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LAMPIRAN I

A. HASIL PENGUJIAN TARIK

B. HASIL PENGUJIAN BENDING

C. HASIL PENGUJIAN IMPAK

A. HASIL PENGUJIAN TARIK

1. Hasil Uji Tarik Perendaman Air Sungai

Nama Spesimen	Waktu Perendaman	Tegangan (MPa)			Regangan (%)			Modulus Elastisitas (MPa)		
		1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis
Normal	0	32,14	44,77	61,28	1,32%	1,56%	1,96%	3407,32	3928,72	4260,18
AS-T10	2	38,00	53,70	38,01	1,64%	1,43%	1,11%	2757,31	3701,69	3485,38
AS-T10	4	44,93	47,25	39,91	1,42%	2,01%	1,47%	4476,43	4128,48	3997,80
AS-T10	6	35,68	46,69	35,68	1,41%	1,31%	1,40%	3475,97	3825,05	2737,25
AS-T10	8	33,84	32,65	33,84	1,92%	1,32%	1,58%	2737,25	3306,30	3073,50
AS-T20	2	33,21	54,41	58,75	2,81%	1,62%	1,16%	2948,40	3908,37	4116,41
AS-T20	4	47,06	43,59	49,31	1,35%	1,32%	1,62%	2668,36	4624,14	3923,35
AS-T20	6	38,20	43,76	46,33	1,60%	2,65%	1,27%	3256,77	3391,51	4495,16
AS-T20	8	36,85	42,83	40,63	1,80%	1,59%	1,45%	3207,80	3999,93	3404,84
AS-T30	2	38,01	44,59	59,38	2,59%	1,36%	2,16%	3401,33	3950,29	2317,02
AS-T30	4	39,91	50,15	52,33	1,88%	1,70%	2,01%	3127,40	3429,21	3619,03
AS-T30	6	35,68	46,49	45,53	1,29%	1,50%	1,72%	2759,59	4682,42	3586,57
AS-T30	8	33,84	45,18	41,90	1,61%	1,66%	1,35%	2877,81	3894,21	3826,59

2. Hasil Uji Tarik Perendaman Air Limbah rumah Tangga

Nama Spesimen	Waktu Perendaman	Tegangan (MPa)			Regangan (MPa)			Modulus Elastisitas (MPa)		
		1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis
Normal	0	32,14	44,77	61,28	1,32%	1,56%	1.96%	3193,77	3928,72	4430,80
LRT-T80	2	35,72	49,91	61,30	1,37%	1,79%	2.09%	3049,97	4587,25	4106,79
LRT-T80	4	32,13	47,89	56,68	1,70%	1,60%	1.54%	2994,67	3911,39	3261,83
LRT-T80	6	27,11	38,76	38,30	1,43%	1,25%	1.23%	2755,06	4048,82	4423,04
LRT-T80	8	26,26	32,30	37,11	0,99%	0,99%	1.44%	2964,90	4105,56	4498,78
LRT-T90	2	41,14	51,03	64,32	1,48%	1,62%	2.23%	3205,30	4272,95	4011,71
LRT-T90	4	37,83	50,68	58,78	1,48%	2,32%	3.00%	3056,28	3063,92	2971,90
LRT-T90	6	28,00	43,19	55,98	1,02%	1,55%	1.71%	3639,56	3638,66	4597,57
LRT-T90	8	24,58	41,94	45,36	1,03%	1,42%	1.37%	3048,27	3818,64	3945,28
LRT-T100	2	32,59	49,23	63,77	1,52%	1,38%	2.04%	2927,52	3776,91	4198,69
LRT-T100	4	36,62	51,70	52,81	1,79%	1,94%	1.96%	3306,93	3740,14	3486,24
LRT-T100	6	31,17	46,43	44,84	1,19%	1,09%	1.14%	3261,59	4486,53	4360,94
LRT-T100	8	28,69	41,71	31,75	1,26%	1,04%	1.10%	2977,29	3630,43	3859,86

B. HASIL PENGUJIAN BENDING

1. Hasil Uji Bending Perendaman Air Sungai

Nama Spesimen	Waktu Perendaman	Tegangan (MPa)			Regangan (%)			Modulus Elastisitas (MPa)		
		1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis
Normal	0	51,40	78,82	68,78	2,8%	3,5%	2,8%	2731,06	4202,93	4739,40
AS-B10	2	61,12	86,82	79,52	2,3%	3,2%	1,4%	2813,83	5814,17	8004,88
AS-B10	4	60,65	67,10	82,96	2,6%	1,6%	2,0%	3159,31	5350,35	5657,55
AS-B10	6	50,02	63,08	70,54	2,9%	1,6%	1,8%	2552,87	5166,77	5340,47
AS-B10	8	48,52	54,89	66,68	1,9%	2,1%	3,0%	2587,20	4862,03	5751,19
AS-B20	2	81,91	79,91	73,75	3,4%	2,1%	2,4%	3185,14	5056,13	5274,31
AS-B20	4	75,80	69,00	84,73	2,7%	2,2%	2,3%	3181,58	5006,75	6500,72
AS-B20	6	68,39	63,08	79,94	3,0%	2,6%	1,7%	3243,33	5417,42	6888,24
AS-B20	8	62,90	60,72	74,89	2,4%	1,1%	2,1%	3370,32	6336,67	6219,00
AS-B30	2	59,92	84,13	69,22	3,0%	2,0%	2,6%	2757,76	4776,89	5639,14
AS-B30	4	62,09	80,35	71,78	3,1%	3,4%	1,9%	2357,96	4092,43	5999,38
AS-B30	6	72,70	60,05	56,91	3,3%	1,8%	2,5%	2655,38	4246,69	5091,18
AS-B30	8	62,63	50,22	46,80	3,1%	1,7%	2,8%	2361,58	3725,65	3497,64

2. Hasil Uji Bending Perendaman Air Limbah Rumah Tangga

Nama Spesimen	Waktu Perendaman	Tegangan (MPa)			Regangan (%)			Modulus Elastisitas (MPa)		
		1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis	1 lapis	2 lapis	3 lapis
Normal	0	57,41	78,82	87,10	3,47%	3,46%	2,87%	2791,56	4983,29	5645,06
LRT-B80	2	62,92	83,66	98,19	2,17%	2.15%	2,57%	3063,07	5707,18	7781,25
LRT-B80	4	69,53	74,50	76,59	2,29%	2,34%	1,97%	3211,35	5728,19	6422,03
LRT-B80	6	62,35	68,41	56,59	4,62%	2,12%	1,28%	1804,78	4812,74	6250,19
LRT-B80	8	54,79	58,94	54,12	2,46%	1,49%	1,16%	2477,27	4666,24	5622,64
LRT-B90	2	65,53	79,84	73,75	2,68%	2,74%	2,03%	2680,91	3951,31	7857,07
LRT-B90	4	59,30	68,00	91,87	2,27%	1,83%	2,12%	2908,59	4666,68	6640,87
LRT-B90	6	54,88	64,96	81,03	3,29%	1,83%	2,51%	2180,23	4663,77	5840,75
LRT-B90	8	46,21	55,76	73,28	1,80%	2,20%	2,76%	2848,76	4022,40	5030,07
LRT-B100	2	59,77	80,42	62,42	1,74%	3,09%	2,75%	3658,11	3671,92	7437,88
LRT-B100	4	54,83	80,26	66,31	2,14%	2,00%	1,98%	2920,09	5603,65	4096,06
LRT-B100	6	52,47	68,49	62,71	3,21%	2,06%	1,67%	1963,64	4041,95	5754,35
LRT-B100	8	50,90	55,68	58,38	1,86%	2,00%	1,81%	2867,15	3676,53	4659,02

C. HASIL PENGUJIAN IMPAK

1. Hasil Uji Impak Perendaman Air Sungai

Nama Spesimen	Waktu Perendaman	Kekuatan Impak (kJ/m^2)		
		1 lapis	2 lapis	3 lapis
Normal	0	8,85	13,68	15,71
AS-I10	2	9,58	15,01	14,35
AS-I10	4	7,41	8,75	6,51
AS-I10	6	6,95	6,95	8,69
AS-I10	8	6,78	6,34	6,23
AS-I20	2	9,26	1,07	9,66
AS-I20	4	8,62	9,53	9,28
AS-I20	6	7,88	9,94	9,01
AS-I20	8	5,56	7,42	9,47
AS-I30	2	9,75	6,97	1,55
AS-I30	4	7,53	5,37	6,97
AS-I30	6	9,05	5,95	8,06
AS-I30	8	5,82	4,39	7,57

2. Hasil Uji Impak Perendaman Air Limbah Rumah Tangga

Nama Spesimen	Waktu Perendaman	Kekuatan Impak (kJ/m^2)		
		1 lapis	2 lapis	3 lapis
Normal	0	8,85	14,55	15,71
LRT-I80	2	7,86	10,72	11,29
LRT-I80	4	6,27	11,54	7,56
LRT-I80	6	6,01	7,43	4,02
LRT-I80	8	3,18	6,34	4,69
LRT-I90	2	9,32	11,23	10,32
LRT-I90	4	7,23	9,88	8,76
LRT-I90	6	4,15	9,51	8,67
LRT-I90	8	10,29	6,39	8,56
LRT-I100	2	11,88	13,74	10,90
LRT-I100	4	8,00	9,76	7,96
LRT-I100	6	7,99	4,86	5,86
LRT-I100	8	6,39	4,07	5,29

LAMPIRAN II

A. Menghitung Volume Cetakan

B. Rasio epoksi dan hardener

C. Menghitung Volume serat

A. Menghitung Volume Cetakan

$$V_c = P \times l \times t$$

Dimana: P = Panjang

l = Lebar

t = Tebal

Diketahui:

p = 250 mm

l = 250 mm

t = 4 mm

V_c= 250 x 250 x 4 mm

= 250 cm^3

B. Rasio epoksi dan hardener yang digunakan

a. Resin = 60 %

b. Hardener = 40 %

C. Menghitung Volume serat (Vf)

Vf = p x l x t

Vf = 250 x250 x 1 mm

= 62500 mm^3

= 62.5 cm^3

Dari hasil perhitungan volume matrik (Vm), maka dapat ditentukan perbandingan resin dan hardener sebagai berikut :

a. Resin = 62.5 cc x 0,6 %

= 37.5 cc

= 38 cc

Untuk menetukan volume resin pada setiap lapisan maka dapat dihitung sebagai berikut:

Jumlah lapisan anyam = 1 Lapis

Jumlah lapisan matrik = 2 lapis

Jadi = $\frac{38}{2}$

= 19

= 20 cc

b. Hardener = 62.5 cc x 0.4 %

= 25 cc

Untuk menentukan volume hardener pada setiap lapisan, maka dapat dihitung sebagai berikut:

Jadi $= \frac{25}{2}$

$= 12.5$

$= 13$ cc

Jadi total volume resin + hardener pada setiap lapisan 38 cc

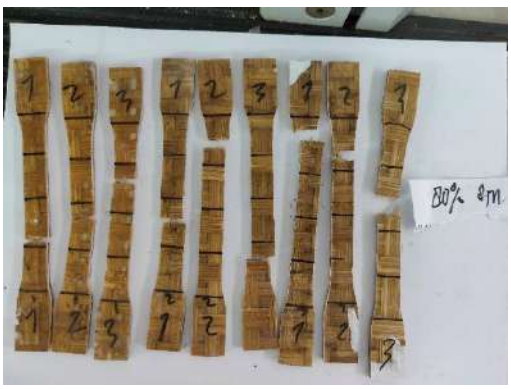
LAMPIRAN III

A. SPESIMEN UJI TARIK

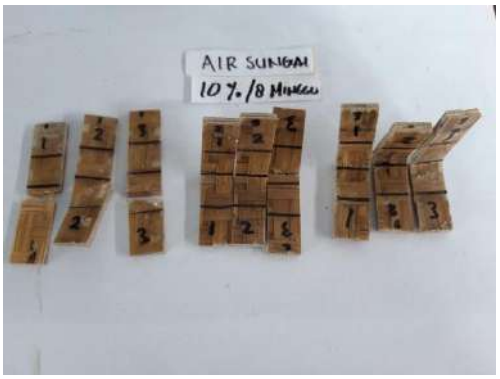
B. SPESIMEN UJI BENDING

C. SPESIMEN UJI IMPAK

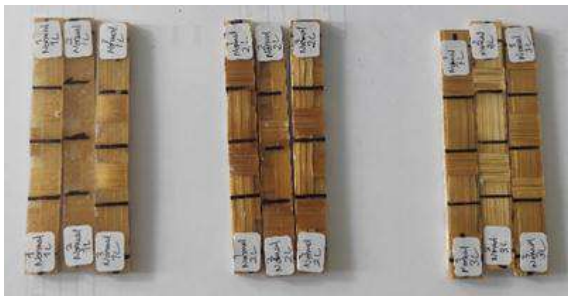
A. SPESIMEN UJI TARIK



B. SPESIMEN UJI BENDING

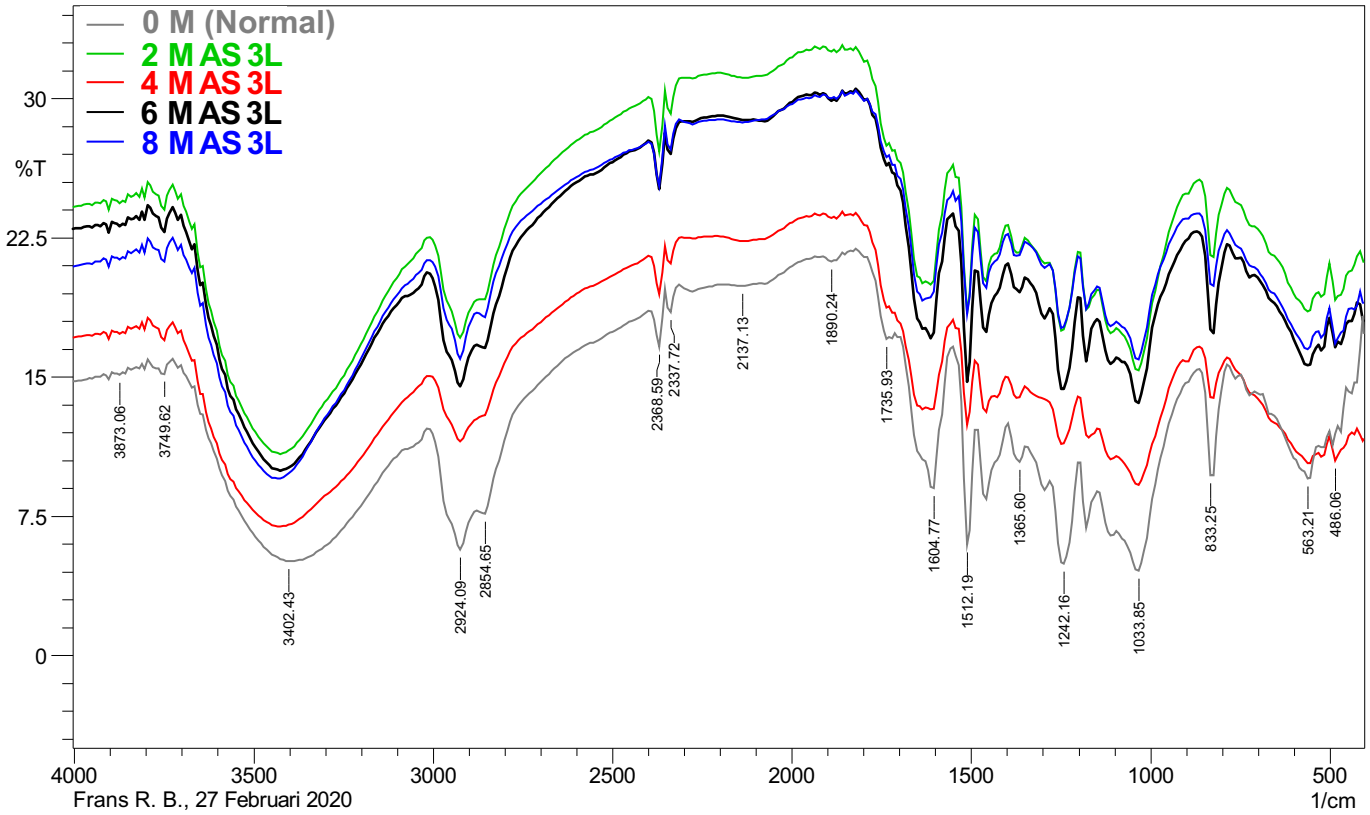


C. SPESIMEN UJI IMPAK



LAMPIRAN IV

A. Hasil Uji FTIR Perendaman Air Sungai Salinitas 30 PPM
B. Hasil Uji FTIR Perendaman Air Limbah Rumah Tangga



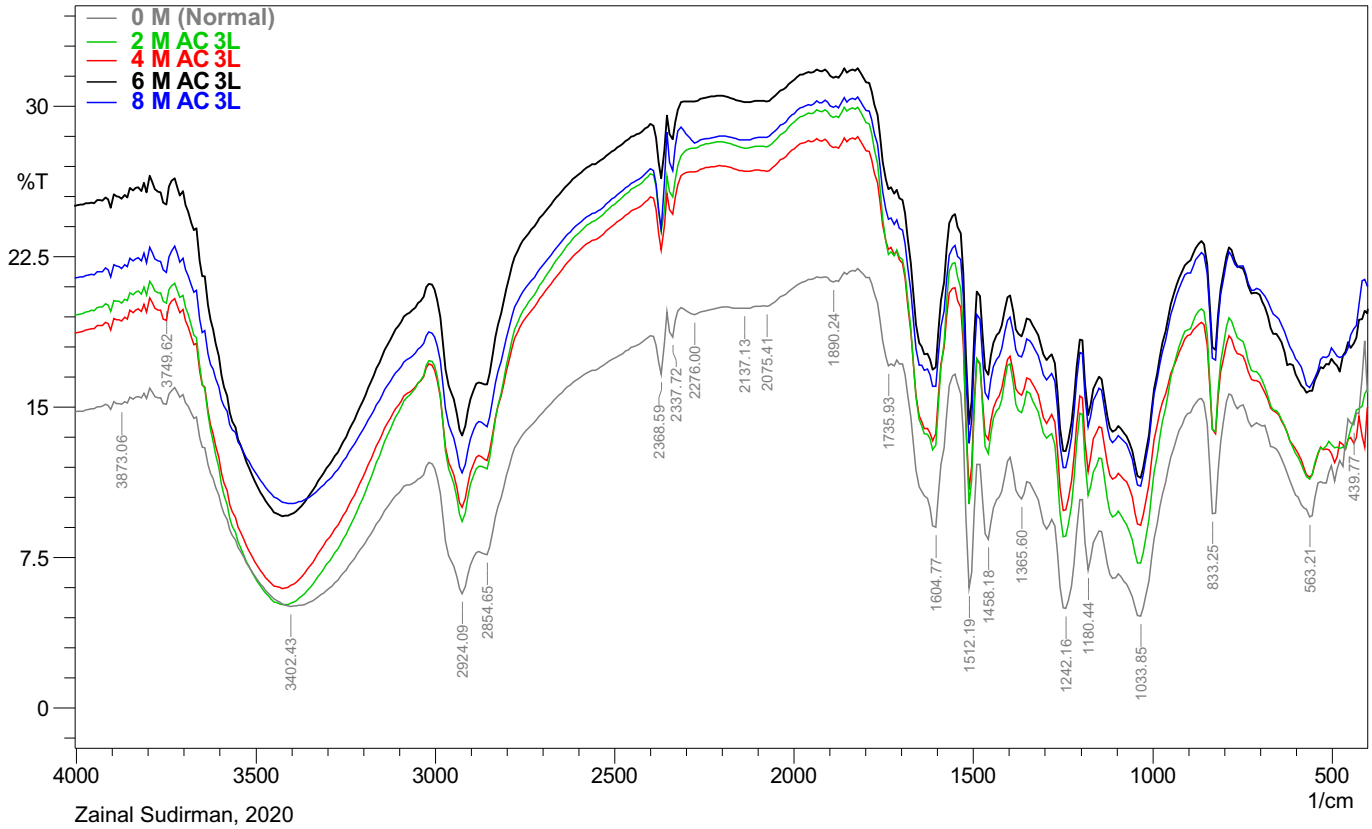
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	308.61	2.469	22.491	316.33	293.18	28.547	13.907
2	354.9	1.164	17.044	370.33	347.19	27.783	10.552
3	401.19	17.923	2.052	416.62	370.33	32.702	1.113
4	470.63	16.742	1.764	501.49	424.34	58.251	1.941
5	563.21	15.637	1.455	709.8	540.07	127.431	2.383
6	825.53	17.344	5.113	871.82	786.96	58.666	3.615
7	1033.85	13.573	4.156	1087.85	879.54	154.484	5.708
8	1180.44	15.842	3.022	1195.87	1149.57	35.395	1.553
9	1249.87	14.333	4.341	1273.02	1203.58	55.169	4.887
10	1288.45	18.386	0.491	1342.46	1280.73	44.533	0.508
11	1365.6	19.55	1.047	1396.46	1350.17	32.397	0.692
12	1458.18	17.415	3.34	1481.33	1404.18	55.417	2.874
13	1512.19	14.721	7.157	1550.77	1489.05	44.376	3.81
14	1612.49	17.068	8.003	1813.09	1558.48	161.697	15.688
15	2075.41	28.76	0.31	2098.55	1959.68	73.758	0.26
16	2121.7	28.821	0.063	2198.85	2106.27	49.896	0.053
17	2276	28.735	0.055	2283.72	2206.57	41.55	0.01
18	2337.72	26.987	1.388	2353.16	2314.58	21.433	0.396
19	2368.59	25.103	2.841	2391.73	2353.16	22.241	0.88
20	2854.65	16.557	0.683	2877.79	2399.45	298.432	0.283
21	2924.09	14.487	3.384	3008.95	2885.51	96.341	5.535
22	3425.58	9.944	11.625	3664.75	3016.67	547.584	112.964
23	[illegible]	[illegible]798	1.117	3788.19	3734.19	34.008	0.487
24		1	0.291	3888.49	3849.92	24.43	0.139
		nsity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1		5	19.88	316.33	293.18	20.282	6.952
2		6	11.843	370.33	347.19	25.675	8.271
3		41	1.346	424.34	378.05	41.906	1.427
4		71	1.343	501.49	447.49	51.548	1.473
5		6	0.808	779.24	540.07	215.345	3.959

Com

Frans R. B., 27 Februari 2020

6	825.53	13.859	2.477	864.11	786.96	63.063	2.291
7	894.97	15.817	0.36	910.4	871.82	30.538	0.161
8	1033.85	9.185	3.059	1087.85	910.4	164.84	8.414
9	1172.72	11.714	1.326	1195.87	1149.57	42.509	1.296
10	1249.87	11.38	2.685	1342.46	1203.58	122.845	4.783
11	1373.32	13.87	0.86	1396.46	1350.17	39.286	0.723
12	1427.32	13.89	0.326	1435.04	1404.18	25.956	0.162
13	1458.18	13.106	1.516	1481.33	1442.75	33.332	1.094
14	1512.19	12.422	4.268	1550.77	1489.05	50.648	2.836
15	1612.49	13.248	0.644	1620.21	1558.48	50.141	0.674
16	2137.13	22.294	0.585	2206.57	1959.68	158.85	1.835
17	2276	22.432	0.1	2306.86	2214.28	59.953	0.061
18	2337.72	21.089	1.124	2353.16	2314.58	25.544	0.408
19	2368.59	19.451	2.344	2391.73	2353.16	26.464	0.938
20	2924.09	11.511	4.435	3008.95	2399.45	470.623	18.281
21	3425.58	6.916	9.776	3726.47	3016.67	699.846	142.394
22	3749.62	16.956	0.861	3788.19	3734.19	40.914	0.507
23	3873.06	17.305	0.224	3888.49	3849.92	29.269	0.143
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	316.33	1.854	9.045	339.47	308.61	41.352	10.953
2	354.9	7.575	13.587	370.33	347.19	19.549	3.925
3	401.19	20.899	1.184	416.62	370.33	30.899	0.753
4	486.06	19.122	2.046	501.49	424.34	53.601	1.799
5	563.21	18.514	1.513	779.24	540.07	160.375	3.131
6	825.53	21.453	3.887	856.39	786.96	43.711	2.268
7	894.97	24.851	0.153	902.69	864.11	23.014	0.02
8	1033.85	15.333	4.393	1087.85	910.4	127.006	6.747
9	1180.44	18.62	2.393	1195.87	1149.57	33.097	1.232
10	1249.87	17.486	3.894	1280.73	1203.58	55.287	3.732
11	1365.6	21.693	1.018	1396.46	1350.17	30.389	0.635
12	1458.18	20.139	3.239	1481.33	1404.18	51.387	2.558
13	1512.19	18.461	6.273	1550.77	1489.05	40.106	2.805
14	1612.49	19.965	0.876	1620.21	1558.48	39.294	0.425
15	2137.13	31.098	0.592	2198.85	1959.68	119.73	1.397
16	2276	31.068	0.11	2299.15	2206.57	46.8	0.036
17	2337.72	29.17	1.511	2353.16	2314.58	20.122	0.398
18	2368.59	27.129	3.107	2391.73	2353.16	20.932	0.892
19	2862.36	19.157	0.199	2870.08	2399.45	273.069	0.082
20	2924.09	17.09	3.24	3008.95	2877.79	94.283	4.464
21	3425.58	10.844	12.09	3664.75	3016.67	527.841	112.151
22	3749.62	23.988	1.148	3788.19	3734.19	32.84	0.482
23	3873.06	24.345	0.304	3888.49	3849.92	23.557	0.136
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	300.9	7.153	10.741	316.33	293.18	21.392	3.874
2	354.9	2.271	19.725	370.33	324.04	56.795	26.337
3	486.06	16.797	1.871	501.49	447.49	40.747	1.373
4	563.21	16.472	1.449	779.24	540.07	171.266	3.075
5	825.53	19.881	3.458	864.11	786.96	51.033	2.207
6	887.26	23.523	0.095	894.97	871.82	14.448	0
7	1033.85	15.933	3.646	1087.85	910.4	126.601	4.94
8	1180.44	18.654	2.224	1195.87	1149.57	32.974	1.097
9	1249.87	17.636	3.587	1280.73	1203.58	55.262	3.418
10	1373.32	21.531	0.957	1396.46	1350.17	30.598	0.565
11	1458.18	19.786	2.956	1481.33	1404.18	52.038	2.349
12	1512.19	18.362	5.4	1550.77	1489.05	40.797	2.423
13	1620.21	19.225	6.887	1789.94	1558.48	144.722	13.581
14	2137.13	28.706	0.452	2198.85	1959.68	128.096	1.139
15	2276	28.603	0.21	2306.86	2206.57	54.306	0.123
16	2337.72	27.256	1.388	2353.16	2314.58	21.291	0.387
17		71	2.854	2391.73	2353.16	22.138	0.884
18		96	0.52	2870.08	2399.45	286.929	0.15
19		68	3.482	3008.95	2877.79	97.213	4.784

20	3425.58	9.516	11.494	3664.75	3016.67	551.916	113.518
21	3749.62	21.206	1.049	3788.19	3734.19	35.755	0.513
22	3873.06	21.306	0.258	3888.49	3849.92	25.782	0.133
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	354.9	10.07	72.86	362.62	331.76	10.51	11.42
2	439.77	14.1	1.15	455.2	416.62	31.99	0.9
3	563.21	9.5	2.04	655.8	540.07	111.78	5.06
4	833.25	9.69	5.83	864.11	786.96	68.61	6.25
5	1033.85	4.56	4.21	1087.85	871.82	224.12	13.05
6	1180.44	6.87	2.99	1195.87	1149.57	50.75	3.29
7	1242.16	4.94	4.71	1273.02	1203.58	81.84	11.71
8	1365.6	10.42	1.24	1396.46	1350.17	44.53	1.47
9	1458.18	8.41	3.76	1481.33	1404.18	76.63	6.17
10	1512.19	5.97	7.86	1550.77	1489.05	60.2	7.46
11	1604.77	8.99	7.73	1705.07	1558.48	132.39	18.88
12	1735.93	17.04	1.28	1820.8	1712.79	77.12	0.79
13	1890.24	21.22	0.3	1905.67	1859.38	31.02	0.2
14	2075.41	20.01	0.1	2083.12	1936.53	99.97	0.08
15	2137.13	19.9	0.1	2191.13	2090.84	70.22	0.12
16	2276	19.58	0.32	2306.86	2198.85	76.01	0.34
17	2337.72	18.48	1.33	2353.16	2314.58	27.61	0.53
18	2368.59	16.64	2.6	2391.73	2353.16	28.79	1.16
19	2854.65	7.63	0.69	2877.79	2399.45	399.65	0.53
20	2924.09	5.7	3.41	3008.95	2885.51	137.17	11.34
21	3402.43	5.06	8.51	3664.75	3016.67	719.18	151.23
22	3873.06	15.12	0.18	3888.49	3849.92	31.52	0.13



Zainal Sudirman, 2020

	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	339.47	43.36	70.8	347.19	324.04	2.22	5.63
2	370.33	16.92	35.92	385.76	354.9	16.1	6.78
3	447.49	17.93	0.65	455.2	393.48	44.26	0.76
4	478.35	16.75	0.85	493.78	455.2	29.24	0.33
5	570.93	15.71	1.48	609.51	501.49	84.59	2.15
6	825.53	17.84	5.18	856.39	786.96	47.74	3.44
7	1033.85	11.46	4.71	1087.85	864.11	171.5	7.42
8	1180.44	14.6	3.11	1195.87	1149.57	37.17	1.82
9	1242.16	12.79	5.2	1280.73	1203.58	63.66	6.25
10	1365.6	18.51	1.28	1396.46	1350.17	33.39	0.91
11	1458.18	16.6	3.9	1481.33	1404.18	56.69	3.56
12	1512.19	14.13	8.07	1550.77	1489.05	44.35	4.21
13	1612.49	16.84	9.18	1820.8	1558.48	164.9	19.25
14	2075.41	30.22	0.27	2098.55	1959.68	70.82	0.22
15	2121.7	30.18	0.1	2198.85	2106.27	48.03	0.1
16	2276	30.21	0.11	2306.86	2206.57	51.93	0.04
17	2337.72	28.32	1.47	2353.16	2314.58	20.61	0.4
18	2368.59	26.39	2.92	2391.73	2353.16	21.42	0.86
19	2854.65	16.11	0.51	2870.08	2399.45	285.25	0.13
20	2924.09	13.57	4.37	3008.95	2877.79	103.75	7.19
21	3425.58	9.54	13.34	3664.75	3016.67	550.61	130.31
22	3749.62	25.09	1.14	3788.19	3734.19	31.89	0.5
23	[illegible]	[illegible]	0.3	3888.49	3849.92	22.86	0.13
		[illegible]nsity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1		[illegible]38	18.5	316.33	300.9	9.637	2.62
2		[illegible]8	29.87	354.9	331.76	14.779	5.225
3		[illegible]21	7.699	393.48	354.9	30.441	5.618
4		[illegible]82	2.19	779.24	532.35	207.465	6.711
5		[illegible]62	5.178	856.39	786.96	54.642	4.21
6		[illegible]9	4.323	1087.85	864.11	190.133	7.934

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Zulkifli Djafar, Sampel 100AC6-3L, pelet, 27 Februari

Zulkifli Djafar, Sampel 100AC4-3L, pelet, 27 Februari 2020

Zulkifli Djafar, Sampel 100AC2-3L, pelet, 27 Februari 2020

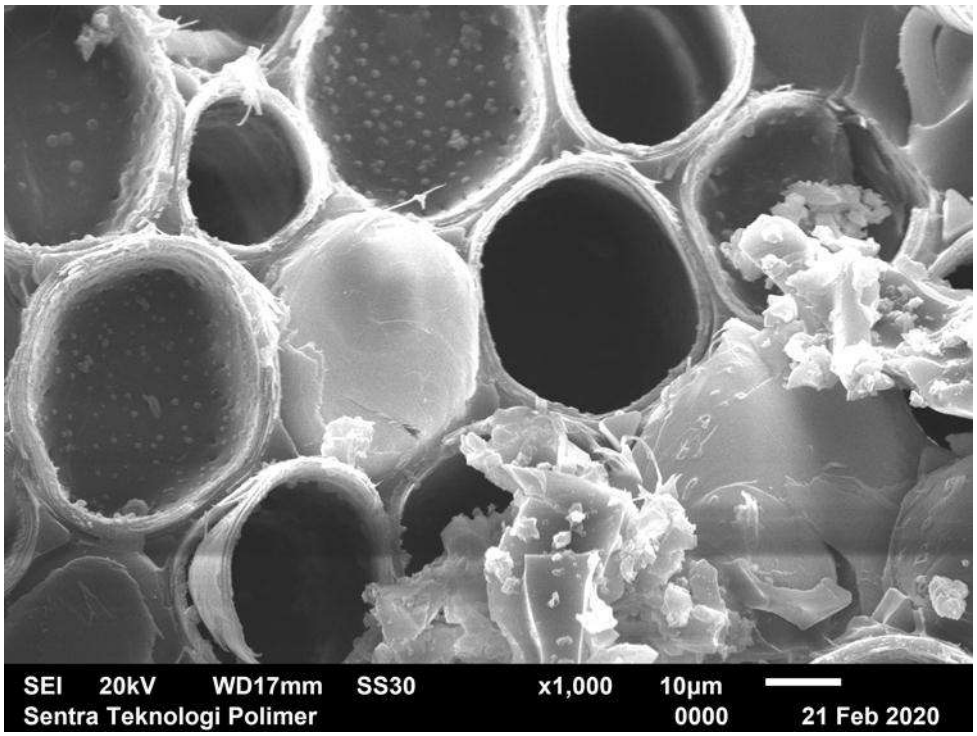
Zulkifli Djafar, Sampel 100AC8-3L, pelet, 27 Februari

7	1180.44	11.793	3.181	1195.87	1149.57	40.868	2.184
8	1249.87	9.84	4.827	1273.02	1203.58	64.461	7.133
9	1365.6	15.566	1.231	1396.46	1350.17	36.801	1.031
10	1458.18	13.388	3.807	1481.33	1404.18	63.122	4.249
11	1512.19	10.876	7.843	1550.77	1489.05	49.706	4.991
12	1612.49	13.325	9.138	1820.8	1558.48	183.034	21.852
13	1874.81	27.993	0.449	1905.67	1859.38	25.552	0.193
14	2075.41	26.744	0.29	2098.55	1959.68	77.956	0.247
15	2129.41	26.731	0.114	2198.85	2106.27	52.911	0.1
16	2268.29	26.698	0.035	2276	2206.57	39.573	0
17	2337.72	24.597	1.303	2353.16	2291.43	36.196	0.383
18	2368.59	22.805	2.734	2391.73	2353.16	23.798	0.93
19	2854.65	12.318	0.622	2870.08	2399.45	320.713	0.248
20	2924.09	9.984	4.177	3008.95	2877.79	118.888	8.981
21	3425.58	5.953	13.055	3726.47	3016.67	691.608	174.269
22	3749.62	19.312	0.924	3788.19	3734.19	38.002	0.519
23	3873.06	19.28	0.183	3880.78	3849.92	21.923	0.103
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	316.33	7.466	37.963	324.04	300.9	19.877	9.156
2	347.19	3.495	22.92	354.9	331.76	20.5	7.742
3	462.92	12.898	1.282	501.49	401.19	85.616	1.613
4	563.21	11.411	2.805	709.8	509.21	174.513	8.375
5	825.53	13.764	5.853	856.39	786.96	53.856	4.682
6	1033.85	7.205	4.894	1087.85	864.11	198.665	10.722
7	1180.44	10.604	3.296	1195.87	1149.57	43.151	2.605
8	1249.87	8.536	5.538	1280.73	1203.58	74.504	9.135
9	1365.6	14.701	1.519	1396.46	1350.17	37.774	1.331
10	1458.18	12.687	4.451	1481.33	1404.18	64.303	5.152
11	1512.19	10.162	9.03	1550.77	1489.05	49.807	5.782
12	1612.49	12.86	9.53	1712.79	1558.48	118.583	18.53
13	2075.41	27.962	0.295	2098.55	1959.68	75.218	0.262
14	2137.13	27.897	0.153	2198.85	2106.27	51.186	0.117
15	2337.72	25.466	1.192	2353.16	2206.57	82.033	0.312
16	2368.59	23.75	2.758	2391.73	2353.16	23.144	0.9
17	2854.65	11.899	0.606	2870.08	2399.45	314.511	0.205
18	2924.09	9.303	4.587	3008.95	2877.79	120.862	9.984
19	3425.58	5.137	14.388	3726.47	3016.67	715.9	205.822
20	3749.62	20.171	0.877	3788.19	3734.19	37.014	0.465
21	3873.06	20.182	0.244	3888.49	3849.92	26.671	0.129
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	308.61	15.44	63.81	316.33	300.9	8.57	5.24
2	378.05	20.71	34	385.76	331.76	21.08	18.12
3	478.35	17.46	0.97	493.78	416.62	56.44	1.83
4	563.21	15.97	2.02	702.09	532.35	126.16	3.49
5	825.53	17.33	5.31	856.39	786.96	48.31	3.53
6	894.97	21.66	0.2	902.69	864.11	25.19	0.04
7	1033.85	11.04	4.88	1087.85	910.4	143.77	8.33
8	1103.28	13.38	0.57	1141.86	1095.57	39.9	1.04
9	1180.44	14.01	3.08	1195.87	1149.57	37.94	1.87
10	1249.87	11.97	5.11	1280.73	1203.58	65.46	6.53
11	1365.6	17.49	1.25	1396.46	1350.17	34.51	0.93
12	1458.18	15.42	3.92	1481.33	1404.18	58.89	3.84
13	1512.19	13.2	7.69	1550.77	1489.05	45.96	4.2
14	1604.77	16.01	8.23	1820.8	1558.48	171.43	19.31
15	2137.13	28.29	0.58	2191.13	1959.68	124.93	1.53
16	2276	28.16	0.65	2314.58	2198.85	63.26	0.55
17	2368.59	23.85	4.06	2391.73	2353.16	22.65	1.27
18	2854.65	14.02	0.61	2870.08	2399.45	306.42	0.22
19	2924.09	11.71	4.11	3008.95	2877.79	111.28	7.59
20		8	9.78	3664.75	3016.67	564.97	107.98
21		1	1.02	3788.19	3734.19	35.27	0.52
22		8	0.27	3888.49	3849.92	25.32	0.13

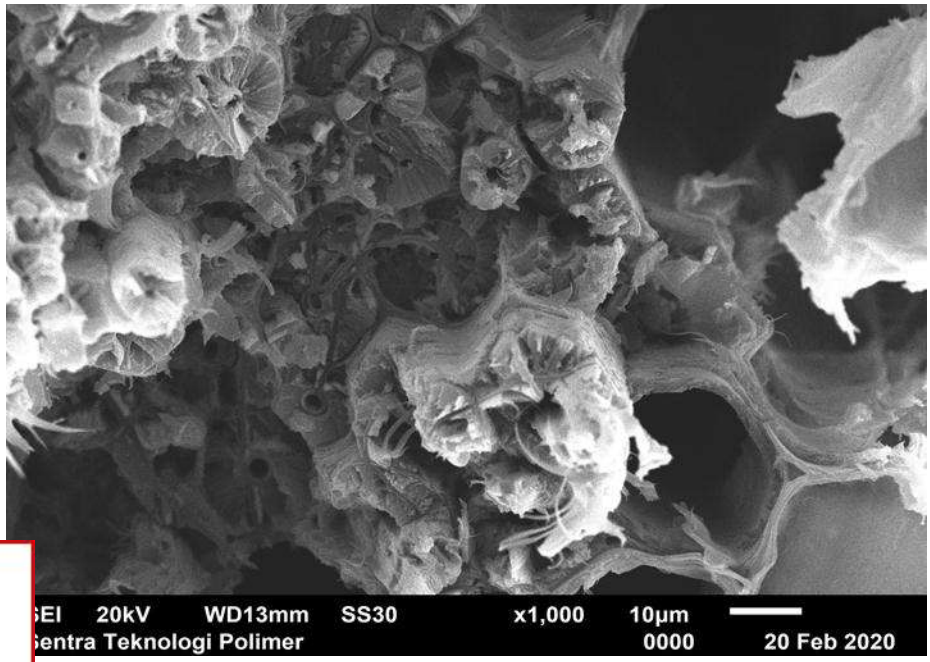
	Peak	Intensity	Corr. Intensity	Base (H)	Base (L)	Area	Corr. Area
1	354.9	10.07	72.86	362.62	331.76	10.51	11.42
2	439.77	14.1	1.15	455.2	416.62	31.99	0.9
3	563.21	9.5	2.04	655.8	540.07	111.78	5.06
4	833.25	9.69	5.83	864.11	786.96	68.61	6.25
5	1033.85	4.56	4.21	1087.85	871.82	224.12	13.05
6	1180.44	6.87	2.99	1195.87	1149.57	50.75	3.29
7	1242.16	4.94	4.71	1273.02	1203.58	81.84	11.71
8	1365.6	10.42	1.24	1396.46	1350.17	44.53	1.47
9	1458.18	8.41	3.76	1481.33	1404.18	76.63	6.17
10	1512.19	5.97	7.86	1550.77	1489.05	60.2	7.46
11	1604.77	8.99	7.73	1705.07	1558.48	132.39	18.88
12	1735.93	17.04	1.28	1820.8	1712.79	77.12	0.79
13	1890.24	21.22	0.3	1905.67	1859.38	31.02	0.2
14	2075.41	20.01	0.1	2083.12	1936.53	99.97	0.08
15	2137.13	19.9	0.1	2191.13	2090.84	70.22	0.12
16	2276	19.58	0.32	2306.86	2198.85	76.01	0.34
17	2337.72	18.48	1.33	2353.16	2314.58	27.61	0.53
18	2368.59	16.64	2.6	2391.73	2353.16	28.79	1.16
19	2854.65	7.63	0.69	2877.79	2399.45	399.65	0.53
20	2924.09	5.7	3.41	3008.95	2885.51	137.17	11.34
21	3402.43	5.06	8.51	3664.75	3016.67	719.18	151.23
22	3873.06	15.12	0.18	3888.49	3849.92	31.52	0.13

LAMPIRAN V

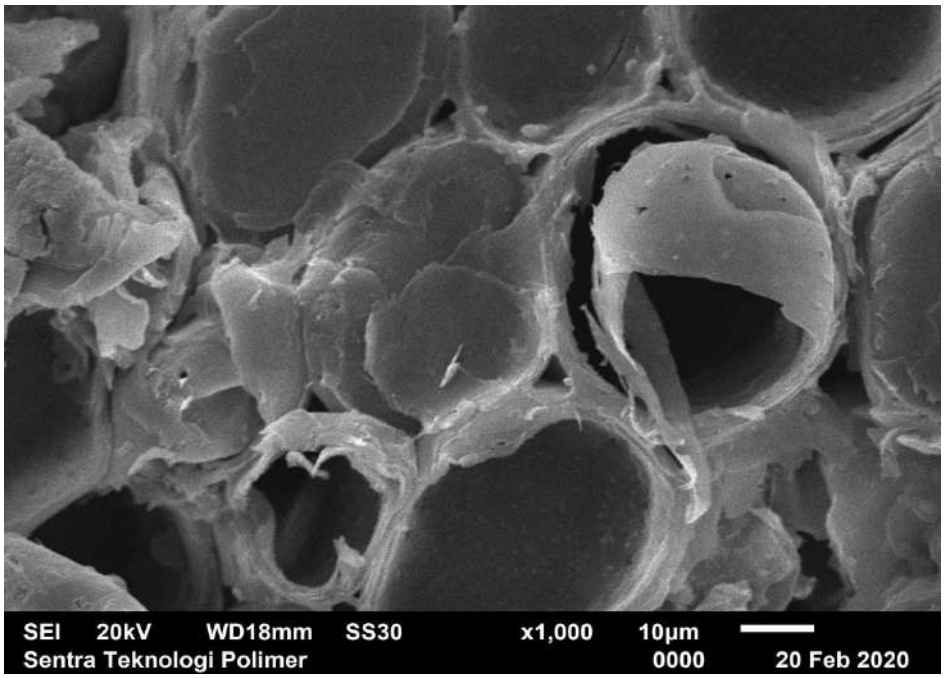
A. Hasil Foto SEM Perendaman Air Sungai Salinitas 30 PPM
B. Hasil Foto SEM Perendaman Air Limbah Rumah Tangga



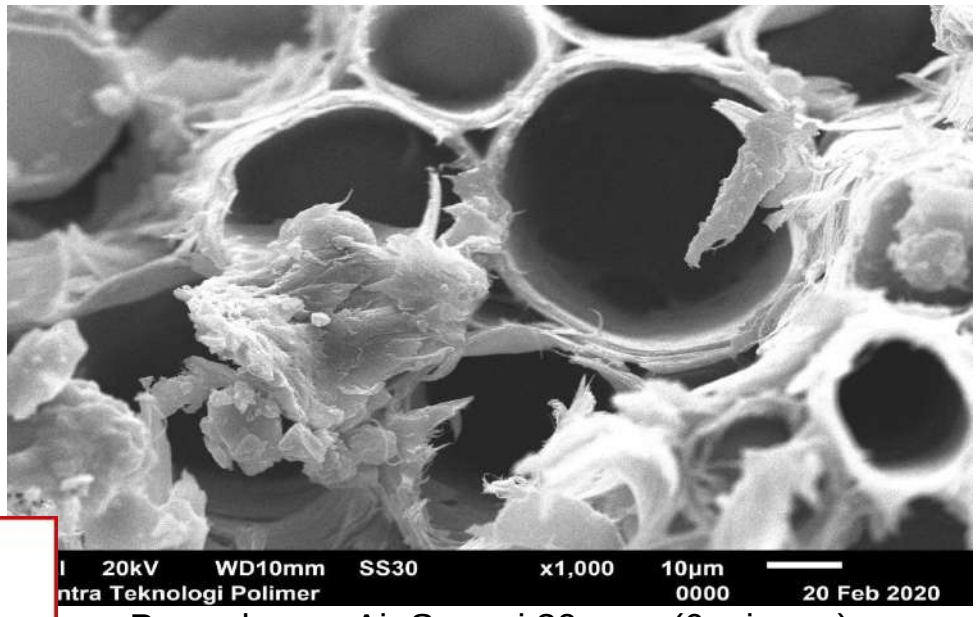
Tanpa Perendaman



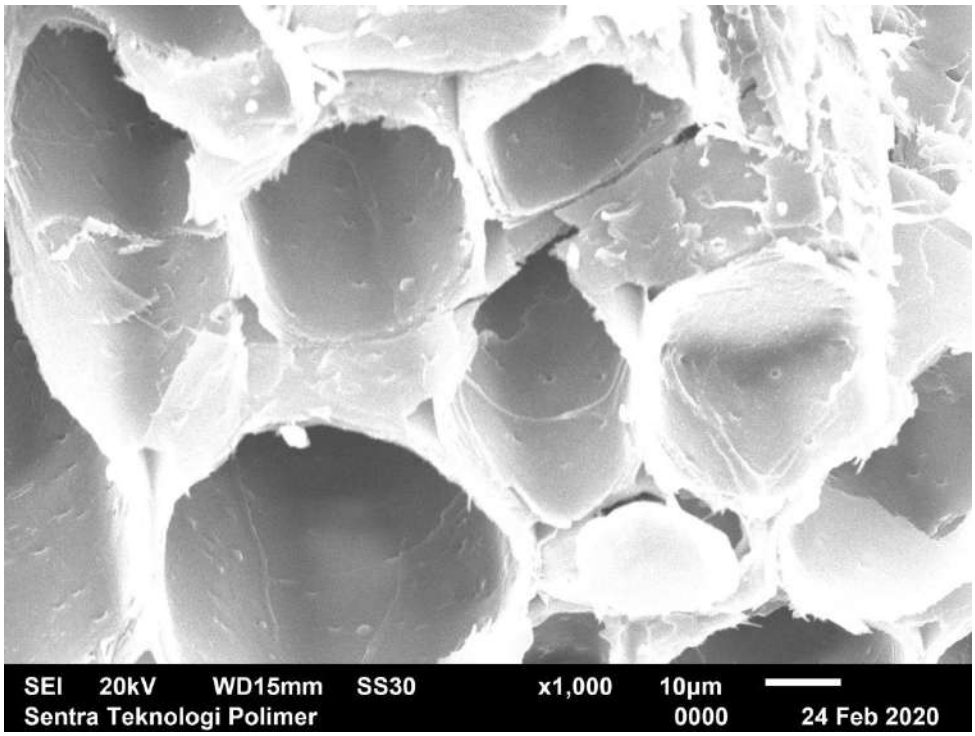
Perendaman Air Sungai 30 ppm (2 minggu)



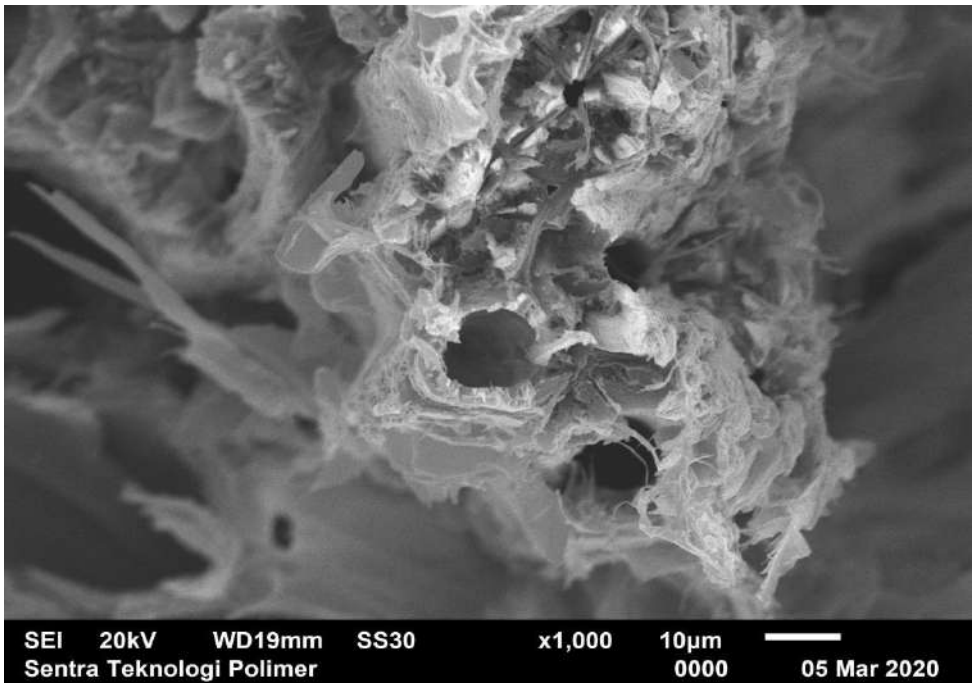
Perendaman Air Sungai 30 ppm (4 minggu)



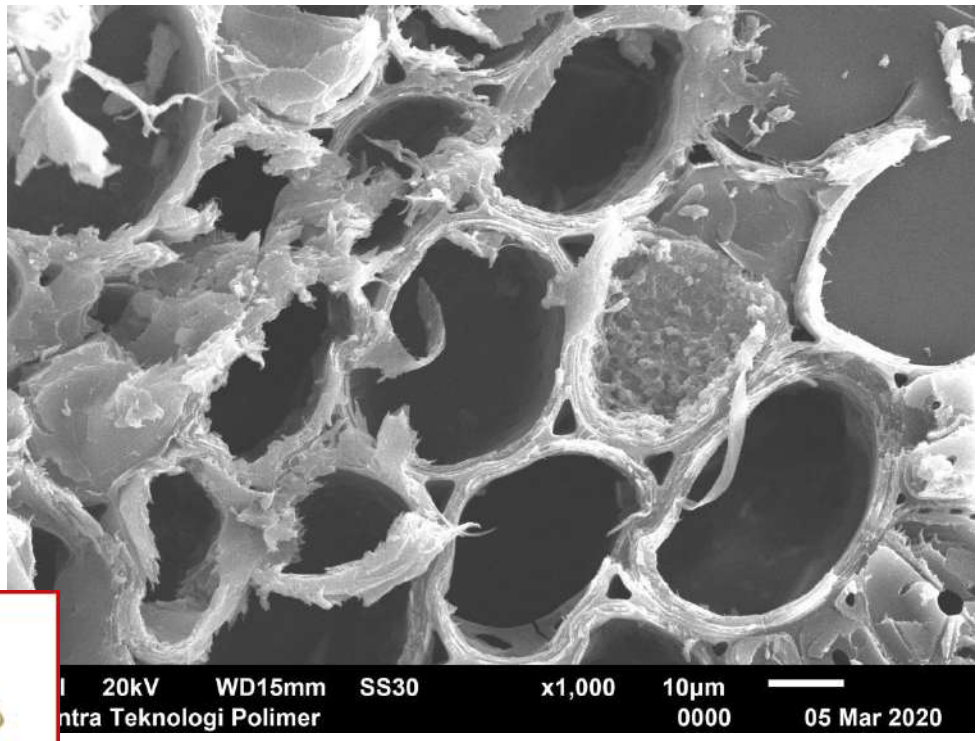
Perendaman Air Sungai 30 ppm (6 minggu)



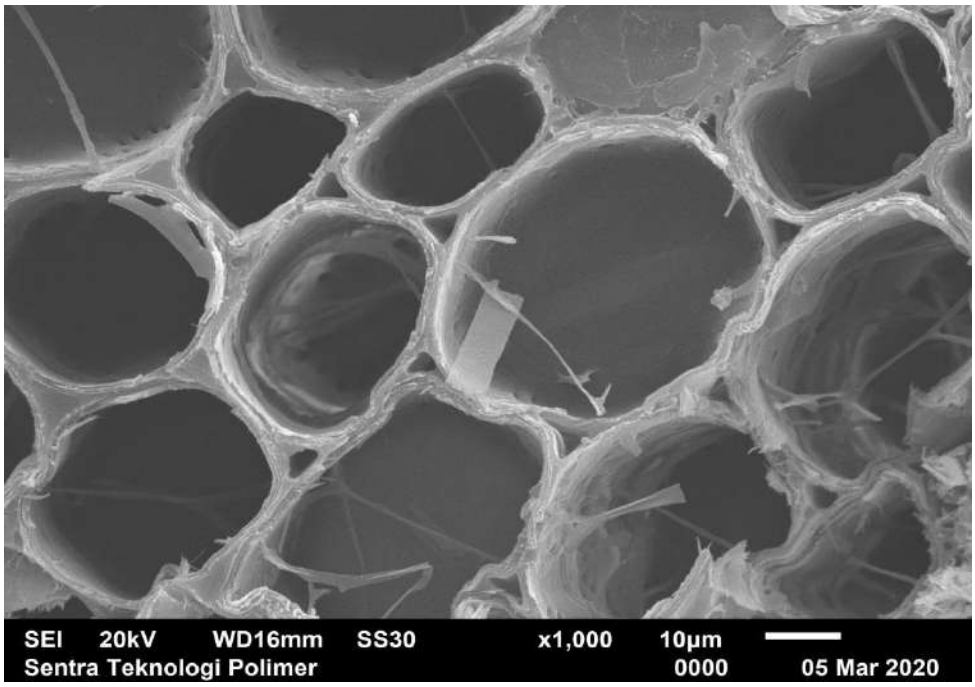
Perendaman Air Sungai 30 ppm 8 minggu



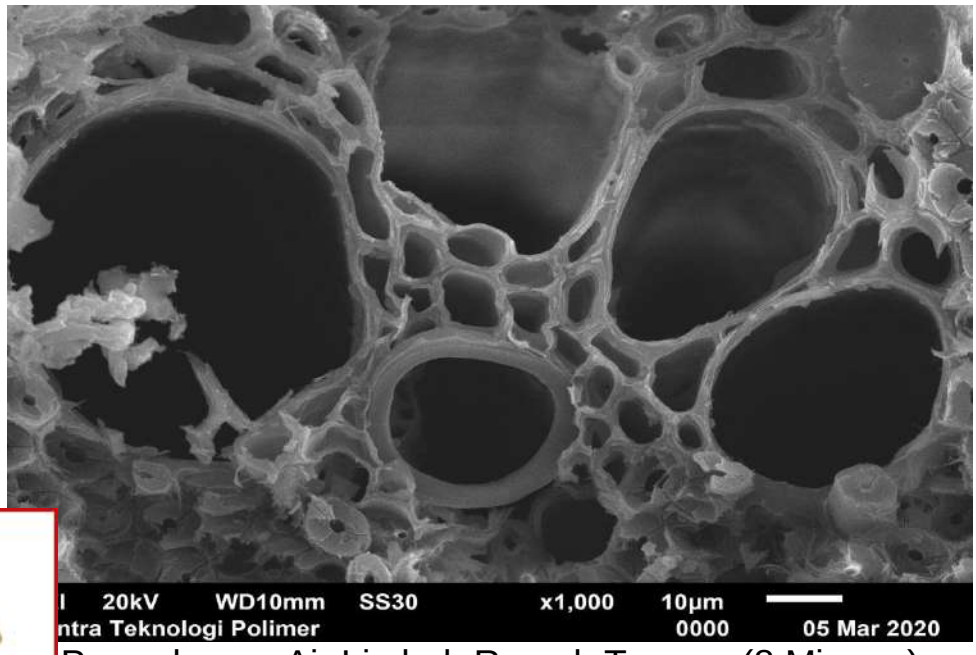
Perendaman Air Limbah Rumah Tangga (2 Minggu)



Perendaman Air Limbah Rumah Tangga (4 Minggu)



Perendaman Air Limbah Rumah Tangga (6 Minggu)



Perendaman Air Limbah Rumah Tangga (8 Minggu)


PDF
Optimization Software:
www.balesio.com

LAMPIRAN VI

A. HASIL ANALISA TAGUCHI TERHADAP KEKUATAN TARIK

B. HASIL ANALISA TAGUCHI TERHADAP KEKUATAN BENDING

C. HASIL ANALISA TAGUCHI TERHADAP KEKUATAN IMPAK

A. KEKUATAN TARIK

1. Kekuatan Tarik Perlakuan Perendaman Air Sungai

Salinitas	Waktu Perendaman	Kekutan Tarik 1 Lapis	Kekuatan Tarik 2 Lapis	Kekuatan Tarik 3 Lapis	SNRA1	SNRA2	SNRA3
10	0	32,14	44,77	61,28	30,14	33,02	35,75
10	2	38,01	53,70	63,73	31,60	34,60	36,09
10	4	44,94	47,25	52,71	33,05	33,49	34,44
10	6	35,68	46,69	39,75	31,05	33,38	31,99
10	8	33,84	32,65	35,37	30,59	30,28	30,97
20	0	32,14	44,77	61,28	30,14	33,02	35,31
20	2	33,21	54,41	58,75	30,42	34,71	35,38
20	4	47,06	43,59	49,31	33,45	32,79	33,86
20	6	38,20	43,76	46,33	31,64	32,82	33,32
20	8	36,85	42,83	40,63	31,33	32,64	32,18
30	0	32,14	44,77	61,28	30,14	33,02	35,46
30	2	38,01	44,59	59,38	31,60	32,98	35,47
30	4	39,91	50,15	52,33	32,02	34,01	34,37
30	6	35,68	46,49	45,53	31,05	33,35	33,17
30	8	33,84	45,18	41,90	30,59	33,10	32,44

2. Kekuatan Tarik Perlakuan Perendaman Air Limbah Rumah Tangga

Kadar Limbah	Waktu Perendaman	Kekuatan Tarik 1 Lapis	Kekuatan Tarik 2 Lapis	Kekuatan Tarik 3 Lapis	SNRA1	SNRA2	SNRA3
80	0	32,14	44,77	61,28	30,14	33,02	35,75
80	2	35,72	49,91	61,30	31,06	33,96	35,75
80	4	32,13	47,89	56,68	30,14	33,61	35,07
80	6	27,11	38,76	38,30	28,66	31,77	31,66
80	8	26,26	32,30	37,11	28,39	30,18	31,39
90	0	32,14	44,77	61,28	30,14	33,02	35,75
90	2	41,14	51,03	64,32	32,28	34,16	36,17
90	4	37,83	50,68	58,78	31,56	34,10	35,38
90	6	28,00	43,19	55,98	28,94	32,71	34,96
90	8	24,58	41,94	45,36	27,81	32,45	33,13
100	0	32,14	44,77	61,28	30,14	33,02	35,75
100	2	32,59	49,23	63,77	30,26	33,84	36,09
100	4	36,62	51,70	52,81	31,27	34,27	34,45
100	6	31,17	46,43	44,84	29,87	33,34	33,03
100	8	28,69	41,71	31,75	29,15	32,40	30,04

B. KEKUATAN BENDING

1. Kekuatan Bending Perlakuan Perendaman Air Sungai

Salinitas	Waktu Perendaman	Kekutan Bending 1 Lapis	Kekuatan Bending 2 Lapis	Kekuatan Bending 3 Lapis	SNRA1	SNRA2	SNRA3
10	0	51,40	78,82	68,78	34,22	37,93	36,75
10	2	61,12	86,82	79,52	35,72	38,77	38,01
10	4	60,65	67,10	82,96	35,66	36,53	38,38
10	6	50,02	63,08	70,54	33,98	36,00	36,97
10	8	48,52	54,89	66,68	33,72	34,79	36,48
20	0	51,40	78,82	68,78	34,22	37,93	36,75
20	2	81,91	79,91	73,75	38,27	38,05	37,36
20	4	75,80	69,00	84,73	37,59	36,78	38,56
20	6	68,39	63,08	79,94	36,70	36,00	38,06
20	8	62,90	60,72	74,89	35,97	35,67	37,49
30	0	51,40	78,82	68,78	34,22	37,93	36,75
30	2	59,92	84,13	69,22	35,55	38,50	36,80
30	4	62,09	80,35	71,78	35,86	38,10	37,12
30	6	72,70	60,05	56,91	37,23	35,57	35,10
30	8	62,63	50,22	46,80	35,94	34,02	33,41

2. Kekuatan Bending Perlakuan Perendaman Air Limbah Rumah Tangga

Kadar Limbah	Waktu Perendaman	Kekuatan Bending 1 lapis	Kekuatan Bending 2 lapis	Kekuatan Bending 3 lapis	SNRA1	SNRA2	SNRA3
80	0	57,41	78,82	87,10	35,18	37,93	38,80
80	2	62,92	83,66	98,19	35,98	38,45	39,84
80	4	69,53	74,50	76,59	36,84	37,44	37,68
80	6	62,35	68,41	56,59	35,90	36,70	35,06
80	8	54,79	58,94	54,12	34,77	35,41	34,67
90	0	57,41	78,81	87,10	35,18	37,93	38,80
90	2	65,53	79,84	73,75	36,33	38,04	37,36
90	4	59,30	67,99	91,87	35,46	36,65	39,26
90	6	54,88	64,96	81,03	34,79	36,25	38,17
90	8	46,21	55,75	73,28	33,29	34,93	37,30
100	0	57,41	78,82	87,10	35,18	37,93	38,80
100	2	59,77	80,42	62,42	35,53	38,11	35,91
100	4	54,83	80,26	66,31	34,78	38,09	36,43
100	6	52,47	68,49	62,71	34,40	36,71	35,95
100	8	50,90	55,68	58.38	34,14	34,91	35,32

C. KEKUATAN IMPAK

1. Kekuatan Impak Perlakuan Perendaman Air Sungai

salinitas	waktu perendaman	Kekuatan Impak 1 lapis	Kekuatan Impak 2 lapis	Kekuatan Impak 3 lapis	SNRA1	SNRA2	SNRA3
10	0	8,85	13,68	15,71	18,94	22,72	23,93
10	2	9,58	15,01	14,35	19,63	23,53	23,14
10	4	7,41	8,75	6,51	17,40	18,84	16,27
10	6	6,95	6,95	8,69	16,84	16,83	18,78
10	8	6,78	6,34	6,23	16,63	16,04	15,89
20	0	8,85	13,68	15,71	18,94	22,72	23,93
20	2	9,26	14,07	9,66	19,34	22,97	19,70
20	4	8,62	9,53	9,28	18,71	19,58	19,35
20	6	7,88	9,94	9,01	17,93	19,94	19,10
20	8	5,56	7,42	9,47	14,90	17,41	19,53
30	0	8,85	13,68	15,71	18,94	22,72	23,93
30	2	9,75	6,97	11,55	19,78	16,87	21,25
30	4	7,53	5,37	6,97	17,53	14,60	16,87
30	6	9,05	5,95	8,06	19,13	15,49	18,12
30	8	5,82	4,39	7,57	15,30	12,84	17,59

2. Kekuatan Impak Perlakuan Perendaman Air Limbah Rumah Tangga

Kadar Limbah	Waktu Perendaman	Kekuatan Impak 1 lapis	Kekuatan Impak 2 lapis	Kekuatan Impak 3 lapis	SNRA1	SNRA2	SNRA3
80	0	8,85	14,55	15,71	18,94	23,26	23,93
80	2	7,86	10,72	11,29	17,90	20,61	21,05
80	4	6,27	11,54	7,56	15,94	21,24	17,57
80	6	6,01	7,43	4,02	15,57	17,42	12,09
80	8	3,18	6,34	4,69	10,06	16,04	13,43
90	0	8,85	14,55	15,71	18,94	23,26	23,93
90	2	9,32	11,23	10,32	19,39	21,01	20,28
90	4	7,23	9,88	8,76	17,19	19,89	18,85
90	6	4,15	9,51	8,67	12,36	19,56	18,76
90	8	10,29	6,39	8,56	20,25	16,11	18,64
100	0	8,85	14,55	15,71	18,94	23,26	23,93
100	2	11,88	13,74	10,90	21,49	22,76	20,75
100	4	8,00	9,76	7,96	18,06	19,79	18,01
100	6	7,99	4,86	5,86	18,05	13,74	15,35
100	8	6,39	4,07	5,29	16,11	12,20	14,47

LAMPIRAN VII

A. Hasil Uji Kandungan COD Pada Air Sungai

B. Hasil Uji Kandungan COD Pada Air Limbah Rumah Tangga

LABORATORIUM OSEANOGRAFI KIMIA
DEPARTEMEN ILMU KELAUTAN
FAKULTAS ILMU KELAUTAN DAN PERIKANAN
UNIVERSITAS HASANUDDIN

Laporan Hasil Uji
No. 02.b/LOK/IX/2020

Nama Mahasiswa : Zainal Sudirman
Stambuk : D022171003
Jenis Contoh : Air Sungai
Tanggal Analisis : 31 Agustus 2020

AIR SUNGAI					
No	Kode Sampel	COD Ulangan 1 (mg/L)	COD Ulangan 2 (mg/L)	COD Ulangan 3 (mg/L)	COD Rata - Rata (mg/L)
1	30/2 Minggu	192	190	198	191
2	30/4 Minggu	270	277	277	277
3	30/6 Minggu	300	304	427	302
4	30/8 Minggu	324	316	323	324
5	20/2 Minggu	282	282	284	283
6	20/4 Minggu	292	298	288	295
7	20/6 Minggu	330	313	313	313
8	20/8 Minggu	321	334	333	334
9	10/2Minggu	275	283	284	284
10	10/4Minggu	292	298	288	290
11	10/6Minggu	320	313	313	313
12	10/8Minggu	337	338	345	338
13	Tanpa Perlakuan	179	177	176	177

Makassar, 16 September 2020

Mengetahui
Kepala Laboratorium

Dr. Ir. Rahmadi Tambaru, M.Si
NIP.196901251993032002

PLP

Isyanita, S.TP., M.M
NIP.197601221997032001

LABORATORIUM OSEANOGRAFI KIMIA
DEPARTEMEN ILMU KELAUTAN
FAKULTAS ILMU KELAUTAN DAN PERIKANAN
UNIVERSITAS HASANUDDIN

Laporan Hasil Uji
No. 02.a/LOK/IX/2020

Nama Mahasiswa : Zainal Sudirman
Stambuk : D022171003
Jenis Contoh : Air Limbah Rumah Tangga
Tanggal Analisis : 31 Agustus 2020

AIR LIMBAH RUMAH TANGGA					
No	Kode Sampel	COD Ulangan 1 (mg/L)	COD Ulangan 2 (mg/L)	COD Ulangan 3 (mg/L)	COD Rata - Rata (mg/L)
1	100/2 Minggu	226	222	236	224
2	100/4 Minggu	234	241	239	236,500
3	100/6 Minggu	321	314	317	317,33333
4	100/8Minggu	348	348	342	346
5	90/2 Minggu	213	230	219	216
6	90/4 Minggu	231	229	222	230
7	90/6 Minggu	249	249	249	249
8	90/8 Minggu	262	260	268	249
9	80/2 Minggu	138	148	148	148
10	80/4 Minggu	220	208	208	208
11	80/6 Minggu	278	291	280	279
12	80/8 Minggu	300	302	301	301
13	Tanpa Perlakuan	154	151	157	154

Makassar, 16 September 2020

Mengetahui
Kepala Laboratorium

Dr. Ir. Rahmadi Tambaru, M.Si
NIP. 196901251993032002

PLP

Isyanita, S.TP., M.M
NIP.197601221997032001

LAMPIRAN VII

- Artikel Ilmiah

Effect of immersion time on *petung* bamboo (*dendrocalamus asper*) strips as a composite reinforce on mechanical properties

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Abstract. This study aims to determine the effect of mechanical properties due to the immersion times of *petung* bamboo strips as composite reinforcement. *Petung* bamboo strips are woven in the size of 250x250 mm with orientation of 0^o and immersed in a container filled with sewage water with variation of immersion time 2, 4, 6 and 8 Weeks. Specimens without immersion were used as a comparison in this study. Composite material is made using compression moulding with epoxy matrix, with a ratio resin-hardener 60/40. Standard test specimens refer to ASTM D 638-02 for tensile test, ASTM D 790-02 flexural test and ASTM D 5942-96 for impact testing. Tensile test results due to effect of immersion obtained the optimal value of maximum stress of 36.6 ± 0.18 MPa at the time of immersion 4 weeks, flexural testing obtained an optimal value of 59.7 ± 0.74 MPa at 2 weeks immersion, impact testing with the highest value of 11.87 ± 0.7 kJ/m^2 at 2 weeks immersion. The results of SEM observations on the 8 week immersion, the effect of the immersion duration will cause a pull out due to the de-bonding fiber-matrix interface.

1. Introduction

Composite is a type of technical material that results from combining two or more basic materials arranged macroscopically. Fiber materials composite continue to be researched and developed in order to become an alternative material to replace metal materials; this is due to the nature of fiber composites that are stronger and lighter compared to metals. Composite development is not only from synthetic fiber composites but also renewable natural fiber composites thereby reducing the environmental pollution. The advantages possessed by natural fibers are the potential as a composite reinforcement, renewable, lightweight, inexpensive, environmentally friendly, biodegradable, non-toxic, non-abrasive, high mechanical properties, [1] .

One of the abundant natural fibers utilized in Indonesia is fiber from bamboo plants. Bamboo can be harvested in a short time of about 3 years and several other advantages compared to wood include strength properties, the process is relatively inexpensive and very easy [2]. Given bamboo that are abundant in the province of South Sulawesi in general, especially *Toraja* district that can be utilized, including *petung* bamboo.

oo is usually done in various ways, can be done by drying and even immersion d. Immersion treatment in river water and in seawater reduces the rate of fungal einforcement so that the use of bamboo becomes more resistant [3]. This is of

particular concern for the need to test its mechanical properties due to the immersion treatment. It has been tested that bamboo-composite laminates have high tensile strength and stiffness. Testing the orientation of the fibers of the bamboo/epoxy laminate composite at 0 °, 45 ° and 90 °, the maximum tensile strength is obtained when the bamboo fiber in the orientation direction of 0° due to the condition of the fiber direction parallel to the load given [4].

Other research related to *petung* bamboo has been conducted and found that the quality of *petung* bamboo is the best among other types of bamboo [5]. *Petung* bamboo has good fiber characteristics so that it has the potential to replace glass fiber for composite reinforcement. Like most natural fibers, bamboo has high variability in mechanical properties and hygroscopic properties so that it adheres well [6]. Cruz [7] has proven that bamboo fiber composites using epoxy for bulletproof vests are quite efficient, lightweight, and more economical compared to aramid fibers. So that bamboo fibers with epoxy resin composites have good mechanical characteristics [8].

The purpose of this study is to analyze the effect of immersion time of bamboo strips on mechanical properties.

2. Materials and Method

The main material used in this study is the lower part of the *petung* bamboo culm segment which is around ± 3 years old as shown in Figure 1 obtained from *Tana Toraja* Regency, South Sulawesi. Thereafter, *petung* bamboo is made into strips with a thickness of 1 mm, width of 10 mm, and length of 250 mm, as seen in the Figure 2. Finally, the bamboo strip is woven in size 250 x 250 mm and then weighed before immersion.

Petung bamboo strip is immersion by using household sewage with a variation of time 2, 4, 6 and 8 weeks. The immersion treatment process for woven *petung* bamboo strips is carried out with a laboratory-scale shown in Figure 3. After reaching the set time the strip is removed from the submersion container and dried without the aid of sunlight then weighed.

The process of making composites uses a square shape measuring 300 x 300 mm as shown in Figure 4. Mixing matrix of epoxy resin and hardener in a measuring cup by the results of calculations where the mixture of 60% resin and 40% hardener then stir until evenly distributed. The resin and hardener that has been stirred evenly is poured first on the mold then using a brush so that the resin is evenly distributed in the mold and helps break the air bubbles that are attached to the resin. After that, woven bamboo is placed in a 0^o orientation mold that has been poured in the previous resin and poured the resin back onto the webbing using a brush. The closed mold is then placed on a press to press the composite mold.

gure 1. *Petung* Bamboo Stems.

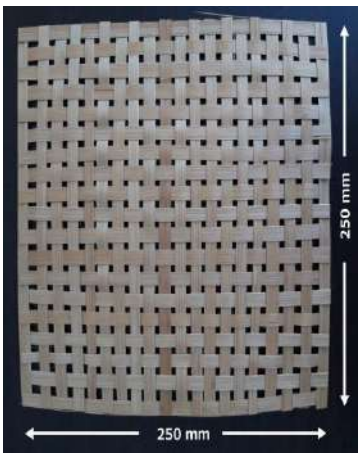


Figure 2. Woven Bamboo *Petung* Strip.

Figure 3. The process of immersion woven bamboo strips.

Figure 4. Composite moulding process.

In the process of making test specimens, composite panels are cut using a scroll saw cutting tools to produce tensile test specimens with ASTM D 638-02 type I standards [9] as shown in Figure 5, for flexural test specimens with ASTM D 790-02 standards [10] as shown in Figure 6 and impact test specimens with ASTM D standards 5942-96 [11] as shown in Figure 7.

2.1. *Mechanical Properties Testing Procedure*

There are three mechanical properties tests carried out in this study, namely tensile strength testing and flexural and impact testing.

2.1.1. Composite Tensile Strength. Tensile strength is one of the mechanical properties of materials; tensile strength is a mechanical stress-strain test that aims to determine the strength of the material against the tensile force [12]. Tensile strength by dividing the maximum force by the initial cross-sectional area of a particular material. Determine the relationship between stress and strain in tensile loads with the following formula;

$$\varepsilon = \frac{\Delta l}{l_o} \tag{1}$$

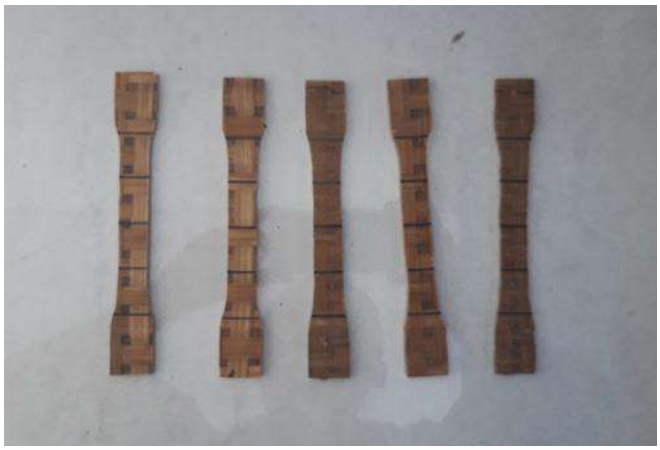


Figure 5. Preparation of tensile test specimens.

e of a tensile test specimen determined in ASTM D 638-02. Specimens to be tested
ber to get the average amount of tensile strength of the composite.

2.1.2. Composite flexural Strength. Composite material has better compressive properties than tensile, in the specimen flexural test treatment, the top of the specimen occurs in the compressive process and failure that occurs due to flexural test is fracture down because it is unable to withstand the tensile stress. Flexural test specimens can be seen in Figure 6 below;

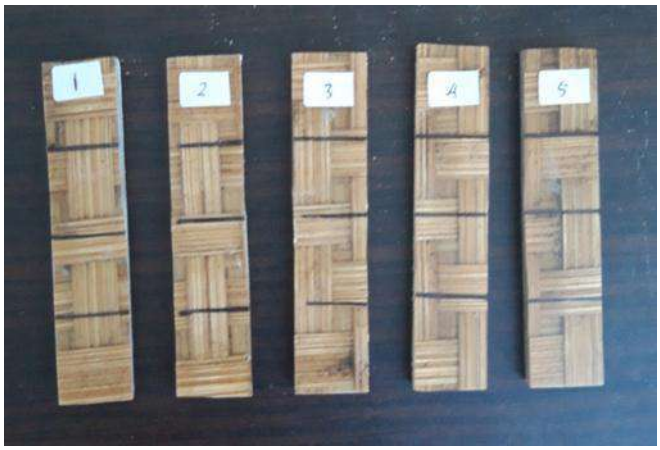


Figure 6. Preparation of flexural test specimens.

The moment that occurs on the composite can be calculated by the equation;

$$M = \frac{P}{2} \cdot \frac{L}{2} \tag{2}$$

Determine the flexural strength using the equation;

$$\sigma_b = \frac{3\,P.L}{2.b.d^2} \tag{3}$$

Meanwhile, to determine flexural elastic modulus using the as following formula;

$$E_b = \frac{L^3 m}{4bd^3} \tag{4}$$

Whereas stiffness can be searched by equation, [13]:

$$D = EI \tag{5}$$

2.1.3. Strength of composite impact. To measure how much energy a material can absorb until the material fracture. Impact testing is a response to an impact load [14]:

$$I_s = \frac{E_s - E_0}{A} \tag{6}$$

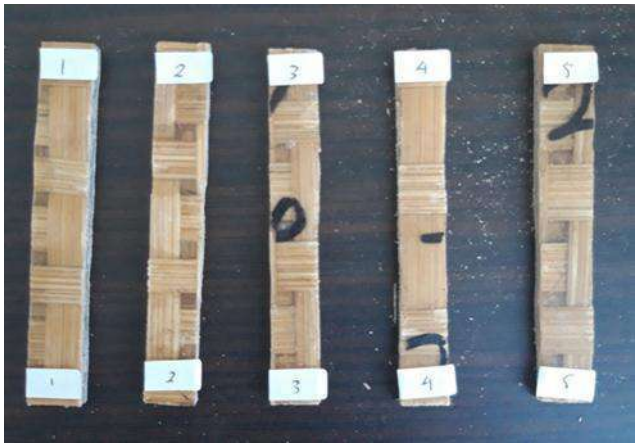


Figure 7. Preparation of impact test specimens.

Figure 7 is an image of an impact test specimen determined in ASTM D standards 5942-96. Specimens to be tested are given each number to get the average amount of impact strength of the composite.

2.2. *Scanning Electron Microscope (SEM) of Analysis*
The results of the fracture of the tensile test specimen are cut and mounted on the SEM testing. To analyse the results of fracture micro-structure failure due to tensile load, pull out and the presence of debonding interface on the fiber-matrix was analysed using SEM.

3. Results and Discussion

Tensile, flexural and impact testing is carried out in the Material Technology and Production laboratory of the Mechanical Engineering Department, Faculty of Engineering, State University of Makassar. Scanning Electron Microscope was analysed at polymer technology centre of BPPT Serpong.

3.1. *Tensile Testing results.*
Tensile testing is carried out to determine the stress, strain, modulus of elasticity of the material by pulling the specimen until it fractures. Before carrying out a tensile test, prepare the test specimens that have been marked so that it is easier to record the test results and follow the standard procedures. The average tensile test results are shown in Figure 8 and Figure 9.

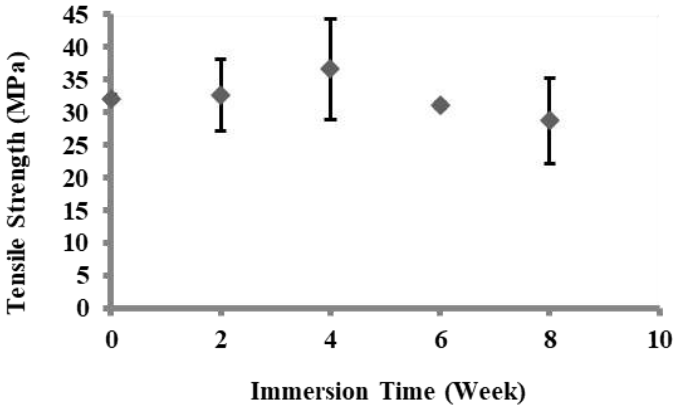


Figure 8. Relationship between tensile strength and immersion time.

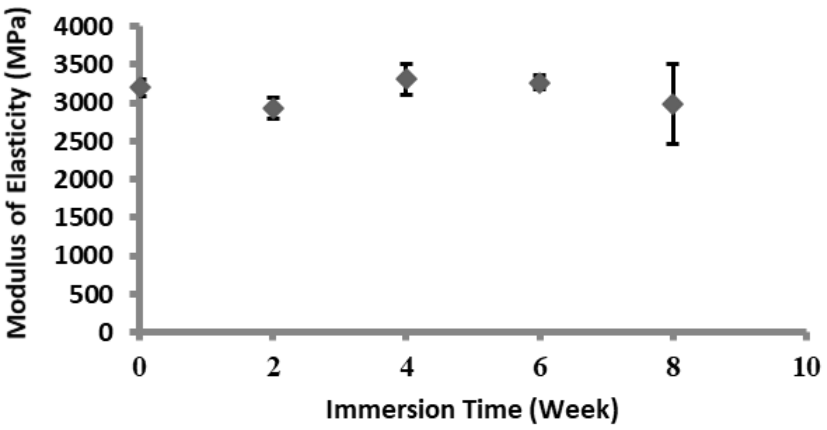
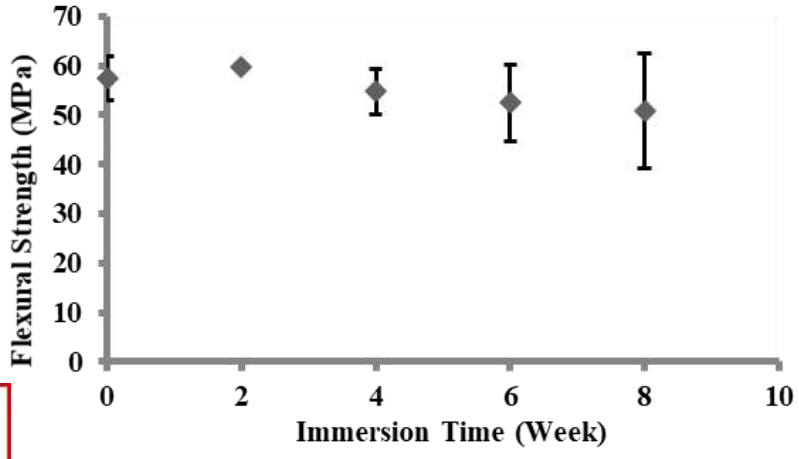


Figure 9. Relation between modulus of elasticity relationship with tensile time immersion.

The results of the tensile test can be seen from Figure 8 and Figure 9 the maximum stress (tensile) obtained by one of the materials that have the highest maximum tensile stress value, i.e. immersion time of 4 weeks with an average maximum stress (tensile) value of 36.6 ± 0.18 MPa and the modulus of elasticity of 3306.9 ± 0.25 MPa compared to the value of the maximum stress and stretch from without immersion (0 week). In weeks 6 and 8, the tensile strength decreased 3.1% and 10.7% compared without immersion. In harmony with the research of tensile testing of Reinforced Glass fiber polymer composites where Young Modulus along the axial and lateral direction of the specimen when immersed in seawater for a period of 15 days showed a decrease compared to normal specimens [15].

3.2. *Composite Flexural Testing Results*.

Flexural testing is done to determine the ability of a material to withstand the load. Before conducting flexural testing, first prepare the test specimens that have been marked to facilitate the recording of test results and follow existing standard procedures. The average flexural test results are shown in Figure 10.



gure 10. Relationship between flexural strength and immersion time.

The average bending stress value show that the immersion time 2 weeks is higher with a value of 59.7 ± 0.74 MPa compared to without immersion. In weeks 4, 6 and 8 shows the flexural strength decreased 4.496%, 8.598%, and 11.33%. In line with research on flexural testing of reinforced glass fiber polymer composites where the specimen when immersed in seawater for 15 days shows a decrease compared to normal specimens [15].

3.3. Composite Impact Testing Results.

Composite impact test results obtained the amount of energy absorbed by the specimen until it is a fracture, then from the data the impact toughness value will be obtained. Before conducting impact testing, first prepare the test specimens that have been marked to facilitate the recording of test results and follow existing standard procedures. The average impact test results are shown in Figure 11.

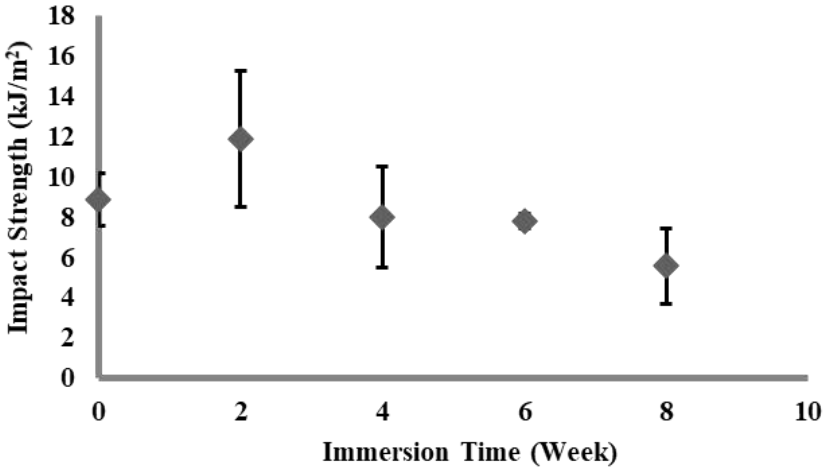


Figure 11. Relationship between impact strength and immersion time.

Impact testing and calculation results can be seen from Figure 11 impact strength increased by 25.4% at the time of immersion 2 weeks with a value of 11.8 ± 0.75 (kJ/m^2) compared without immersion. In weeks 4, 6 and 8 shows impact toughness decreased by 9.6%, 11.9%, and 37.4% respectively of the ratio without immersion. This shows a significant increase occurred at the time of immersion 2 weeks and happen a decrease in the time of immersion 4,6 and 8 weeks.

3.4. Observation of Scanning Electron Microscope (SEM) Test Results

Observation of SEM Test Results was carried out on the fracture of tensile test specimens. The following are observations on specimens without immersion and 8 weeks immersion shown in Figure 12 and Figure 13. The results of observations on specimens without immersion as shown in Figure 12, there are no visible gaps in the fiber and matrix interface. On the surface of the bamboo strip it looks perfectly fracture due to tensile loads and the presence of visible fractures on the matrix surface (matrix fracture). From the observations of the 8 weeks immersion specimen as shown in Figure 13 tensile load causes pull out due to de-bonding of the fiber and matrix interfaces. This is due to the long immersion which causes a gap in the matrix bonding interface. In previous studies through the optical microscopy and pull-out test, it was found that the interface between the bamboo fiber reinforced
sin was poor, but the interfacial adhesion could be improved by alkaline treatment
ctions are seen almost all over the matrix surface. The effect of immersion of
waste insufficiently long periods of time decreases the bonding strength of the
ce.

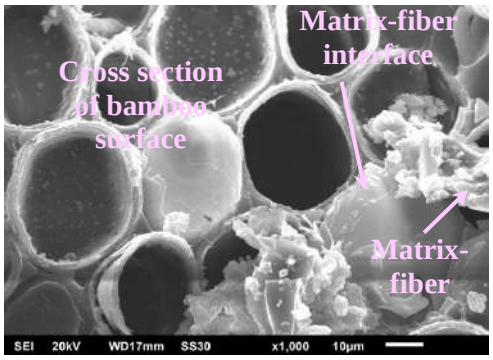


Figure 12. SEM image of tensile fracture without immersion.

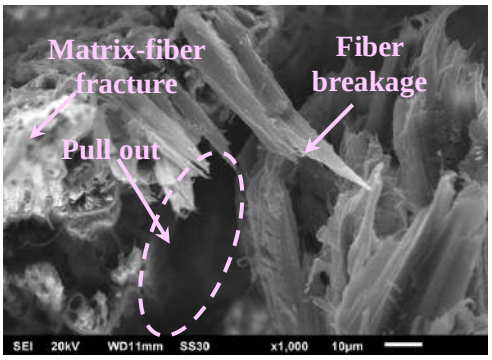


Figure 13. SEM image of tensile fracture 8 weeks.

4. Conclusion

From the results of research and analysis of test data obtained, it can be concluded that there is an influence of time immersion *petung* bamboo strips as composite reinforcement on mechanical strength. Where the results of the tensile strength in the immersion of 4 weeks of sewage water have a value of 36.6 ± 0.18 MPa compared to without immersion of 32.14 ± 0.2 MPa. The lowest value of tensile strength at 8 weeks immersion of 28.68 ± 0.7 MPa has a decrease in value from without immersion of 10.7%. The highest flexural stress value at 2 weeks immersion is 59.7 ± 0.74 MPa when compared to the value without immersion of 42.54 ± 0.15 MPa, so that it has the effect of a voltage value of 28.8% greater than without immersion. Impact strength increased at 2 weeks immersion by 11.87 ± 0.7 (kJ/m^2) compared without immersion of 8.85 ± 0.1 (kJ/m^2), so that it has an effective strength impact of 25.4%. From the results of SEM observations on the 8 week immersion, the effect of the immersion duration will cause a pull out due to the de-bonding fiber-matrix interface.

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