LAMPIRAN

Lampiran 1. Perhitungan Pembuatan Larutan

1. Pembuatan Larutan KOH 5M dalam Labu Ukur 1000 mL

$$M = \frac{\frac{massa}{Mr}}{Volume\ (L)}$$

$$5 = \frac{\frac{massa}{56,11}}{1}$$

$$5 = \frac{massa}{56,11}$$

$$massa = 5 \times 56,11$$

$$massa = 280,55\ gram$$

2. Pembuatan Larutan Surfaktan HDTMA-Br 300 ppm

$$300\ ppm = \frac{324\ mg}{1000\ mL} = 0,324\ gram$$

3. Pembuatan Larutan Induk RBBR 1000 ppm dalam 1000 mL

$$1000\ ppm = \frac{1105\ mg}{1\ L} = 1,105\ mg$$

4. Pembuatan Larutan Standar RBBR

4.1. Larutan 0 ppm

$$M_1 . V_1 = M_2 . V_2$$

$$1000\ ppm . V_1 = 0\ ppm . 100\ mL$$

$$V_1 = 0\ mL$$

4.2. Larutan 5 ppm

$$M_1 . V_1 = M_2 . V_2$$

$$1000\ ppm . V_1 = 5\ ppm . 100\ mL$$

$$V_1 = 0,5\ mL$$

4.4. Larutan 10 ppm

$M_1 . V_1 = M_2 . V_2$

$1000 \text{ ppm} . V_1 = 0 \text{ ppm} . 100 \text{ mL}$

$V_1 = 1 \text{ mL}$

4.5. Larutan 15 ppm

$M_1 . V_1 = M_2 . V_2$

$1000 \text{ ppm} . V_1 = 15 \text{ ppm} . 100 \text{ mL}$

$V_1 = 1{,}5 \text{ mL}$

4.6. Larutan 20 ppm

$M_1 . V_1 = M_2 . V_2$

$1000 \text{ ppm} . V_1 = 20 \text{ ppm} . 100 \text{ mL}$

$V_1 = 2 \text{ mL}$

4.7. Larutan 25 ppm

$M_1 . V_1 = M_2 . V_2$

$1000 \text{ ppm} . V_1 = 25 \text{ ppm} . 100 \text{ mL}$

$V_1 = 2{,}5 \text{ mL}$

Lampiran 2. Perhitungan Hasil UV-Vis

1. **Perhitungan Konsentrasi Awal (Co)**

   Persamaan Kurva Kalibrasi : y = 0,0528x + 0,0114

   Larutan standar yang dipakai untuk di adsorpsi : 25 ppm dengan nilai absorbansi 0,2672.

   y = = 0,0105x + 0,0037

   0,2672 = 0,0105x + 0,0037

   $x = \frac{0{,}2672 - 0{,}0037}{0{,}0105}$

   Ce = 25,095 ppm

2. Perhitungan Efisiensi Adsorpsi (%)

2.1 Waktu Optimum

No	Waktu (menit)	Co (ppm)	Ce (ppm)		
			K	KA	KA-HDTMA
1	30	25,095	0,897	0,911	0,673
2	45	25,095	0,863	0,440	0,140
3	60	25,095	0,543	0,660	0,157
4	75	25,095	0,845	0,620	0,421
5	90	25,095	0,789	0,571	0,353

2.1.1 Karbon (K)

a. 30 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}897)}{25{,}095} \times 100\%$$

$$E = 96{,}42\%$$

b. 45 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}863)}{25{,}095} \times 100\%$$

$$E = 96{,}56\%$$

c. 60 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}543)}{25{,}095} \times 100\%$$

$$E = 97{,}83\%$$

d. 75 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}845)}{25{,}095} \times 100\%$$

$$E = 96{,}63\%$$

e. 90 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}789)}{25{,}095} \times 100\%$$

$$E = 96{,}85\%$$

2.1.2 Karbon Aktif (KA)

a. 30 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}911)}{25{,}095} \times 100\%$$

$$E = 96{,}36\%$$

b. 45 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}440)}{25{,}095} \times 100\%$$

$$E = 98{,}24\%$$

c. 60 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}660)}{25{,}095} \times 100\%$$

$$E = 97{,}36\%$$

d. 75 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}620)}{25{,}095} \times 100\%$$

$$E = 97{,}52\%$$

e. 90 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}571)}{25{,}095} \times 100\%$$

$$E = 97{,}72\%$$

2.1.3 Karbon Aktif dengan Surfaktan HDTMA-Br (KA-HDTMA)

a. 30 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}673)}{25{,}095} \times 100\%$$

$$E = 97{,}31\%$$

b. 45 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}140)}{25{,}095} \times 100\%$$

$$E = 99{,}44\%$$

c. 60 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}157)}{25{,}095} \times 100\%$$

$$E = 99{,}37\%$$

d. 75 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}421)}{25{,}095} \times 100\%$$

$$E = 98{,}32\%$$

e. 90 menit

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}353)}{25{,}095} \times 100\%$$

$$E = 98{,}59\%$$

2.2 Pengaruh Massa

No	Massa (gram)	Co (ppm)	Ce (ppm)		
			K	KA	KA-HDTMA
1	0,0425	25,095	4,012	1,678	0,962
2	0,0718	25,095	2,452	0,953	0,046
3	0,1013	25,095	2,050	1,488	0,593
4	0,1320	25,095	1,963	1,476	0,568
5	0,1631	25,095	1,910	1,409	0,574

2.2.1 Karbon (K)

a. 0,0425 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 4{,}012)}{25{,}095} \times 100\%$$

$$E = 84{,}01\%$$

b. 0,0718 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 2{,}452)}{25{,}095} \times 100\%$$

$$E = 90{,}22\%$$

c. 0,1013 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 2{,}050)}{25{,}095} \times 100\%$$

$$E = 91{,}83\%$$

d. 0,1320 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}963)}{25{,}095} \times 100\%$$

$$E = 92{,}17\%$$

e. 0,1631 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}910}{25{,}095} \times 100\%$$

E = 92,38%

2.2.2 Karbon Aktif (KA)

a. 0,0425 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}678)}{25{,}095} \times 100\%$$

E = 93,31%

b. 0,0718 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}953)}{25{,}095} \times 100\%$$

E =96,20%

c. 0,1013 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}488)}{25{,}095} \times 100\%$$

E = 94,07%

d. 0,1320 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}467)}{25{,}095} \times 100\%$$

E = 94,15%

e. 0,1631 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 1{,}409)}{25{,}095} \times 100\%$$

E = 94,38%

2.2.3 Karbon Aktif dengan Surfaktan HDTMA-Br (KA-HDTMA)

a. 0,0425 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}962)}{25{,}095} \times 100\%$$

$$E = 96{,}16\%$$

b. 0,0718 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}046}{25{,}095} \times 100\%$$

$$E = 99{,}81\%$$

c. 0,1013 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}593)}{25{,}095} \times 100\%$$

$$E = 97{,}63\%$$

d. 0,1320 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}568)}{25{,}095} \times 100\%$$

$$E = 97{,}73\%$$

e. 0,1631 gram

$$E = \frac{(Co - Ce)}{Co} \times 100\%$$

$$E = \frac{(25{,}095 - 0{,}537)}{25{,}095} \times 100\%$$

$$E = 97{,}86\%$$

Lampiran 3. Perhitungan Hasil TOC

1. Efisiensi Surfaktan yang Terikat pada Karbon Aktif

Diketahui :

TOC surfaktan awal = 135,5 mg/L

TOC surfaktan akhir = 94,03 mg/L

$$\%\text{Efisiensi} = \frac{(\text{TOC surfaktan awal} - \text{TOC surfaktan akhir})}{\text{TOC surfaktan awal}} \times 100\%$$

$$\%\text{Efisiensi} = \frac{(135{,}5\ \frac{mg}{L} - 94{,}03\ \frac{mg}{L})}{135{,}5\ \frac{mg}{L}} \times 100\%$$

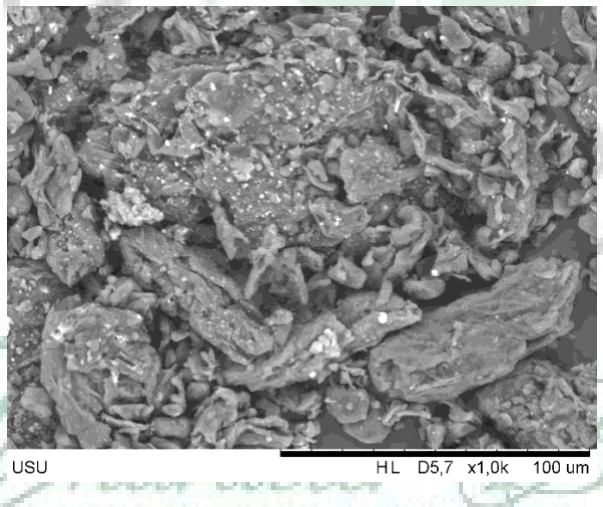
%Efisiensi = 30,60%

Lampiran 4. Hasil Karakterisasi

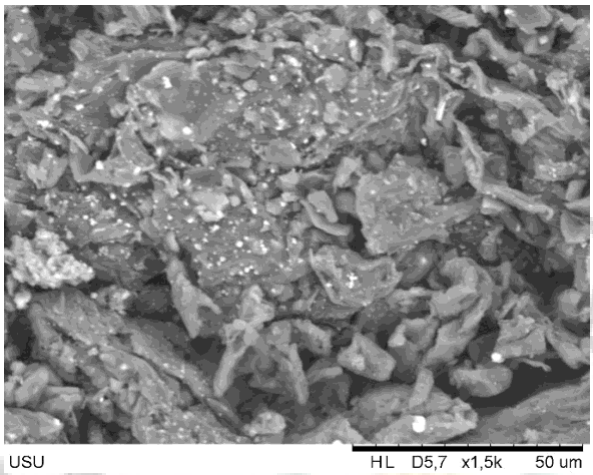
1. Hasil SEM

1.1. Karbon (K)

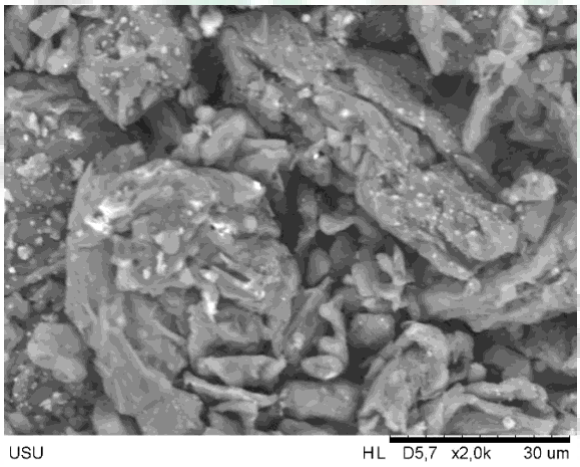
a. Perbesaran 1000x



b. Perbesaran 1500x

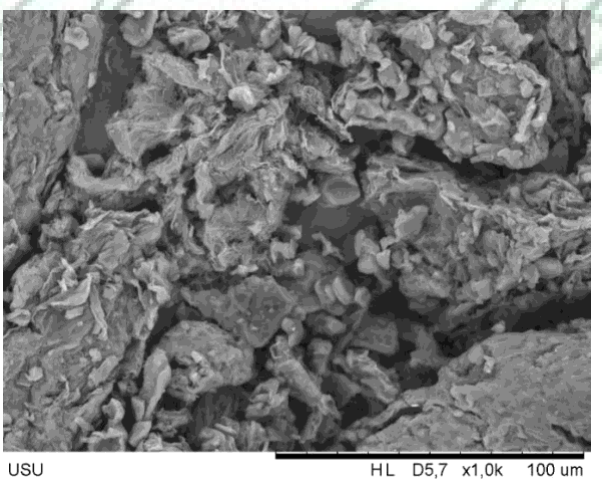


c. Perbesaran 2000x

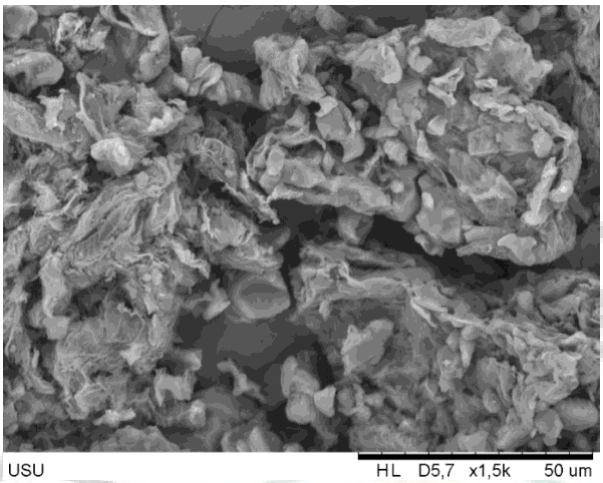


1.2. Karbon Aktif (KA)

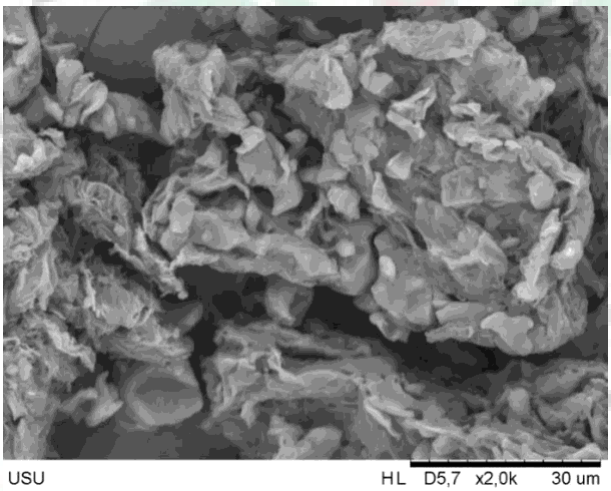
a. Perbesaran 1000x



b. Perbesaran 1500x

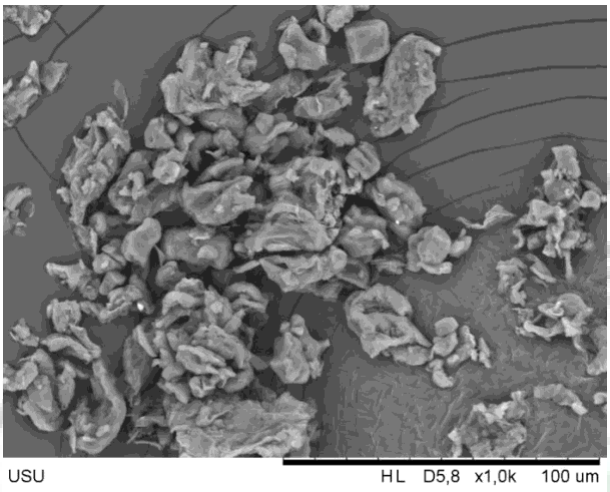


c. Perbesaran 2000x

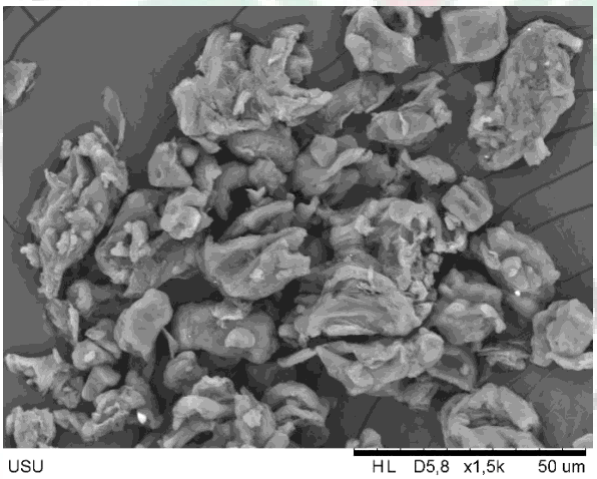


1.3. Karbon Aktif dengan Surfaktan HDTMA-Br (KA-HDTMA)

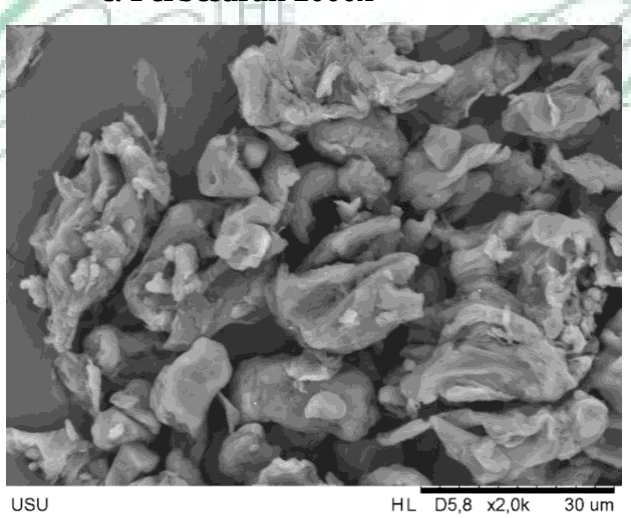
a. Perbesaran 1000x



b. Perbesaran 1500x

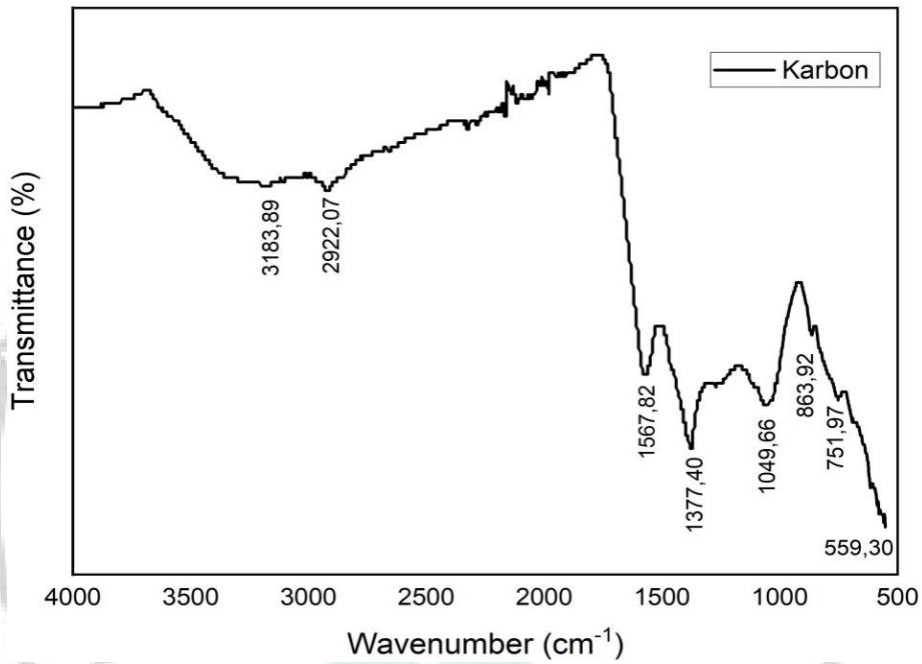


c. Perbesaran 2000x

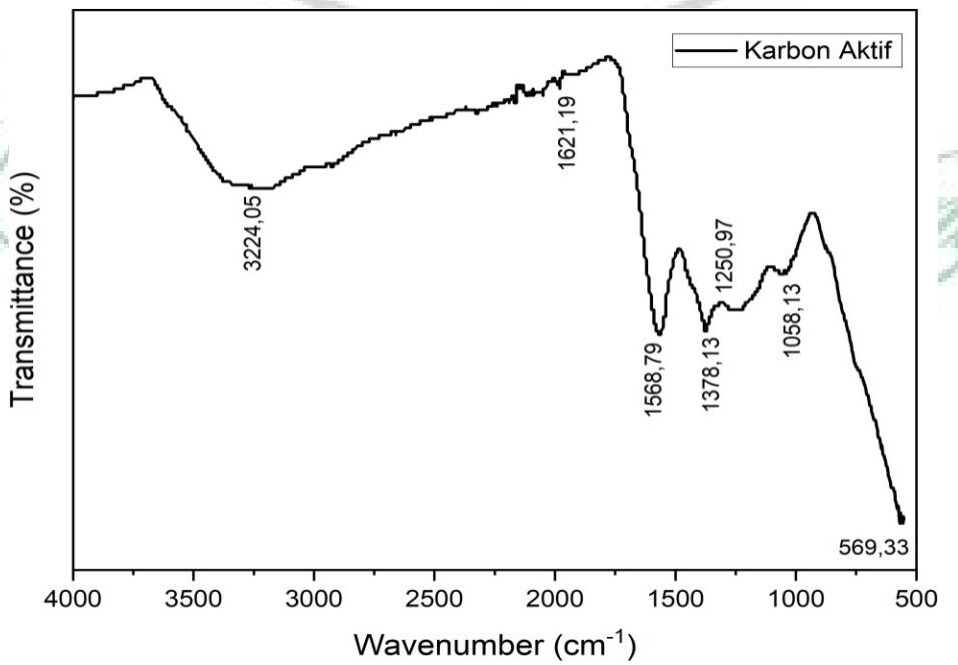


2. Hasil FTIR

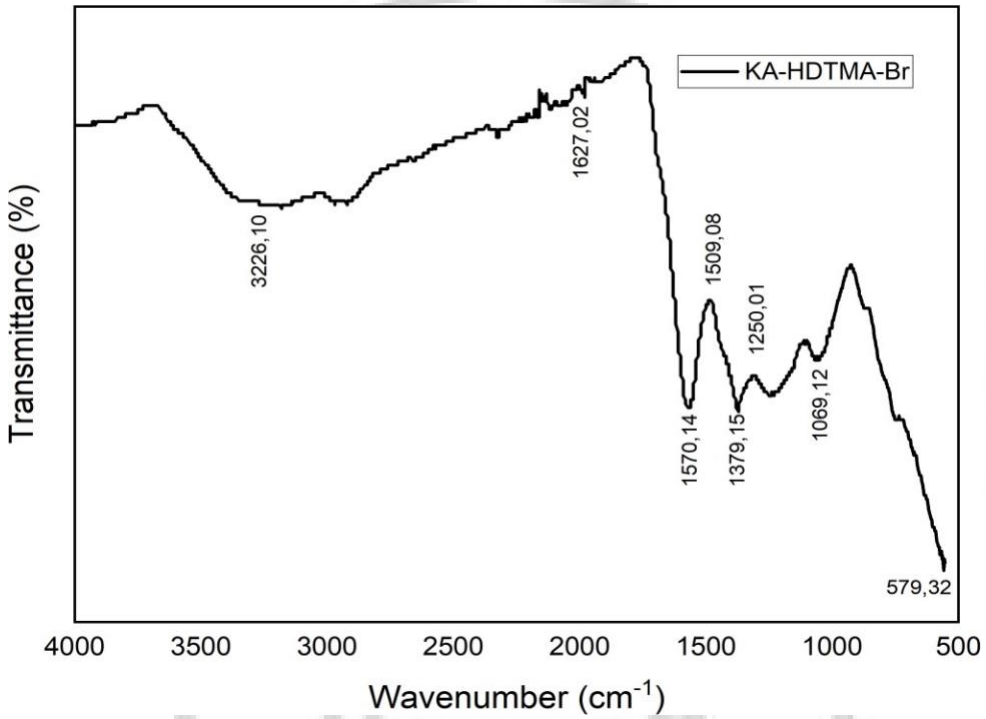
2.1. Karbon (K)



2.2. Karbon Aktif (KA)



2.1. Karbon Aktif dengan Surfaktan HDTMA-Br (KA-HDTMA)



KEMENTERIAN KEUANGAN REPUBLIK INDONESIA
DIREKTORAT JENDERAL BEA DAN CUKAI
KANTOR WILAYAH DJBC SUMATERA UTARA
BALAI LABORATORIUM BEA DAN CUKAI KELAS II MEDAN
JALAN SUMATERA No. 115 BELAWAN 20411
TELEPON : 061-6946238 FAKSIMILI : 061-6945705 SURAT ELEKRONIK : [redacted]

SERTIFIKAT HASIL ANALISA
Nomor : S-17/SHA/BLBC.22/2024

Nama Contoh Uji	: 1. Karbon 2. Karbon aktif 3. Karbon HDTMA Br
Merk Contoh Uji	: -
Tipe Contoh Uji	: -
Pengirim	: Khoiriyah Nabillah
Alamat Pengirim	: Jl. Pembangunan Tuntungan II Pancur Batu
No. Tlp./ Fax.	: 085763920983
No. /Tgl Form Permohonan	: 2035/ 28.03.2024
Tanggal Diterima	: 28 Maret 2024
Tanggal Selesai	: 28 Maret 2024

I. **Hasil Pengujian**

No	Parameter Uji		Instrumen
1.	Karbon FTIR	: Terlampir	FTIR (01/IKA/MT)
2.	Karbon aktif FTIR	: Terlampir	
3.	Karbon HDTMA Br FTIR	: Terlampir	

Dikeluarkan di : Belawan
Tanggal : 28 Maret 2024
Kepala Seksi Teknis Laboratorium

Ade Firman Sonjaya

NB: Hasil pemeriksaan hanya berlaku untuk contoh yang diperiksa

Halaman 1 dari 1

No. Form : 04/PP/F.08/07
Revisi : 00

3. Hasil TOC

3.1. TOC Surfaktan Awal

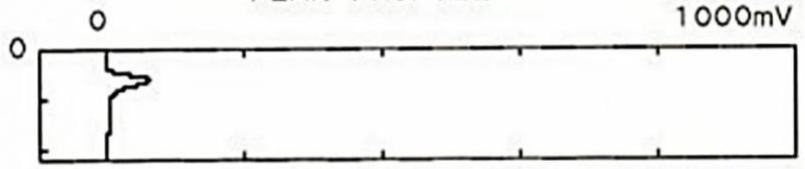
I5.2024 LSUMP 382

SAMPLE NAME : I5 2024 ✓

TYPE : TC
[INJ 20uL, C# TC4 , DL 1,
ACID 0.0%, #WASH 2]

#	AREA	mg/L	C#	INJ	DL
1	247.7	146.5	TC4	20	1

PEAK PROFILE



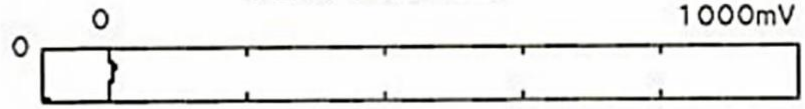
SAMPLE NAME : I5 2024

TYPE : IC
[INJ 32uL, C# IC3 , DL 1,
ACID 0.0%, #WASH 2]

#	AREA	mg/L	C#	INJ	DL
1	18.57	-3.125	IC3	32	1

TOC (TC-IC) : 135.5 mg/L

PEAK PROFILE



3.2. TOC Surfaktan Akhir

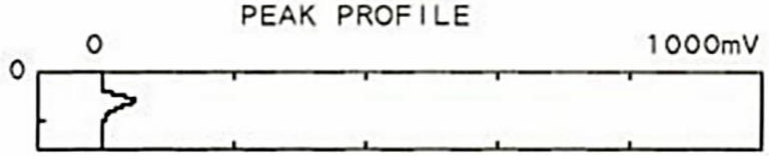
I6.2024 LSUMP 382

SAMPLE NAME : I6 2024 ✓

TYPE : TC
[INJ 20uL, C# TC4 , DL 1,
ACID 0.0%, #WASH 2]

#	AREA	mg/L	C#	INJ	DL
1	171.4	100.4	TC4	20	1

PEAK PROFILE



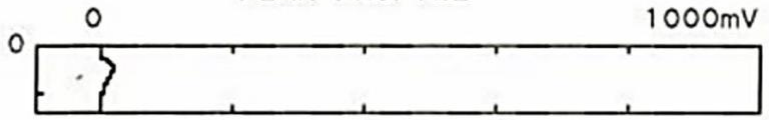
SAMPLE NAME : I6 2024

TYPE : IC
[INJ 32uL, C# IC3 , DL 1,
ACID 0.0%, #WASH 2]

#	AREA	mg/L	C#	INJ	DL
1	202.7	11.24	IC3	32	1

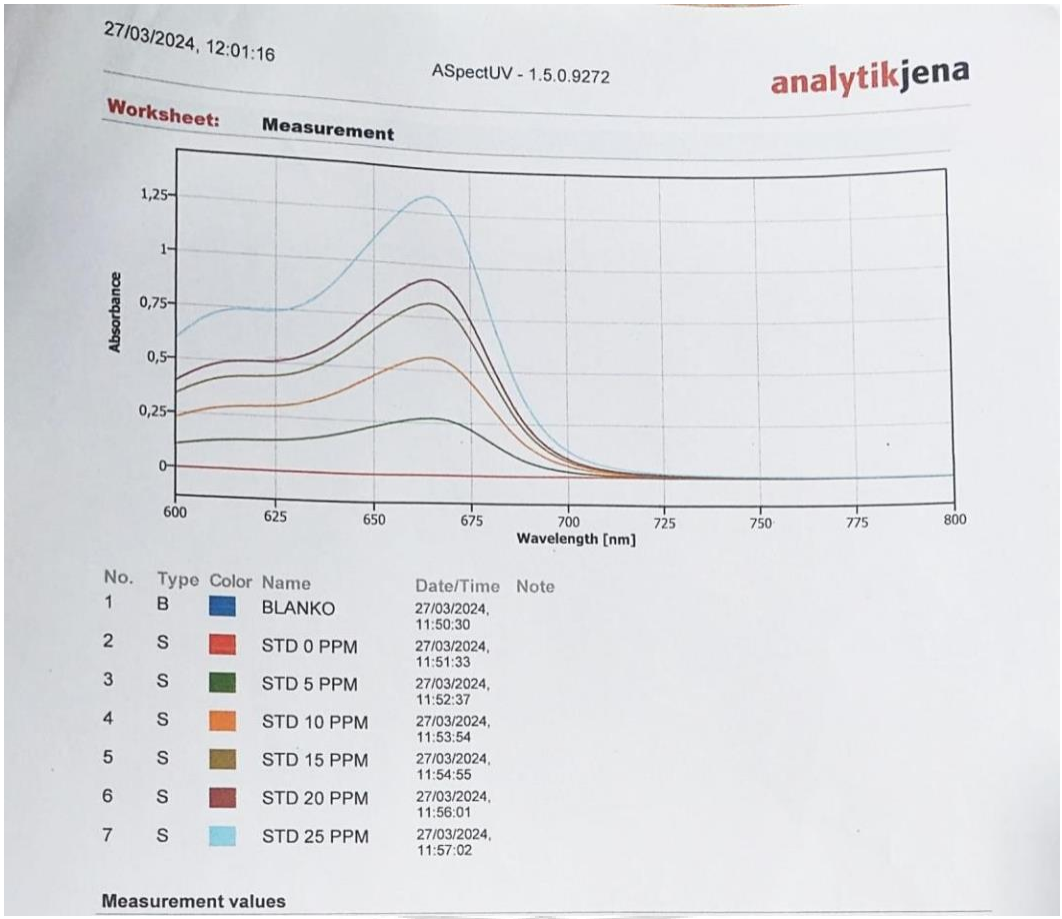
TOC (TC-IC) : 94.03 mg/L

PEAK PROFILE



4. Hasil Spektrofotometer UV-Vis

4.1 Panjang Gelombang

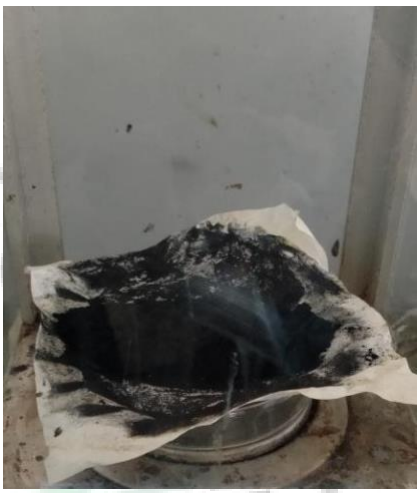


No.	Type	Color	Name	Date/Time	Note
1	B		BLANKO	27/03/2024, 11:50:30	
2	S		STD 0 PPM	27/03/2024, 11:51:33	
3	S		STD 5 PPM	27/03/2024, 11:52:37	
4	S		STD 10 PPM	27/03/2024, 11:53:54	
5	S		STD 15 PPM	27/03/2024, 11:54:55	
6	S		STD 20 PPM	27/03/2024, 11:56:01	
7	S		STD 25 PPM	27/03/2024, 11:57:02	

Measurement values

Lampiran 5. Dokumentasi Penelitian

Gambar 1. Hasil fitrat karbon yang sudah netral



Gambar 2. Hasil pengeringan karbon aktif dengan oven

Gambar 3. Kulit nangka kering sudah dibersihkan

Gambar 6. ditanur selama 2 jam pada suhu 400˚

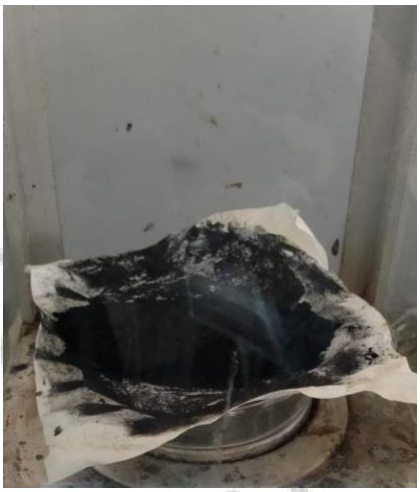
Gambar 4. Hasil karbonisasi dengan ditanur

Gambar 5. Aktivasi karbon secara kimia

Gambar 7. Hasil karbon yang sudah diayak

Gambar 8. Penetralan hasil aktivasi karbon

Gambar 9. Hasil fitrat karbon yang sudah netral



Gambar 10. Hasil pengeringan karbon aktif dengan oven

Gambar 11. Hasil pengontakan karbon aktif dengan surfaktan HDTMA-Br

Gambar 12. Hasil KA HDTMA-Br yang sudah dioven

Gambar 13. Larutan induk metilen biru 1000 ppm

Gambar 14. Larutan standar metilen biru

Gambar 15. Variasi massa karbon setelah adsorpsi

Gambar 16. Variasi massa KA setelah adsorpsi

Gambar 17. Variasi massa KA-HDTMA-Br setelah adsorpsi

Gambar 18. Variasi waktu kontak karbon setelah adsorpsi

Gambar 19. Variasi waktu kontak KA setelah adsorpsi

Gambar 20. Variasi waktu kontak KA-HDTMA-Br setelah adsorpsi