{0.13838} \tag{B.19}$$