LAMPIRAN

KARTU PESERTA TUGAS AKHIR

NO	NAMA	NO MHS	PRODI
1	M. Jazuli Iman S.S.	00513064	Teknik Lingkungan
2			

JUDUL TUGAS AKHIR : Pemanfaatan Limbah Katalis sebagai Panel Board Dengan Penambahan Serat Bambu

PERIODE : IV
TAHUN : 2004/2005

No	kegiatan	Bulan Ke ; Juni	Juli	Agust	Sept	Okt	Nov
1	Pendaftaran						
2	Penentuan Dosen pembimbing						
3	Pembuatan Proposal						
4	Seminar proposal						
5	Konsultasi Penyusunan TA						
6	Sidang - sidang						
7	Pendadaran						

DOSEN PEMBIMBIG I : Ir. H. Kasam, MT
DOSEN PEMBIMBING II : Eko Siswoyo, ST
DOSEN PEMBIMBING III : ;

Yogyakarta, 14 Juni 2005
Koordinator TA

(Andik Yulianto, ST)

Catatan

Seminar :.....
Sidang : .....
Pendadaran :.....

Lampiran 2

SURAT KETERANGAN

Yang bertanda tangan dibawah ini Kepala Laboratorium Teknologi Bangunan Jurusan Arsitektur Universitas Islam Indonesia menerangkan bahwa :

Nama : Mohd. Jazuli Iman Setia. S
No. Mhs : 00. 513. 064
Jurusan : Teknik Lingkungan
Fakultas : Teknik Sipil dan Perencanaan
Universitas : Universitas Islam Indonesia

Benar-benar telah selesai melakukan penelitian/tidak mempunyai tanggungan meminjam alat/administrasi pada Laboratorium Teknologi Bahan.
Surat keterangn ini kami buat untuk keperluan pembuatan/penyetakan panel board (penelitian Tugas Akhir).
Demikian yang berkepentingan maklum

Yogyakarta, 10 Agustus 2005
Kepala Laboratorium Teknologi Bangunan
Jurusan Arsitektur
Universitas Islam Indonesia

Yulianto P Prihatmaji ST, MSA

SURAT KETERANGAN

Yang bertanda tangan dibawah ini teknisi Laboratorium Bahan Konstruksi Universitas Islam Indonesia menerangkan bahwa :

Nama : Mohd. Jazuli Iman Setia. S
No. Mhs : 00. 513. 064
Jurusan : Teknik Lingkungan
Fakultas : Teknik Sipil dan Perencanaan
Universitas : Universitas Islam Indonesia

Benar-benar telah selesai melakukan penelitian/tidak mempunyai tanggungan meminjam alat/administrasi pada Laboratorium Mekanika Bahan.
Surat keterangn ini kami buat untuk keperluan pengujian daya serap air panel board (penelitian Tugas Akhir).
Demikian yang berkepentingan maklum

Yogyakarta, 8 Agustus 2005
Laboratorium Bahan Konstruksi
Universitas Islam Indonesia

LABORATORIUM
BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK UII

SURAT KETERANGAN

Yang bertanda tangan dibawah ini teknisi Laboratorium Rekayasa Pangan dan Gizi Pusat Antar Universitas UGM menerangkan bahwa :

Nama : Mohd. Jazuli Iman Setia. S
No. Mhs : 00. 513. 064
Jurusan : Teknik Lingkungan
Fakultas : Teknik Sipil dan Perencanaan
Universitas : Universitas Islam Indonesia

Benar-benar telah selesai melakukan penelitian/tidak mempunyai tanggungan meminjam alat/administrasi pada Laboratorium Rekayasa Pangan dan Gizi Pusat Antar Universitas UGM.

Surat keterangn ini kami buat untuk keperluan pengujian kuat lentur panel board (penelitian Tugas Akhir).
Demikian yang berkepentingan maklum

Yogyakarta, 9 Agustus 2005
Laboratorium Rekayasa Pangan dan Gizi
Pusat Antar Universitas UGM

LABORATORIUM BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
UNIVERSITAS ISLAM INDONESIA
Jln. Kaliurang Km. 14,4 Telp. (0274) 895707, 895042 Fax. (0274) 895330 Yogyakarta.

DATA PEMERIKSAAN
BERAT JENIS AGREGAT HALUS

Nama benda uji : KATALIS
Asal : PERTAMINA
Keperluan : Tugas Akhir

Di periksa Oleh :
1. Emzita Hudaya
2. M.J Iman Setia
Tanggal : 29 Juni 2005

Alat – alat
1. Gelas ukur kap 1000 ml
2. Timbangan ketelitian
3. Piring, sendok, Lap, Dll

	Benda Uji 1		Benda Uji 2	
Berat agregat (W)	400	Gram	400	Gram
Volume Air (V_1)	600	Cc	600	Cc
Volume Air + Agregat (V_2)	795		740	
Berat Jenis (Bj) $\frac{W}{V2-V1}$	$\frac{400}{795-600} = 2.05 gr/ml$		$\frac{400}{740-600} = 2.86 gr/ml$	
Berat Jenis rata-rata	2.445 gr/ml			

Catatan :

Yogyakarta,.....

Mengetahui
Laboratorium BKT FTSP UII

LABORATORIUM
BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK UII

.....

LABORATORIUM BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
UNIVERSITAS ISLAM INDONESIA
Jl. Kaliurang Km.14,4 telp. (0274) 895707, 895042 fax.: (0274) 895330 Yogyakarta

HASIL PEMERIKSAAN BERAT ISI PADAT AGREGAT HALUS

ıgirim : ....
terima tanggal : ....
regat asal : Katalis Pertamina
ıerluan : TUGAS AKHIR

	Sampel 1	Sampel 2	Rata - rata
Bearat tabung (W 1) gram	5245	5225	5235
Barat tabung + Agregat kering (W2) gram	7396	7561	7478
Berat Agregat bersih (W3) (W2-W1)	2151	2316	2233
Volume tabung (V)	1900	1900	1900
Berat isi padat = (W3/V), gram/cm^3	1.13	1.22	1.17

ahkan

LABORATORIUM
BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK UII

Yogyakarta, 2 - Juli - 2005
Dikerjakan oleh :

Emalta Hudaya

LABORATORIUM BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK SIPIL DAN PERENCANAAN
UNIVERSITAS ISLAM INDONESIA
Jln. Kaliurang Km. 14,4 Telp. (0274) 895707, 895042 Fax. (0274) 895330 Yogyakarta.

DATA PEMERIKSAAN
MODULUS HALUS BUTIR PASIR

Nama benda uji : KATALIS
Asal : PERTAMINA
Keperluan : Tugas Akhir

Di periksa Oleh :
1. Emzita Hudaya
2. M.J Iman setia

Tanggal : 29 Juni 2005

Saringan		Berat tertinggal gram		Berat tertinggal %		Berat kumulatif	
No	Ø lubang mm	I	II	I	II	I	II
1	40	-----	------	-------	-------	------	-------
2	20	-----	------	-------	-------	------	-------
3	10	-----	------	-------	-------	------	-------
4	4.75	0	0	0	0	0	0
5	2.36	0	0	0	0	0	0
6	1.18	0	0	0	0	0	0
7	0.600	0	0	0	0	0	0
8	0.300	5	0	1.25	0	1.25	0
9	0.150	140	370	35	91.13	36.25	91.13
10	Pan	255	36	63.75	8.87	-----	-----
		400	406	**Jumlah**		**37.5**	**91.13**

Jumlah rata-rata 64,5315

$$\textbf{MODULUS HALUS BUTIR} = \frac{64{,}315}{100} * 100\% = 0.643$$

Yogyakarta, _____

Mengetahui
Laboratorium BKT FTSP UII

LABORATORIUM
BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK UII

...RATORIUM KIMIA ANALITIK
...N KIMIA
...AS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

Selokan Utara PO Box 803
Yogyakarta 55281 Telp. (0274) 902740, 545185 pes.
Faks. 0274-545

No. : 822/HA-KA/04/05
Pengirim : **Mohd. Jazuli Iman Setia**, Universitas Islam Indonesia Yogyakarta.
Jumlah sampel : 1
Penentuan : Al_2O_3, CaO, Fe_2O_3 dan SiO_2 dalam sampel zeolit.
Tgl. Analisis : 08 April 2005

NO	KODE SAMPEL	PARA METER	HASIL PENGUKURAN (ppm)			METODE
			I	II	III	
1.	Zeolit	Al_2O_3	275819,125	339899,629	307144,483	Atomic Absorption Spect.
2.		CaO	5245,492	5245,492	5109,024	"
3.		Fe_2O_3	7029,216	6757,292	7029,216	"
4.		SiO_2	631517,941	647945,992	642469,975	"

AS GADJAH MADA

ATORIUM KIMIA ANALITIK
KIMIA
MATEMATIKA DAN ILMU PENGETAHUAN ALAM

Sekip Utara PO Box BLS 21,
Yogyakarta 55281 Telp. (0274) 902740, 545188 pes. 116
Faks. 0274-545188

HASIL ANALISIS

No. : 920/HA-KA/08/05
Pengirim : **Mohd. Jazuli Iman Setia**, Pogung Lor 4B Yogyakarta
Jumlah sampel : 1
Penentuan : Kadar Cr, Cu, Pb dan Zn dalam sampel katalis.
Tgl. Analisis : 11 Agustus 2005

NO	KODE SAMPEL	PARA METER	HASIL PENGUKURAN (ppm)			METODE
			I	II	III	
1.	Katalis	Cr	18,115	18,883	18,883	Atomic Absorption Spect.
2.		Cu	16,878	16,878	16,446	"
3.		Pb	40,551	35,250	29,950	"
4.		Zn	19,139	19,620	19,380	"

LABORATORIUM KIMIA ANALITIK

PUSAT PENELITIAN DAN PENGEMBANGAN TEKNOLOGI MAJU-BATAN

Terakreditasi sebagai Laboratorium Penguji (LP-119-IDN)

Jl. Babarsari Kotak Pos 1008, Yogyakarta, Indonesia Tel. (62) (0274) 488435 Fax (0274) 487824

Form-29/Sert/Uji

Hasil Pengujian
Test Result

Nama Contoh	Kode	Label	Parameter	Satuan	Hasil Uji	Metode Uji
Keramik	443/P/KA	F_1	Ni	µg/g	< 0,040	F-AAS
		F_2	Ni	µg/g	< 0,040	F-AAS
		F_3	Ni	µg/g	< 0,040	F-AAS
		F_4	Ni	µg/g	< 0,040	F-AAS
		F_5	Ni	µg/g	0,120 ± 0,010	F-AAS
Gipsum	443/P/KA	I	Ni	µg/g	0,160 ± 0,010	F-AAS
		II	Ni	µg/g	0,290 ± 0,010	F-AAS
		III	Ni	µg/g	0,350 ± 0,010	F-AAS
		IV	Ni	µg/g	0,350 ± 0,010	F-AAS
		V	Ni	µg/g	0,490 ± 0,020	F-AAS
Katalis	443/P/KA	-	Ni	µg/g	12750,000 ± 250,000	F-AAS

Keterangan :

Satuan : *µg/g = ppm*

F-AAS : *Flame Atomic Absorption Spectrophotometry*

Yogyakarta, 5 September 2005

Manajer Teknik,

LABORATORIUM KIMIA ANALITIK PUSAT PENELITIAN DAN PENGEMBANGAN TEKNOLOGI MAJU BATAN YOGYAKARTA

Samin APU.

NIP. 150001309

Catatan / *Note*

1 Hasil pengujian ini hanya berlaku untuk contoh yang diuji
These test result are only valid for the tested samples

2 Sertifikat ini tidak boleh diperbanyak/digandakan tanpa ijin dari Manajer Teknik Laboratorium
The certificate shall not be reproduced (copied) without the written permission of the laboratory Technical Manager

Tabel Pengukuran Daya Serap Air

Sampel	Kode Sampel	Berat Kering (gram)	Berat Basah (Gram)	Daya Serap Air (%)	Daya Serap Air Rata-rata (%)
T1	T 1.1	560	723	29.1	28,3
	T 1.2	545	710	30.3	
	T 1.3	590	766	29.8	
	T 1.4	602	767.5	27.5	
	T 1.5	632	788.7	24.8	
T2	T 2.1	526	687	30.6	28.76
	T 2.2	566	727.3	28.5	
	T 2.3	550	710	29.1	
	T 2.4	573.5	735.8	28.3	
	T 2.5	567.3	722.2	27.3	
T3	T 3.1	581	745.4	28.3	28.96
	T 3.2	554	709	28	
	T 3.3	522.5	678	29.8	
	T 3.4	528	684	29.5	
	T 3.5	552.5	714	29.2	
T4	T 4.1	565	732	29.5	29.34
	T 4.2	560	732.5	30.8	
	T 4.3	590	760.5	28.9	
	T 4.4	574.2	736	28.2	
	T 4.5	578.2	747.6	29.3	
T5	T 5.1	533.4	692	29.8	29.47
	T 5.2	562	715	27.2	
	T 5.3	515	664	28.96	
	T 5.4	524	681	30	
	T 5.5	513.5	675	31.4	

Mengetahui,
Laboratorium mekanika bahan
Universitas Islam Indonesia

LABORATORIUM
BAHAN KONSTRUKSI TEKNIK
FAKULTAS TEKNIK UII (Darmaraksin).

Tabel Pengukuran Kuat Lentur

Sampel	Kode Sampel	Beban (N)	Beban (Kg)	Jarak Tumpuan (cm)	Lebar Benda (cm)	Tebal Benda (cm)	Kuat Lentur (Kg/cm^2)	Kuat Lentur Rata-rata (Kg/cm^2)
T1	T1.1	148	15.08	27	13	1	46.98	47.24
	T1.2	160.3	16.34	27	13	1	50.90	
	T1.3	177.4	18.08	27	13	1	56.33	
	T1.4	163.9	16.71	27	13	1	52.01	
	T1.5	88.43	9.01	27	13	1	28.07	
	T1.6	175.1	17.85	27	13	1	55.61	
	T1.7	171.5	17.48	27	13	1	54.46	
	T1.8	127.9	13.04	27	13	1	40.62	
	T1.9	137.9	14.06	27	13	1	43.80	
	T1.10	137.4	14.00	27	13	1	43.61	
T2	T2.1	171	17.43	27	13	1	54.30	53.63
	T2.2	146.2	14.9	27	13	1	46.42	
	T2.3	113.2	11.54	27	13	1	35.95	
	T2.4	159.2	16.23	27	13	1	50.56	
	T2.5	156.2	15.92	27	13	1	49.60	
	T2.6	196.9	20.07	27	13	1	62.53	
	T2.7	144.4	14.72	27	13	1	45.86	
	T2.8	155	15.80	27	13	1	49.22	
	T2.9	262.3	26.74	27	13	1	83.30	
	T2.10	184.5	18.81	27	13	1	58.60	
T3	T3.1	172.1	17.54	27	13	1	54.64	53.55
	T3.2	182.2	18.57	27	13	1	57.85	
	T3.3	206.3	21.03	27	13	1	65.52	
	T3.4	185.7	18.93	27	13	1	58.97	
	T3.5	173.3	17.67	27	13	1	55.05	
	T3.6	139.1	14.18	27	13	1	44.18	
	T3.7	180.4	18.39	27	13	1	57.29	
	T3.8	160.9	16.40	27	13	1	51.09	
	T3.9	135	13.76	27	13	1	42.87	
	T3.10	151.3	15.42	27	13	1	48.04	

T4	T4.1	150.9	15.38	27	13	1	47.91	49.32
	T4.2	150.9	15.38	27	13	1	47.91	
	T4.3	148	15.09	27	13	1	47.01	
	T4.4	160.3	16.34	27	13	1	50.90	
	T4.5	156.2	15.92	27	13	1	49.60	
	T4.6	143.3	14.61	27	13	1	45.52	
	T4.7	180.4	18.39	27	13	1	57.29	
	T4.8	142.1	14.48	27	13	1	45.11	
	T4.9	171.5	17.48	27	13	1	54.46	
	T4.10	149.7	15.26	27	13	1	47.54	
T5	T5.1	180.4	18.39	27	13	1	57.29	42.36
	T5.2	101.4	10.34	27	13	1	32.21	
	T5.3	140.9	14.36	27	13	1	44.74	
	T5.4	89.02	9.07	27	13	1	28.26	
	T5.5	143.8	14.66	27	13	1	45.67	
	T5.6	109.1	11.12	27	13	1	34.64	
	T5.7	189.8	19.35	27	13	1	60.28	
	T5.8	174.5	17.79	27	13	1	55.42	
	T5.9	122	12.44	27	13	1	38.75	
	T5.10	83.12	8.47	27	13	1	26.39	

Mengetahui,
Laboratorium Rekayasa Pangan dan Gizi
Pusat Antar Universitas-UGM

od Name: Ni Flame Element: Ni
od Description: Ni Flame

: 08/20/2005
nique: Flame Calibration Equation: Zero Intercept: Linear
length: 232.0 nm Slit Width: 0.20 nm
Current: 15 Energy: 64
~~le Info File: JAZULI.SIF Results Data Set: emzita Ni~~

o.	SampleID	Seq	El	Mean Signal (Absorbance)	Standard Dev Calibration	Mean Sample	Standard Deviation	Samp Units
1	Calib Blank	8	Ni	-0.000196	0.000326			mg/L
2	std 1	9	Ni	0.008182	0.000456			mg/L
3	std 2	10	Ni	0.019146	0.000929			mg/L
4	std 3	11	Ni	0.031059	0.001463			mg/L
5	std 4	12	Ni	0.039018	0.000530			mg/L
6	std 5	13	Ni	0.048181	0.000658			mg/L
7	T-11 ·	32	Ni	0.002831		0.115936	0.013367	mg/L
8	T-12	33	Ni	0.002929		0.119953	0.009522	mg/L
9	T-13	34	Ni	0.002528		0.103521	0.013756	mg/L
10	T-21 ·	35	Ni	0.003023		0.123787	0.010468	mg/L
11	T-22	36	Ni	0.002691		0.110185	0.004503	mg/L
12	T-23	37	Ni	0.002802		0.114750	0.021432	mg/L
13	T-31 ·	38	Ni	0.003179		0.130177	0.006848	mg/L
14	T-32	39	Ni	0.002871		0.117580	0.006229	mg/L
15	T-33	40	Ni	0.003968		0.162494	0.006077	mg/L
16	T-41 ·	41	Ni	0.002599		0.106442	0.009784	mg/L
17	T-42	42	Ni	0.002715		0.111189	0.008828	mg/L
18	T-43	43	Ni	0.004798		0.196453	0.011780	mg/L
19	T-51 ·	44	Ni	0.037765		1.546428	0.015123	mg/L
20	T-52	45	Ni	0.007500		0.307095	0.012193	mg/L
21	T-53	46	Ni	0.006122		0.250678	0.011412	mg/L

iod Name: Cu Flame Element: Cu
iod Description: Cu Flame

e: 07/28/2005
inique: Flame Calibration Equation: Zero Intercept: Linear
elength: 324.8 nm Slit Width: 0.70 nm
) Current: 8 Energy: 71
)le Info File: JAZULI.SIF Results Data Set: emzita Cu

No.	SampleID	Seq	El	Mean Signal (Absorbance)	Standard Dev Calibration	Mean Sample	Standard Deviation	Samp Units
1	Calib Blank	1	Cu	-0.000013	0.000405			mg/L
2	std 1	2	Cu	0.038470	0.002722			mg/L
3	std 2	3	Cu	0.095978	0.000998			mg/L
4	std 3	4	Cu	0.135293	0.001512			mg/L
5	std 4	5	Cu	0.190646	0.000916			mg/L
6	std 5	6	Cu	0.246772	0.001037			mg/L
7	T11	7	Cu	0.003429		0.070600	0.006418	mg/L
8	T12	8	Cu	0.003418		0.070370	0.002085	mg/L
9	T13 .	9	Cu	0.002967		0.061098	0.003021	mg/L
10	T21	10	Cu	0.003944		0.081203	0.005219	mg/L
11	T22	11	Cu	0.003478		0.071610	0.007001	mg/L
12	T23	12	Cu	0.003768		0.077577	0.004980	mg/L
13	T31.	13	Cu	0.004363		0.089833	0.002963	mg/L
14	T32	14	Cu	0.003618		0.074502	0.001052	mg/L
15	T33	15	Cu	0.003794		0.078128	0.001943	mg/L
16	T41 .	16	Cu	0.003707		0.076338	0.005099	mg/L
17	T42	17	Cu	0.003696		0.076108	0.003983	mg/L
18	T43	18	Cu	0.004456		0.091761	0.006090	mg/L
19	T51.	19	Cu	0.005397		0.111133	0.001447	mg/L
20	T52	20	Cu	0.004396		0.090522	0.004843	mg/L
21	T53	21	Cu	0.004570		0.094102	0.005558	mg/L

Name: Pb Flame Element: Pb
Description: Analisa Pb

7/26/2005
ıe: Flame Calibration Equation: Zero Intercept: Linear
gth: 283.3 nm Slit Width: 0.70 nm
rrent: 5 Energy: 67
Info File: JAZULI.SIF Results Data Set: emzita Pb

No.	SampleID	Seq	El	Mean Signal (Absorbance)	Standard Dev Calibration	Mean Sample	Standard Deviation	Samp Units
1	Calib Blank	1	Pb	-0.000239	0.000816			mg/L
2	std 1	2	Pb	0.018863	0.000549			mg/L
3	std 2	3	Pb	0.043825	0.001144			mg/L
4	std 3	4	Pb	0.058088	0.000639			mg/L
5	std 4	7	Pb	0.078540	0.000310			mg/L
6	std 5	6	Pb	0.106026	0.001213			mg/L
7	T11	8	Pb	0.004521		0.441147	0.014539	mg/L
8	T12	9	Pb	0.003123		0.304757	0.117194	mg/L
9	T13	10	Pb	0.004806		0.468991	0.050262	mg/L
10	T21	11	Pb	0.006244		0.609296	0.099064	mg/L
11	T22	12	Pb	0.005634		0.549694	0.076356	mg/L
12	T23	13	Pb	0.005391		0.525983	0.027083	mg/L
13	T31	23	Pb	0.007573		0.738943	0.059772	mg/L
14	T32	15	Pb	0.007100		0.692827	0.210436	mg/L
15	T33	16	Pb	0.007152		0.697830	0.035888	mg/L
16	T41	17	Pb	0.006938		0.676947	0.026527	mg/L
17	T42	18	Pb	0.007058		0.688694	0.011607	mg/L
18	T43	19	Pb	0.007308		0.713057	0.021116	mg/L
19	T51	20	Pb	0.007361		0.718278	0.047612	mg/L
20	T52	21	Pb	0.007381		0.720236	0.041827	mg/L
21	T53	22	Pb	0.007500		0.731765	0.106618	mg/L

ɔ	KODE SAMPEL	PARA METER	HASIL PENGUKURAN (ppm)			METODE
			I	II	III	
ɔ.		Zn	0,020	0,022	0,039	"
1.		Cr	0,060	0,050	0,021	"
2.		Cu	0,052	0,041	0,041	"
3.	Pasir-Katalis 0,8	Ni	0,441	0,261	0,171	"
4.		Pb	0,102	ttd	0,264	"
5.		Zn	0,041	0,029	0,044	"
6.		Cr	0,088	0,021	0,031	"
7.		Cu	0,041	0,041	0,041	"
8.	Pasir-Katalis 1,0	Ni	0,126	0,261	0,081	"
9.		Pb	0,102	0,102	0,102	"
0.		Zn	0,090	0,085	0,094	"
1.		Cr	0,281	0,262	0,242	"
2.		Cu	0,064	0,052	0,064	"
3.	T 32	Ni	0,441	0,351	0,576	"
4.		Pb	0,264	0,020	0,346	"
5.		Zn	0,027	0,015	0,034	"

Keterangan:
- Tidak terdeteksi dengan batas deteksi alat

PERHITUNGAN DAYA SERAP AIR

1. Perhitungan Daya Serap Air Tahap 1

   Dengan menggunakan Persamaan 5 :

$$\text{Daya serap air} = \frac{Berat basah - Berat kering}{Berat kering} \times 100\%$$

$$\text{Daya serap air T1.1} = \frac{(723 - 560)}{560} \times 100\% = 29{,}1\%$$

$$\text{Daya serap air T1.2} = \frac{(710 - 545)}{545} \times 100\% = 30{,}3\ \%$$

$$\text{Daya serap air T1.3} = \frac{(766 - 590)}{590} \times 100\% = 29{,}8\ \%$$

$$\text{Daya serap air T1.4} = \frac{(767{,}5 - 602)}{602} \times 100\% = 27{,}5\ \%$$

$$\text{Daya serap air T1.5} = \frac{(788{,}7 - 632)}{632} \times 100\% = 24{,}8\ \%$$

$$\text{Daya Serap Air Rata-rata pada T1} = \frac{(29{,}1 + 30{,}3 + 29{,}8 + 27{,}5 + 24{,}8)\%}{5} = 28{,}3\ \%$$

2. Perhitungan Daya Serap Air Tahap 2

   Dengan menggunakan Persamaan 5 :

$$\text{Daya serap air} = \frac{Berat basah - Berat kering}{Berat kering} \times 100\%$$

$$\text{Daya serap air T2.1} = \frac{(687 - 526)}{526} \times 100\% = 30{,}6\ \%$$

$$\text{Daya serap air T2.2} = \frac{(727{,}3 - 566)}{566} \times 100\% = 28{,}5\ \%$$

$$\text{Daya serap air T2.3} = \frac{(766 - 590)}{590} \times 100\% = 29{,}1\ \%$$

$$\text{Daya serap air T2.4} = \frac{(735{,}8 - 573{,}5)}{573{,}5} \times 100\% = 28{,}3\ \%$$

Daya serap air T2.5 = $\frac{(722,2 - 567,3)}{567,3} \times 100\% = 27,3\ \%$

Daya Serap Air Rata-rata pada T2 = $\frac{(30,6 + 28,5 + 29,1 + 28,3 + 27,3)\%}{5} = 28,76\ \%$

3. Perhitugan Daya Serap Air Tahap 3

Dengan menggunakan Persamaan 5 :

Daya serap air = $\frac{Beratbasah - Berat\,kering}{Berat\,kering} \times 100\%$

Daya serap air T3.1 = $\frac{(745,4 - 581)}{581} \times 100\% = 28,3\ \%$

Daya serap air T3.2 = $\frac{(709 - 554)}{554} \times 100\% = 28\ \%$

Daya serap air T3.3 = $\frac{(678 - 522,5)}{522,5} \times 100\% = 29,8\ \%$

Daya serap air T3.4 = $\frac{(684 - 528)}{528} \times 100\% = 29,5\ \%$

Daya serap air T3.5 = $\frac{(714 - 552,5)}{552,5} \times 100\% = 29,2\ \%$

Daya Serap Air Rata-rata pada T3 = $\frac{(28,3 + 28 + 29,8 + 29,5 + 29,2)\%}{5} = 28,96\ \%$

4. Perhitungan Daya Serap Air pada Tahap 4

Dengan menggunakan Persamaan 5 :

Daya serap air = $\frac{Beratbasah - Berat\,kering}{Berat\,kering} \times 100\%$

Daya serap air T4.1 = $\frac{(732 - 565)}{565} \times 100\% = 29,5\ \%$

Daya serap air T4.2 = $\frac{(732,5 - 560)}{560} \times 100\% = 30,8\ \%$

Daya serap air T4.3 = $\frac{(760,5-590)}{590} \times 100\% = 28,9\ \%$

Daya serap air T4.4 = $\frac{(736-574,2)}{574,2} \times 100\% = 28,2\ \%$

Daya serap air T4.5 = $\frac{(747,6-578,2)}{632} \times 100\% = 29,3\ \%$

Daya Serap Air Rata-rata pada T4 = $\frac{(29,5+30,8+28,9+28,2+29,3)\%}{5} = 29,34\ \%$

5. Perhitungan Daya Serap Air pada Tahap 5

Dengan menggunakan Persamaan 5 :

Daya serap air = $\frac{Berat basah - Berat kering}{Berat kering} \times 100\%$

Daya serap air T5.1 = $\frac{(692-533,4)}{533,4} \times 100\% = 29,8\%$

Daya serap air T5.2 = $\frac{(715-562)}{562} \times 100\% = 27,2\ \%$

Daya serap air T5.3 = $\frac{(664-515)}{515} \times 100\% = 28,96\ \%$

Daya serap air T5.4 = $\frac{(681-524)}{524} \times 100\% = 30\ \%$

Daya serap air T5.5 = $\frac{(675-513,5)}{513,5} \times 100\% = 31,4\ \%$

Daya Serap Air Rata-rata pada T5 = $\frac{(29,8+27,2+28,96+30+31,4)\%}{5} = 29,47\ \%$

PERHITUNGAN KUAT LENTUR

Perhitungan kuat lentur *panel board* menggunakan Persamaan 4 : $\sigma = \frac{3 \times P \times L}{2 \times b \times h^2}$

1. Perhitungan Kuat Lentur *Panel Board* Tahap 1

Kuat Lentur T1.1 = $\frac{3 \times 15{,}08 \times 27}{2 \times 13 \times 1^2} = 46{,}98$ Kg/cm^2

Kuat Lentur T1.2 = $\frac{3 \times 16{,}34 \times 27}{2 \times 13 \times 1^2} = 50{,}90$ Kg/cm^2

Kuat Lentur T1.3 = $\frac{3 \times 18{,}08 \times 27}{2 \times 13 \times 1^2} = 56{,}33$ Kg/cm^2

Kuat Lentur T1.4 = $\frac{3 \times 16{,}71 \times 27}{2 \times 13 \times 1^2} = 52{,}01$ Kg/cm^2

Kuat Lentur T1.5 = $\frac{3 \times 9{,}01 \times 27}{2 \times 13 \times 1^2} = 28{,}07$ Kg/cm^2

Kuat Lentur T1.6 = $\frac{3 \times 17{,}85 \times 27}{2 \times 13 \times 1^2} = 55{,}61$ Kg/cm^2

Kuat Lentur T1.7 = $\frac{3 \times 17{,}48 \times 27}{2 \times 13 \times 1^2} = 54{,}46$ Kg/cm^2

Kuat Lentur T1.8 = $\frac{3 \times 13{,}04 \times 27}{2 \times 13 \times 1^2} = 40{,}62$ Kg/cm^2

Kuat Lentur T1.9 = $\frac{3 \times 14{,}06 \times 27}{2 \times 13 \times 1^2} = 43{,}80$ Kg/cm^2

Kuat Lentur T1.10 = $\frac{3 \times 14{,}00 \times 27}{2 \times 13 \times 1^2} = 43{,}61$ Kg/cm^2

2. Perhitungan Kuat Lentur *Panel Board* Tahap 2

Kuat Lentur T2.1 = $\frac{3 \times 17{,}43 \times 27}{2 \times 13 \times 1^2} = 54{,}30$ Kg/cm^2

Kua Lentur T2.2 = $\frac{3 \times 14{,}9 \times 27}{2 \times 13 \times 1^2} = 46{,}42$ Kg/cm^2

Kuat Lentur T2.3 = $\frac{3 \times 11{,}54 \times 27}{2 \times 13 \times 1^2} = 35{,}95\ \text{Kg/cm}^2$

Kuat Lentur T2.4 = $\frac{3 \times 16{,}23 \times 27}{2 \times 13 \times 1^2} = 50{,}56\ \text{Kg/cm}^2$

Kuat Lentur T2.5 = $\frac{3 \times 15{,}92 \times 27}{2 \times 13 \times 1^2} = 49{,}60\ \text{Kg/cm}^2$

Kuat Lentur T2.6 = $\frac{3 \times 20{,}07 \times 27}{2 \times 13 \times 1^2} = 62.53\ \text{Kg/cm}^2$

Kuat Lentur T2.7 = $\frac{3 \times 14{,}72 \times 27}{2 \times 13 \times 1^2} = 45{,}86\ \text{Kg/cm}^2$

Kuat Lentur T2.8 = $\frac{3 \times 15{,}80 \times 27}{2 \times 13 \times 1^2} = 49{,}22\ \text{Kg/cm}^2$

Kuat Lentur T2.9 = $\frac{3 \times 26{,}74 \times 27}{2 \times 13 \times 1^2} = 83{,}80\ \text{Kg/cm}^2$

Kuat Lentur T2.10 = $\frac{3 \times 18{,}81 \times 27}{2 \times 13 \times 1^2} = 58{,}60\ \text{Kg/cm}^2$

3. Perhitungan Kuat Lentur *Panel Board* Tahap 3

Kuat Lentur T3.1 = $\frac{3 \times 17{,}54 \times 27}{2 \times 13 \times 1^2} = 54{,}64\ \text{Kg/cm}^2$

Kuat Lentur T3.2 = $\frac{3 \times 18{,}57 \times 27}{2 \times 13 \times 1^2} = 57{,}85\ \text{Kg/cm}^2$

Kuat Lentur T3.3 = $\frac{3 \times 21{,}03 \times 27}{2 \times 13 \times 1^2} = 65{,}52\ \text{Kg/cm}^2$

Kuat Lentur T3.4 = $\frac{3 \times 18{,}93 \times 27}{2 \times 13 \times 1^2} = 58{,}97\ \text{Kg/cm}^2$

Kuat Lentur T3.5 = $\frac{3 \times 17{,}67 \times 27}{2 \times 13 \times 1^2} = 55{,}05\ \text{Kg/cm}^2$

Kuat Lentur T3.6 = $\frac{3 \times 14{,}18 \times 27}{2 \times 13 \times 1^2} = 44{,}18\ \text{Kg/cm}^2$

Kuat Lentur T3.7 = $\frac{3 \times 18{,}39 \times 27}{2 \times 13 \times 1^2} = 57{,}29\ \text{Kg/cm}^2$

Kuat Lentur T3.8 = $\frac{3 \times 16{,}40 \times 27}{2 \times 13 \times 1^2} = 51{,}09$ Kg/cm^2

Kuat Lentur T3.9 = $\frac{3 \times 13{,}76 \times 27}{2 \times 13 \times 1^2} = 42{,}87$ Kg/cm^2

Kuat Lentur T3.10 = $\frac{3 \times 15{,}42 \times 27}{2 \times 13 \times 1^2} = 48{,}04$ Kg/cm^2

4. Perhitungan Kuat Lentur *Panel Board* Tahap 4

Kuat Lentur T4.1 = $\frac{3 \times 15{,}08 \times 27}{2 \times 13 \times 1^2} = 47{,}91$ Kg/cm^2

Kuat Lentur T4.2 = $\frac{3 \times 16{,}34 \times 27}{2 \times 13 \times 1^2} = 47{,}91$ Kg/cm^2

Kuat Lentur T4.3 = $\frac{3 \times 18{,}08 \times 27}{2 \times 13 \times 1^2} = 47{,}01$ Kg/cm^2

Kuat Lentur T4.4 = $\frac{3 \times 16{,}71 \times 27}{2 \times 13 \times 1^2} = 50{,}90$ Kg/cm^2

Kuat Lentur T4.5 = $\frac{3 \times 9{,}01 \times 27}{2 \times 13 \times 1^2} = 49{,}60$ Kg/cm^2

Kuat Lentur T4.6 = $\frac{3 \times 17{,}85 \times 27}{2 \times 13 \times 1^2} = 45{,}52$ Kg/cm^2

Kuat Lentur T4.7 = $\frac{3 \times 17{,}48 \times 27}{2 \times 13 \times 1^2} = 57{,}29$ Kg/cm^2

Kuat Lentur T4.8 = $\frac{3 \times 13{,}04 \times 27}{2 \times 13 \times 1^2} = 45{,}11$ Kg/cm^2

Kuat Lentur T4.9 = $\frac{3 \times 14{,}06 \times 27}{2 \times 13 \times 1^2} = 54{,}46$ Kg/cm^2

Kuat Lentur T4.10 = $\frac{3 \times 14{,}00 \times 27}{2 \times 13 \times 1^2} = 47{,}54$ Kg/cm^2

5. Perhitungan Kuat Lentur *Panel Board* Tahap 5

Kuat Lentur T5.1 = $\frac{3 \times 18{,}39 \times 27}{2 \times 13 \times 1^2} = 57{,}29$ Kg/cm^2

Kuat Lentur T5.2 = $\frac{3 \times 10{,}34 \times 27}{2 \times 13 \times 1^2} = 32{,}21$ Kg/cm^2

Kuat Lentur T5.3 = $\frac{3 \times 14{,}36 \times 27}{2 \times 13 \times 1^2} = 44{,}74\ \text{Kg/cm}^2$

Kuat Lentur T5.4 = $\frac{3 \times 9{,}07 \times 27}{2 \times 13 \times 1^2} = 28{,}26\ \text{Kg/cm}^2$

Kuat Lentur T5.5 = $\frac{3 \times 14{,}66 \times 27}{2 \times 13 \times 1^2} = 45{,}67\ \text{Kg/cm}^2$

Kuat Lentur T5.6 = $\frac{3 \times 11{,}12 \times 27}{2 \times 13 \times 1^2} = 34{,}64\ \text{Kg/cm}^2$

Kuat Lentur T5.7 = $\frac{3 \times 19{,}35 \times 27}{2 \times 13 \times 1^2} = 60{,}28\ \text{Kg/cm}^2$

Kuat Lentur T5.8 = $\frac{3 \times 17{,}79 \times 27}{2 \times 13 \times 1^2} = 55{,}42\ \text{Kg/cm}^2$

Kuat Lentur T5.9 = $\frac{3 \times 12{,}44 \times 27}{2 \times 13 \times 1^2} = 38{,}75\ \text{Kg/cm}^2$

Kuat Lentur T5.10 = $\frac{3 \times 8{,}47 \times 27}{2 \times 13 \times 1^2} = 26{,}39\ \text{Kg/cm}^2$

Efisiensi Immobilisasi Logam Berat Cr

Kode Sampel	Nomor Sampel	Sampel Awal		Massa Katalis	Kadar Cr		Sampel Akhir		Massa Cuplikan *Panel*	Massa Sampel *Panel*	Kadar Cr		Efisiensi
		Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	Input (mg)	Rata2 (mg)	Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	(kg)	Output (mg)	Rata2 (mg)	(%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1	18.627	1862.7	0	0		0.147610	14.7610	0.01	0.6	8.857		
	2	18.627	1862.7	0	0	0	0.157983	15.7983	0.01	0.6	9.479	8.699	
	3	18.627	1862.7	0	0		0.129334	12.9334	0.01	0.6	7.76		
T2	1	18.627	1862.7	0.06	111.76		0.327574	32.7574	0.01	0.6	19.654		
	2	18.627	1862.7	0.06	111.76	111.76	0.317695	31.7695	0.01	0.6	19.062	18.289	83.64
	3	18.627	1862.7	0.06	111.76		0.269205	26.9205	0.01	0.6	16.152		
T3	1	18.627	1862.7	0.12	223.52		0.296043	29.6043	0.01	0.6	17.763		
	2	18.627	1862.7	0.12	223.52	223.52	0.264513	26.4513	0.01	0.6	15.871	18.454	91.74
	3	18.627	1862.7	0.12	223.52		0.362151	36.2151	0.01	0.6	21.729		
T4	1	18.627	1862.7	0.18	335.29		0.339264	33.9264	0.01	0.6	20.356		
	2	18.627	1862.7	0.18	335.29	335.29	0.305511	30.5511	0.01	0.6	18.331	19.737	94.11
	3	18.627	1862.7	0.18	335.29		0.342064	34.2064	0.01	0.6	20.524		
T5	1	18.627	1862.7	0.24	447.05		0.403890	40.3890	0.01	0.6	24.233		
	2	18.627	1862.7	0.24	447.05	447.05	0.390389	39.0389	0.01	0.6	23.423	24.826	94.45
	3	18.627	1862.7	0.24	447.05		0.447029	44.7029	0.01	0.6	26.822		

Keterangan :

Kolom 4 = Kolom 3 × 100

Kolom 6 = (Kolom 4 × Kolom 5)

Kolom 9 = Kolom 8 × 100

Kolom 12 = ((Kolom 9 × Kolom 10)) × (Kolom 11/Kolom 10)

Kolom 14 = ((Kolom 7 – Kolom 12)/(Kolom 7)) × 100%

Efisiensi Immobilisasi Logam Berat Zn

Kode Sampel	Nomor Sampel	Sampel Awal		Massa Katalis	Kadar Cr		Sampel Akhir		Massa Cuplikan *Panel*	Massa Sampel *Panel*	Kadar Cr		Efisiensi
		Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	Input (mg)	Rata2 (mg)	Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(mg)	(mg)	Output (mg)	Rata2 (mg)	(%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1	19.379	1937.9	0	0		0.310454*	0.00*	0.01	0.6	0.00		
	2	19.379	1937.9	0	0	0	0.056535	5.6535	0.01	0.6	3.392	2.755	
	3	19.379	1937.9	0	0		0.035294	3.5294	0.01	0.6	2.118		
T2	1	19.379	1937.9	0.06	116.27		0.050946	5.0946	0.01	0.6	3.057		
	2	19.379	1937.9	0.06	116.27	116.27	0.040326	4.0326	0.01	0.6	2.419	2.546	97.81
	3	19.379	1937.9	0.06	116.27		0.036036	3.6036	0.01	0.6	2.162		
T3	1	19.379	1937.9	0.12	232.55		0.042320	4.2320	0.01	0.6	2.539		
	2	19.379	1937.9	0.12	232.55	232.55	0.032534	3.2534	0.01	0.6	1.952	2.468	98.94
	3	19.379	1937.9	0.12	232.55		0.048534	4.8534	0.01	0.6	2.912		
T4	1	19.379	1937.9	0.18	348.82		0.043062	4.3062	0.01	0.6	2.584		
	2	19.379	1937.9	0.18	348.82	348.82	0.025670	2.5670	0.01	0.6	1.540	2.434	99.30
	3	19.379	1937.9	0.18	348.82		0.052987	5.2987	0.01	0.6	3.179		
T5	1	19.379	1937.9	0.24	465.1		0.327335*	0.00*	0.01	0.6	0.00		
	2	19.379	1937.9	0.24	465.1	465.1	0.074877	7.4877	0.01	0.6	4.493	4.711	98.99
	3	19.379	1937.9	0.24	465.1		0.082135	8.2135	0.01	0.6	4.928		

Keterangan :

* = Data tidak digunakan

Kolom 4 = Kolom 3 × 100

Kolom 6 = (Kolom 4 × Kolom 5)

Kolom 9 = Kolom 8 × 100

Kolom 12 = ((Kolom 9 × Kolom 10)) × (Kolom 11/Kolom 10)

Kolom 14 = ((Kolom 7 – Kolom 12)/(Kolom 7)) × 100%

Efisiensi Immobilisasi Logam Berat Cu

Kode Sampel	Nomor Sampel	Sampel Awal		Massa Katalis	Kadar Cr		Sampel Akhir		Massa Cuplikan *Panel*	Massa Sampel *Panel*	Kadar Cr		Efisiensi
		Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	Input (mg)	Rata2 (mg)	Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(mg)	(mg)	Output (mg)	Rata2 (mg)	(%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1	16.734	1673.4	0	0		0.070600	7.0600	0.01	0.6	4.236		
	2	16.734	1673.4	0	0	0	0.070370	7.0370	0.01	0.6	4.222	4.041	
	3	16.734	1673.4	0	0		0.061098	6.1098	0.01	0.6	3.666		
T2	1	16.734	1673.4	0.06	100.40		0.081203	8.1203	0.01	0.6	4.872		
	2	16.734	1673.4	0.06	100.40	100.40	0.071610	7.1610	0.01	0.6	4.296	4.608	95.41
	3	16.734	1673.4	0.06	100.40		0.077577	7.7577	0.01	0.6	4.655		
T3	1	16.734	1673.4	0.12	200.81		0.089833	8.9833	0.01	0.6	5.389		
	2	16.734	1673.4	0.12	200.81	200.81	0.074502	7.4502	0.01	0.6	4.470	4.849	97.58
	3	16.734	1673.4	0.12	200.81		0.078128	7.8128	0.01	0.6	4.688		
T4	1	16.734	1673.4	0.18	301.21		0.076338	7.6338	0.01	0.6	4.580		
	2	16.734	1673.4	0.18	301.21	301.21	0.076108	7.6108	0.01	0.6	4.566	4.884	98.38
	3	16.734	1673.4	0.18	301.21		0.091761	9.1761	0.01	0.6	5.506		
T5	1	16.734	1673.4	0.24	401.62		0.111133	11.1133	0.01	0.6	6.668		
	2	16.734	1673.4	0.24	401.62	401.62	0.090522	9.0522	0.01	0.6	5.431	5.915	98.53
	3	16.734	1673.4	0.24	401.62		0.094102	9.4102	0.01	0.6	5.646		

Keterangan :

Kolom 4 = Kolom 3 × 100

Kolom 6 = (Kolom 4 × Kolom 5)

Kolom 9 = Kolom 8 × 100

Kolom 12 = ((Kolom 9 × Kolom 10)) × (Kolom 11/Kolom 10)

Kolom 14 = ((Kolom 7 – Kolom 12)/(Kolom 7)) × 100%

Efisiensi Immobilisasi Logam Berat Pb

Kode Sampel	Nomor Sampel	Sampel Awal		Massa Katalis	Kadar Cr		Sampel Akhir		Massa Cuplikan *Panel*	Massa Sampel *Panel*	Kadar Cr		Efisiensi
		Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	Input (mg)	Rata2 (mg)	Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(mg)	(mg)	Output (mg)	Rata2 (mg)	(%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1	35.250	3525	0	0		0.441147	44.1147	0.01	0.6	26.469		
	2	35.250	3525	0	0	0	0.304757	30.4757	0.01	0.6	18.285	24.298	
	3	35.250	3525	0	0		0.468991	46.8991	0.01	0.6	28.139		
T2	1	35.250	3525	0.06	211.5		0.609296	60.9296	0.01	0.6	36.558		
	2	35.250	3525	0.06	211.5	211.5	0.549694	54.9694	0.01	0.6	32.982	33.699	84.07
	3	35.250	3525	0.06	211.5		0.525983	52.5983	0.01	0.6	31.559		
T3	1	35.250	3525	0.12	423		0.738943	73.8934	0.01	0.6	44.336		
	2	35.250	3525	0.12	423	423	0.692827	69.2827	0.01	0.6	41.569	42.591	89.93
	3	35.250	3525	0.12	423		0.697830	69.7830	0.01	0.6	41.869		
T4	1	35.250	3525	0.18	634.5		0.676947	67.6947	0.01	0.6	40.617		
	2	35.250	3525	0.18	634.5	634.5	0.688694	68.8694	0.01	0.6	41.322	42.296	93.33
	3	35.250	3525	0.18	634.5		0.713057	71.3057	0.01	0.6	42.783		
T5	1	35.250	3525	0.24	846		0.718278	71.8278	0.01	0.6	43.097		
	2	35.250	3525	0.24	846	846	0.720236	72.0236	0.01	0.6	43.214	43.406	94.87
	3	35.250	3525	0.24	846		0.731765	73.1765	0.01	0.6	43.906		

Keterangan :

Kolom 4 = Kolom 3 × 100

Kolom 6 = (Kolom 4 × Kolom 5)

Kolom 9 = Kolom 8 × 100

Kolom 12 = ((Kolom 9 × Kolom 10)) × (Kolom 11/Kolom 10)

Kolom 14 = ((Kolom 7 – Kolom 12)/(Kolom 7)) × 100%

Efisiensi Immobilisasi Logam Berat Ni

Kode Sampel	Nomor Sampel	Sampel Awal		Massa Katalis	Kadar Cr		Sampel Akhir		Massa Cuplikan *Panel*	Massa Sampel *Panel*	Kadar Cr		Efisiensi
		Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(kg)	Input (mg)	Rata2 (mg)	Konsentrasi Pengukuran (mg/l)	Massa Pengukuran (mg/kg)	(mg)	(mg)	Output (mg)	Rata2 (mg)	(%)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
T1	1	12750	1275000	0	0		0.115936	11.5936	0.01	0.6	6.956		
	2	12750	1275000	0	0	0	0.119953	11.9953	0.01	0.6	7.197	6.788	
	3	12750	1275000	0	0		0.103521	10.3521	0.01	0.6	6.211		
T2	1	12750	1275000	0.06	76500		0.123787	12.3787	0.01	0.6	7.427		
	2	12750	1275000	0.06	76500	76500	0.110185	11.0185	0.01	0.6	6.611	6.974	99.99
	3	12750	1275000	0.06	76500		0.114750	11.4750	0.01	0.6	6.885		
T3	1	12750	1275000	0.12	153000		0.130177	13.0177	0.01	0.6	7.811		
	2	12750	1275000	0.12	153000	153000	0.117580	11.7580	0.01	0.6	7.055	8.205	99.99
	3	12750	1275000	0.12	153000		0.162494	16.2494	0.01	0.6	9.749		
T4	1	12750	1275000	0.18	229500		0.106442	10.6442	0.01	0.6	6.386		
	2	12750	1275000	0.18	229500	229500	0.111189	11.1189	0.01	0.6	6.671	8.281	99.99
	3	12750	1275000	0.18	229500		0.196453	19.6453	0.01	0.6	11.787		
T5	1	12750	1275000	0.24	306000		1.546428*	0.00	0.01	0.6	0.00		
	2	12750	1275000	0.24	306000	306000	0.307095	30.7095	0.01	0.6	18.426	16.733	99.99
	3	12750	1275000	0.24	306000		0.250678	25.0678	0.01	0.6	15.041		

Keterangan :

* = Data tidak digunakan

Kolom 4 = Kolom 3 × 100

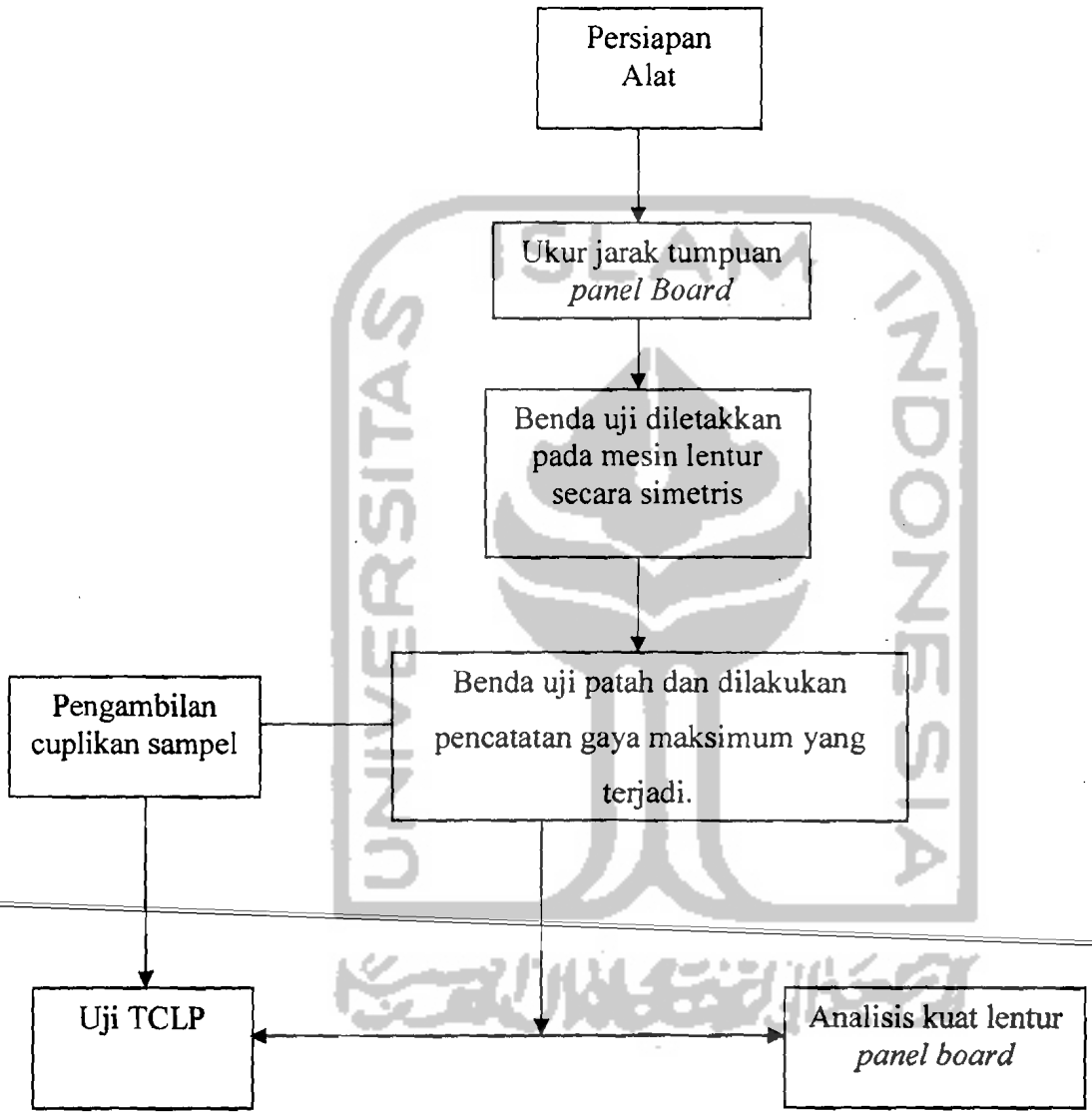
Kolom 6 = (Kolom 4 × Kolom 5)

Kolom 9 = Kolom 8 × 100

Kolom 12 = ((Kolom 9 × Kolom 10)) × (Kolom 11/Kolom 10)

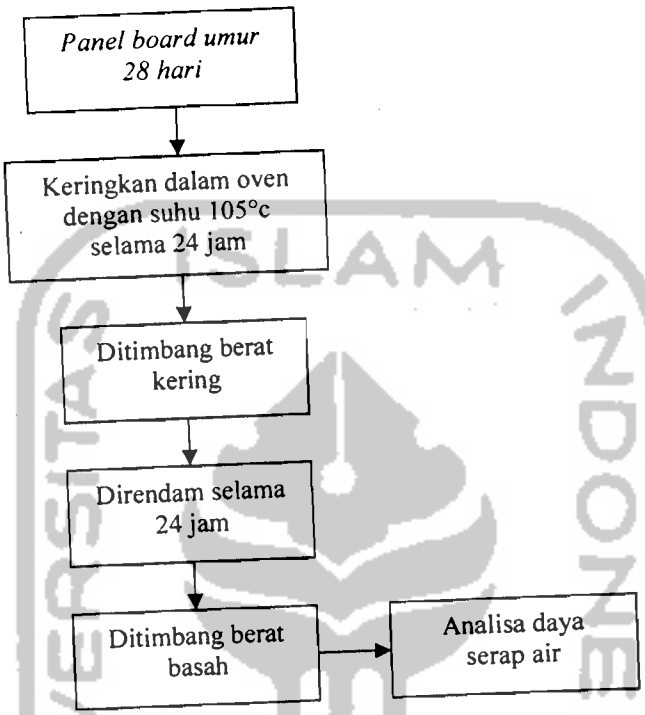
Kolom 14 = ((Kolom 7 – Kolom 12)/(Kolom 7)) × 100%

Pelaksanaan Pengujian Kuat Lentur



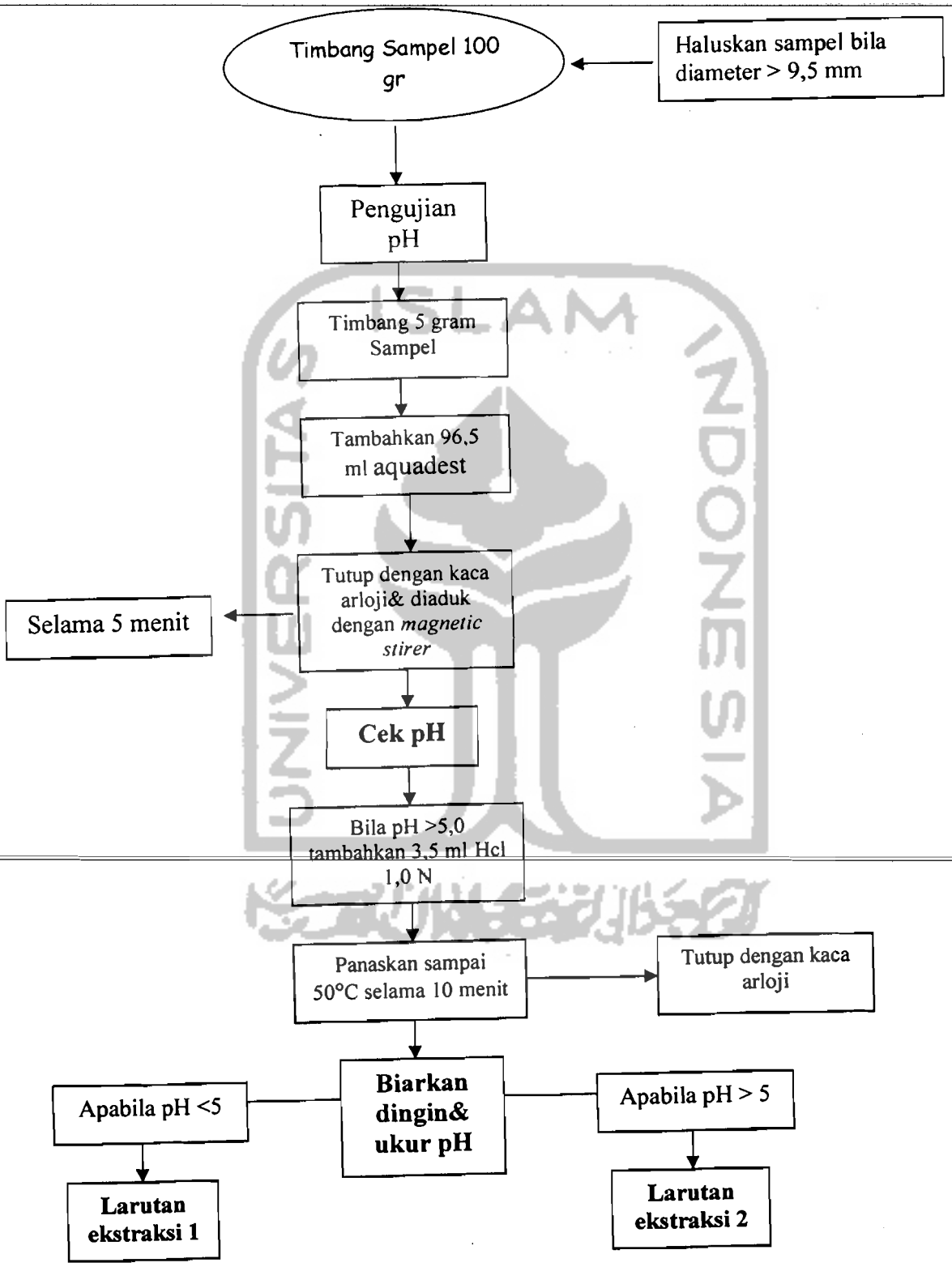
Gambar 3.3 Tahapan Pengujian Kuat Lentur

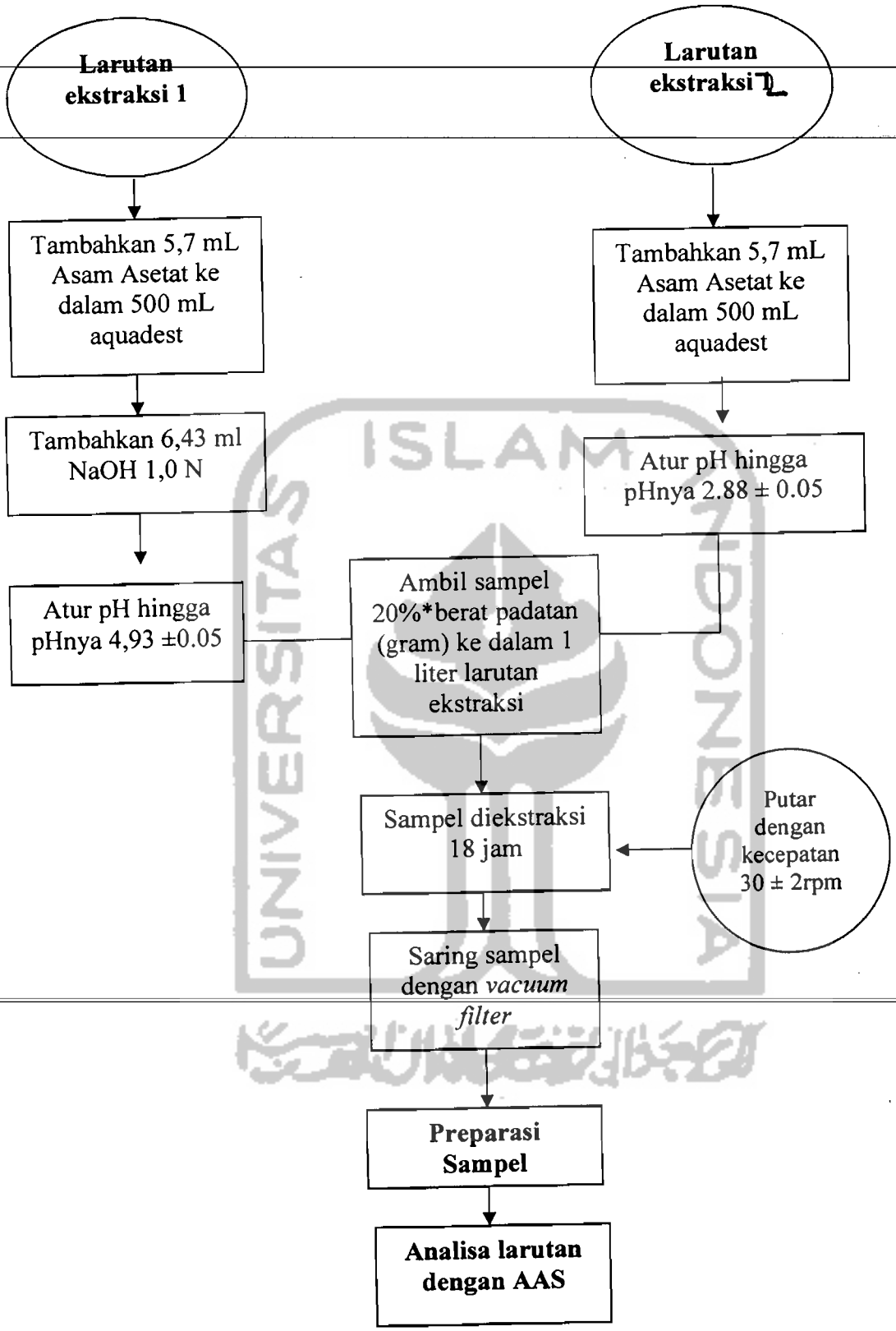
Pelaksanaan pengujian Daya Serap Air



Tahapan Pengujian Daya Serap Air

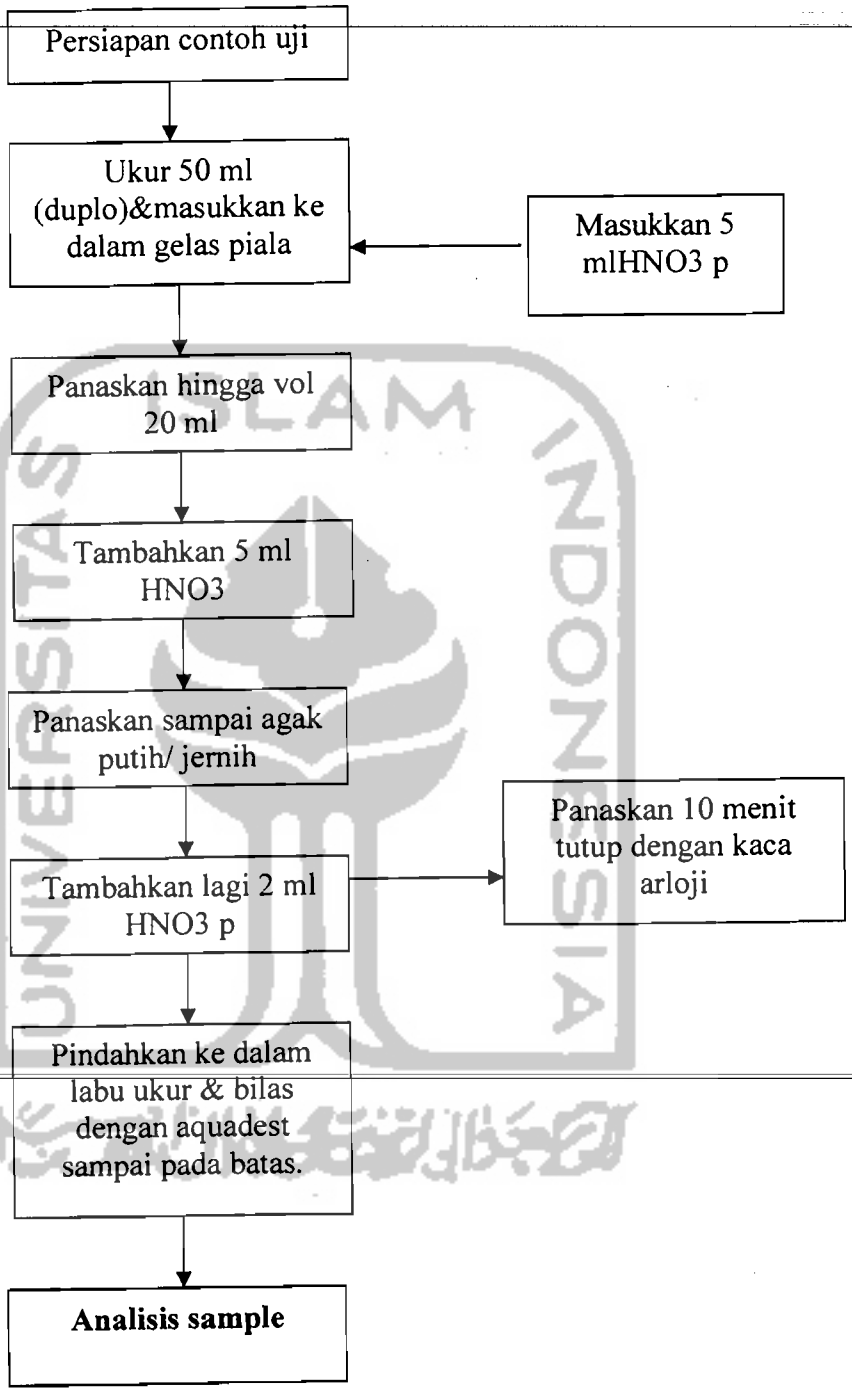
Pelaksanaan Analisa *Leachate*/Lindi dengan metode TCLP





Gambar 3.5 Tahapan Pengujian *Leachate*/Lindi

Pelaksanaan Preparasi Sample



Tahapan Preparasi Sampel

NONVOLATILE TCLP EXTRACTION

1. Perform Preliminary evaluations on the sample.
2. A minimum of 100 grams of extract (solid and liquid phases) is required for this procedure.
3. Ensure that a sufficient quantity of sample is available to ensure that the volume of the TCLP extract will be sufficient to support all of the analyses required.
4. The required TCLP extract volume is sample volume for each test + volume for matrix spikes.

If the Percent solids, as determined in the Preliminary Evaluations, is < 0.5%, then

1. Generate the required volume for analysis by filtering the sample through the filtration device using the procedure as described in **Instructions for Filtering samples**. The filtrate is the TCLP extract. If two phases are present after filtration, process each phase separately and combine the results mathematically.
2. Record the pH of the extract. Aliquot and preserve the extract for sample extraction and analysis. Store extract at 4 °C.

If the Percent solids, as determined in the Preliminary Evaluations, is ≥ 0.5%, then

1. Calculate the amount of sample to generate the required TCLP extract volume.
   a. Amount of sample required for extraction = [(Required TCLP extract volume)/(1 + 19 x Percent solids)]
2. Weigh out the appropriate amount of sample.

1. Proceed to **Particle size reduction** if necessary to reduce the particle size of the sample.

If the **Percent solids**, as determined in the **Preliminary Evaluations**, is ≥ 0.5% and < 100%, then

1. Transfer the sample to the filtration device and separate the liquid phase from the solid phase as described in **Instructions for Filtering samples**. Save the filtrate for recombination with the sample extract or for independent analysis.

Proceed to **Particle size reduction** if necessary to reduce the particle size of the solid phase of the sample.

1. After the particle size of the sample or solid phase has been reduced to meet method requirements, transfer the material (including the filter used to separate the phases) to the extraction vessel.
2. *Note*: A plastic extraction vessel can be used for extracting inorganic analytes. A glass extraction vessel must be used for extracting the organic compounds.

1. Refer to **Extraction fluid determination** for the appropriate extraction fluid.
2. Two methods can be used to calculate the weight of extraction fluid. Wt. of extraction fluid =
   a. [20 x (**Percent solids**) x (sample wt.)] if **Percent solids** is = 100%.
   b. [20 x (sample wt. - wt. of filtrate)] if **Percent solids** is ≥ 0.5% and < 100%.

   Note: Because subsampling errors can occur between the original determination of the **Percent solids** and the selection of the weight of the multiphasic sample for filtration and extraction, calculate the actual weight of filtered solids at the time the material is separated for extraction.
3. Prepare the appropriate extraction fluid as follows:
   a. Extraction fluid #1: Add 5.7 ml of acetic acid for every liter of extraction fluid required to 500 ml of laboratory grade water, add 64.3 ml of 1 N NaOH for every liter of extraction fluid required and dilute to the final volume. Use a pH meter to adjust if necessary, the pH of the solution to 4.93 ± 0.05 with acetic acid or 1 N NaOH.
   b. Extraction fluid #2: Add 5.7 ml of acetic acid for every liter of extraction fluid required to 500 ml of laboratory grade water and dilute to the final volume. Use a pH meter to adjust if necessary, the pH of the solution to 2.88 ± 0.05 with acetic acid or 1 N NaOH.
4. Add the extraction fluid to the extraction vessel.
5. Wrap Teflon tape around the threads of the extraction vessel.
6. Close the extraction vessel.
7. Place the extraction vessel in the TCLP rotation device, secure the vessel, and rotate the vessel at 30 rpm for 18 ± 2 hrs.
8. Ambient temperature in the extraction room shall be maintained at 23 ± 2 °C during agitation.
9. *Note*: As agitation continues, pressure may build up within the vessel for some types of solids. To relieve excess pressure, the extractor vessel may be periodically opened inside a fume hood.
10. Filter the sample as described in **Instructions for Filtering samples**. The filter may be changed, if necessary to facilitate filtration.
11. Save filtrate and discard solids.

If the **Percent solids** = 100%

1. Record the pH of the TCLP extract and aliquot and preserve the extract for sample extraction and analysis. Store extract at 4 °C.

If original sample contained one or more liquid phase(s) and the extract is *miscible* with the filtrate,

1. Combine the extract with filtrate, this becomes the TCLP extract
2. Record the pH of the TCLP extract and aliquot and preserve the extract for sample extraction and analysis. Store extract at 4 °C.

If original sample contained one or more liquid phase(s) and the extract is not *miscible* with the filtrate.

1. Record the pH of the extract.
2. Record the pH of the filtrate
3. Aliquot and preserve the extract and filtrate separately for sample extraction and analysis. Store extract and filtrate at 4 °C
4. Combine results from the analyses for the extract and filtrate mathematically according to the volume ratio of the original phases
   a. Final analyte concentration = $[(V_1) \times (C_1) + (V_2) \times (C_2)]/[V_1 + V_2]$
      i V_1 = the volume of the first phase (L)
      ii C_1 = the concentration of the analyte of concern in the first phase (mg/L)
      iii V_2 = the volume of the second phase (L).
      iv C_2 = the concentration of the analyte of concern in the second phase (mg/L)

Compare the analyte concentrations in the TCLP extract with the levels identified in the appropriate regulations.

PRELIMINARY EVALUATIONS

[illegible]

Percent solids

1. Percent solids is defined as that fraction of a waste sample from which no liquid may be forced out by an applied pressure, as described below.
2. If the waste will obviously yield no liquid when subject to pressure filtration (i.e. is 100% solids), Proceed to **Particle size reduction**.
3. If the sample contains one or more liquid phase(s):
   a. Determine and record the volume of each phase of the sample.
   b. Determine the percent solids by using the filtration device.
4. *Note*: Some wastes, such as oily wastes, obviously contain some material that appears to be a liquid. Even after applying vacuum or pressure filtration, this material may not filter. If this is the case, the material inside the filtration device is defined as a solid. Do not replace the filter during the percent solids determination.

If sample contains one or more liquid phase(s):

1. Preweigh the filter, sample container, and the filtrate container.
2. Assemble the filtration device with the filter in place.
3. Weigh out an aliquot of the sample (100 gram minimum) and record the weight.
4. Quantitatively transfer the sample to the filtration device [illegible] to the filtration device. Place the filtration container underneath the filtration device.
5. If sample residue has adhered to the sample container, reweigh the sample container and record the amount of sample transferred to the filtration device.

Follow Instructions for Filtering samples.

Instructions for Filtering samples

1. Apply between [illegible]
2. If there is no [illegible]
3. Proceed to the [illegible]
4. When the [illegible]

Calculate the [illegible]

Calculate Percent solids [illegible]

Percent Dry Solids

If the **percent solids** is ≥ 0.5% and a small amount of liquid is entrapped in the filter, determine Percent dry solids.

1. Remove the solid phase and the filter from the filtration device.
2. Dry the filter and solid phase at 100 °C ± 20 °C until two successive weighings of the filter are within ± 1%. Record the final weight.
   $|100 - [((2^{nd}\text{ wt. of dried filter}) / (1^{st}\text{ wt. of dried filter})) \times 100]| \leq 1\%$
3. *Note*: *Caution* should be used to ensure that the solid phase will not flash (ignite) upon heating and it is recommended that the drying oven is vented to a chemical fume hood.
4. Calculate Percent dry solids: [((wt. of dry waste + filter) - (tare wt. of filter)) / (sample wt.)] x 100.
5. If Percent dry solids is ≥ 0.5%, separate the liquid phase from the solid phase on a fresh aliquot of the sample and perform particle size reduction if necessary and determine the appropriate extraction fluid.

If the Percent solids or Percent Dry solids is < 0.5%, go to Nonvolatile TCLP extraction or

Particle size reduction

If the **Percent solids** or **Percent Dry solids** is ≥ 0.5%, then determine if the solid phase requires particle size reduction.

1. Particle size reduction is required if the solid phase is incapable of passing through a 9.5 mm sieve or if the surface area per gram is less than 3.1 cm^2/g.
2. *Note*. Surface area per gram criteria are meant for filamentous (paper, cloth, and similar) waste materials. Measure the surface area of a portion of the sample with a ruler. Weigh the measured portion of the sample. Divide the area by the weight to calculate surface area per gram and to determine if the reduction of the particle size for the sample is required.
3. If particle size reduction is required, prepare the solid phase of the sample for extraction by grinding, crushing or cutting the solids to meet the particle size requirements.
4. *Note*. If solids require the **Volatile TCLP extraction**, minimize the exposure of the solid phase to the atmosphere and do not generate heat during the particle size reduction step.

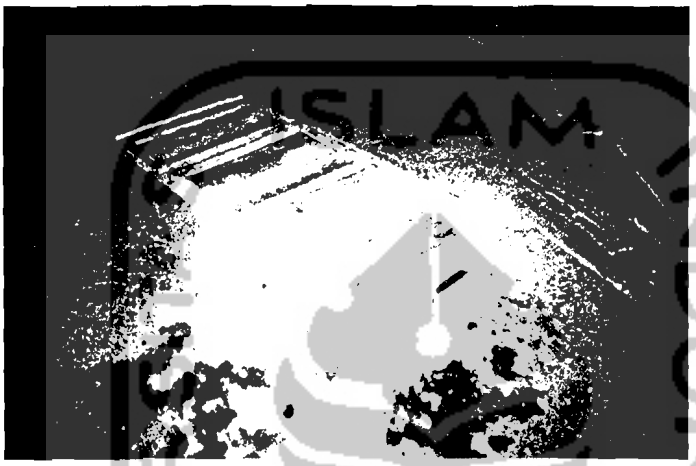
Extraction fluid determination

If the **Percent solids** or **Percent dry solids** is ≥ 0.5%, determine the appropriate extraction fluid for **Nonvolatile TCLP extraction**.
Note: Only extraction fluid #1 is used for the **Volatile TCLP extraction.**

1. Reduce the solid phase (if necessary) to a particle size of approximately 1 mm in diameter and transfer 5 grams to a beaker.
2. Add 96.5 ml of water, cover with a watchglass and stir for 5 minutes. Measure and record the pH.
3. If the pH of the slurry is ≤ 5.0, use extraction fluid #1 for the nonvolatile TCLP extraction.
4. If the pH of the slurry is > 5.0:
   a. Add 3.5 ml of HCl and stir briefly.
   b. Cover the beaker with a watchglass and place on a hotplate.
   c. Heat to 50 °C and hold at 50 °C for 10 minutes.
   d. Let the slurry cool to room temperature and record the pH.
   e. If the pH is ≤ 5.0, use extraction fluid #1, otherwise use extraction fluid #2 for the nonvolatile TCLP extraction.

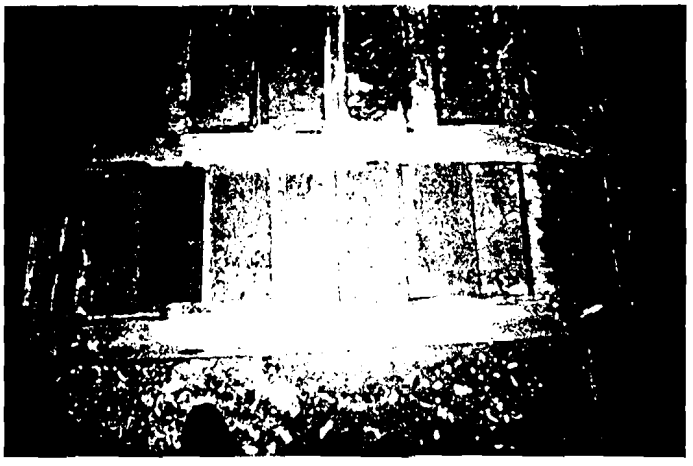
Go to either the Nonvolatile TCLP extraction or the

Penimbangan Fibre

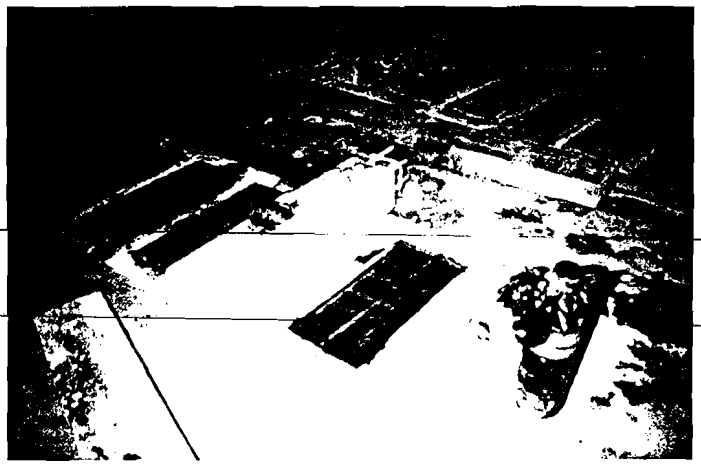


Cetakan *panel board*

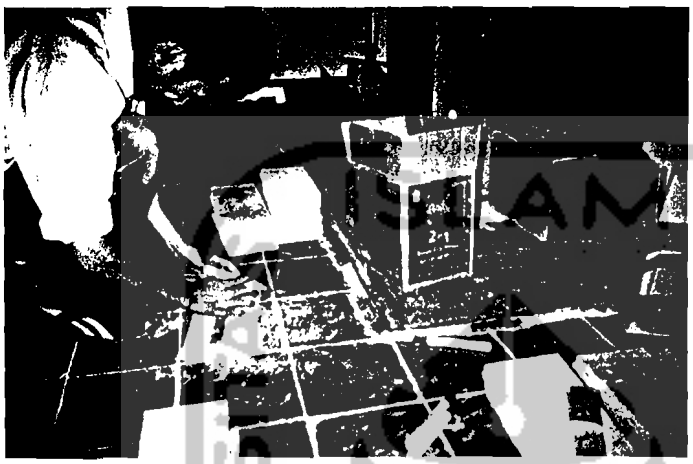
Proses pencetakan



Hasil cetakan

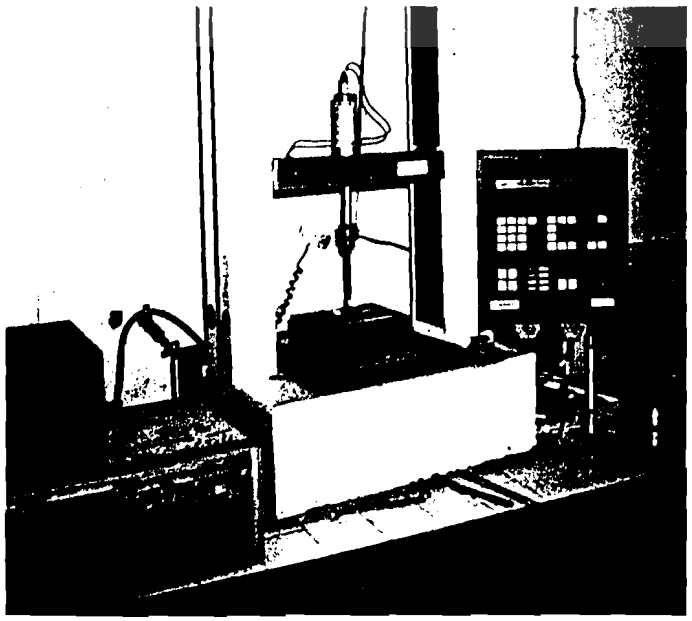


Proses pengepressan



Pengukuran jarak tumpuan

Proses pengeringan



Universal Testing Machine