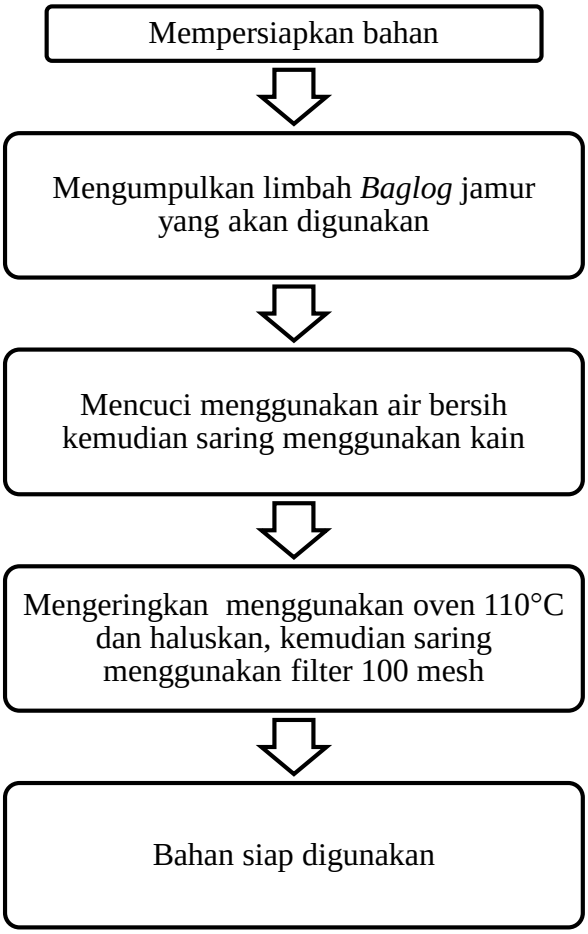
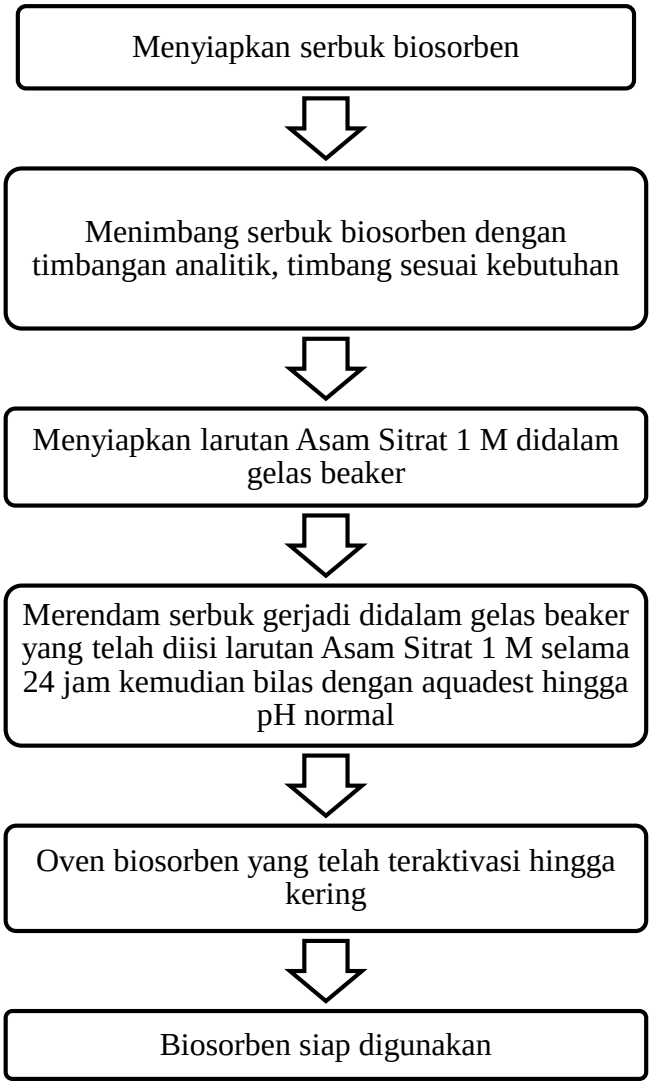
LAMPIRAN I

LANGKAH KERJA PENGUJIAN

a. Persiapan Biosorben *Baglog*

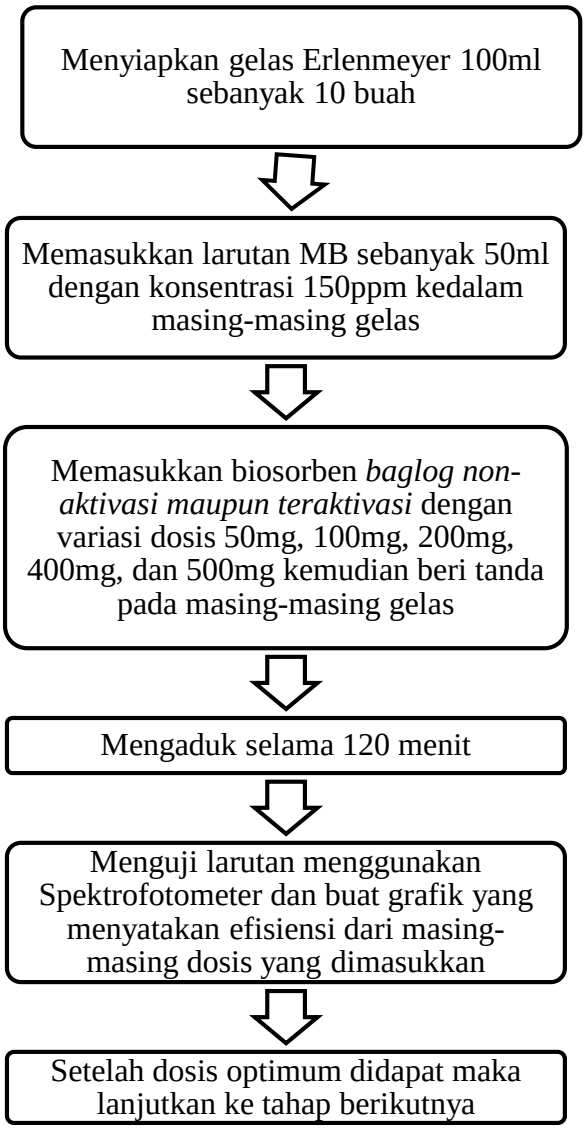


b. Aktivasi Biosorben *Baglog* dengan Asam Sitrat ($C_6H_8O_7$) **1 M**

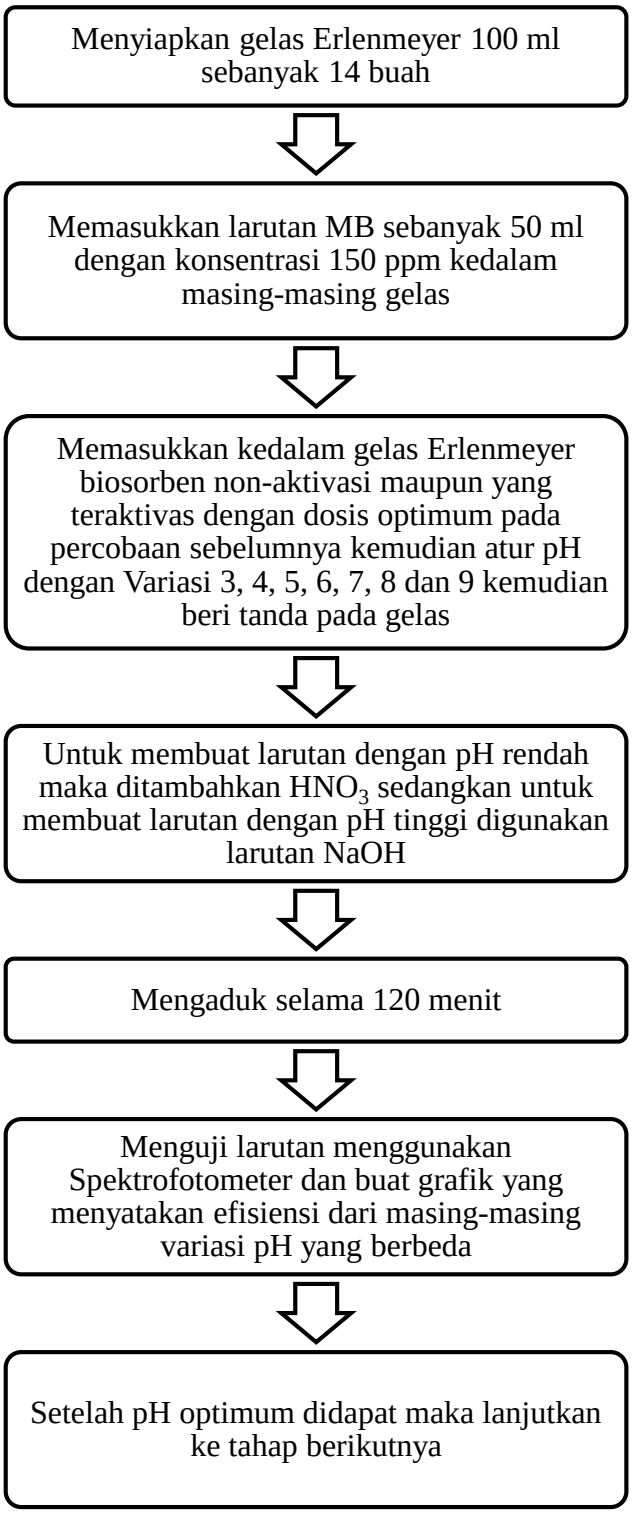


c. Pembuatan Larutan Standar Zat Warna *Methylene Blue* (MB)

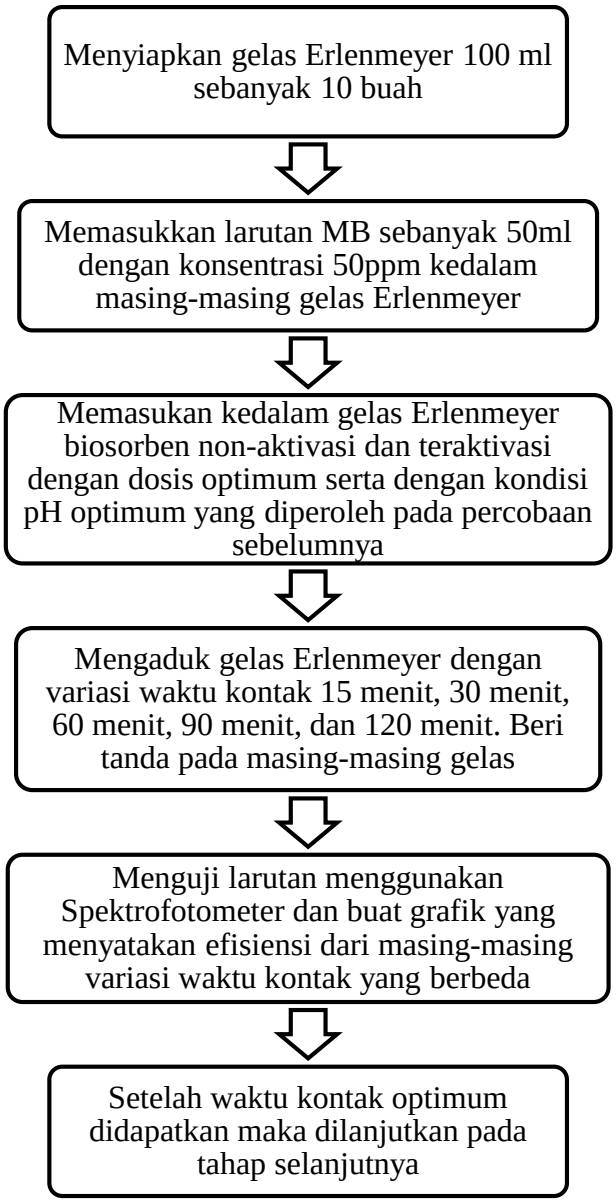
d. Penentuan Massa Optimum



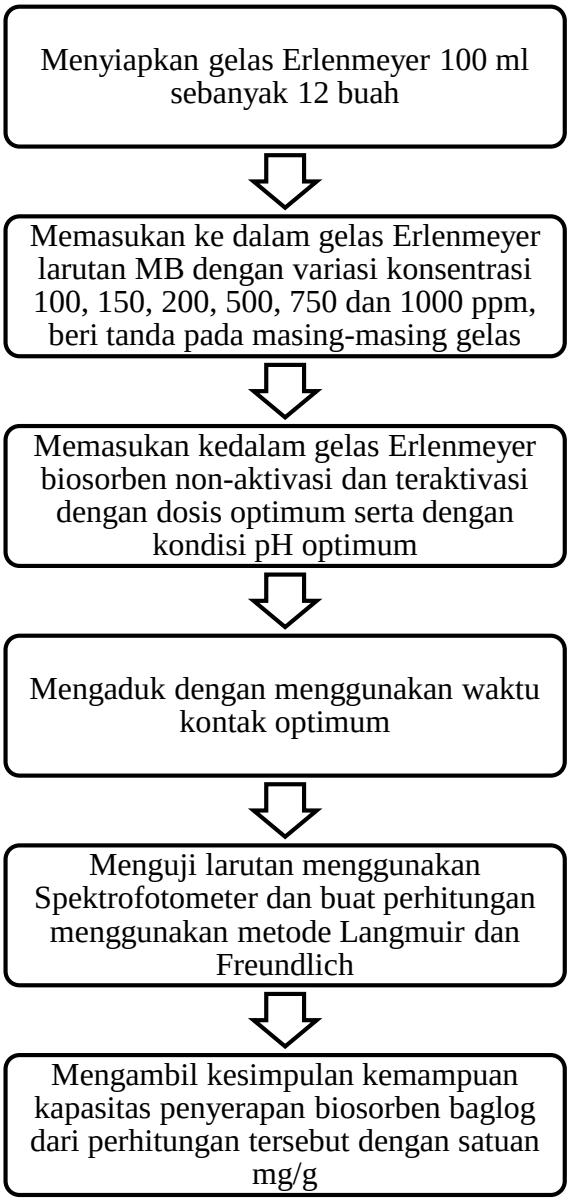
e. Penentuan pH Optimum



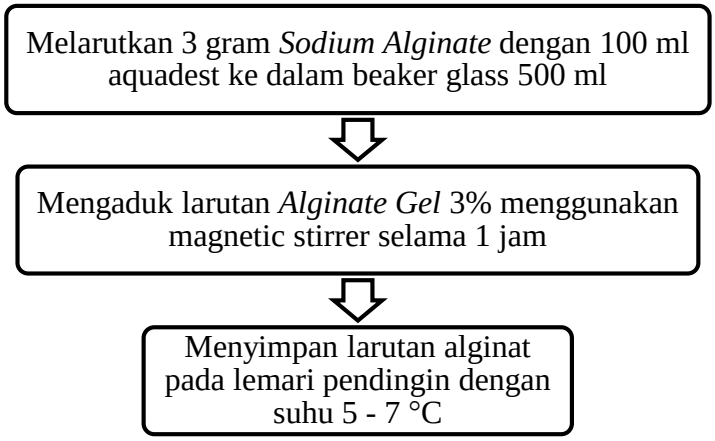
f. Penentuan Waktu Kontak Optimum



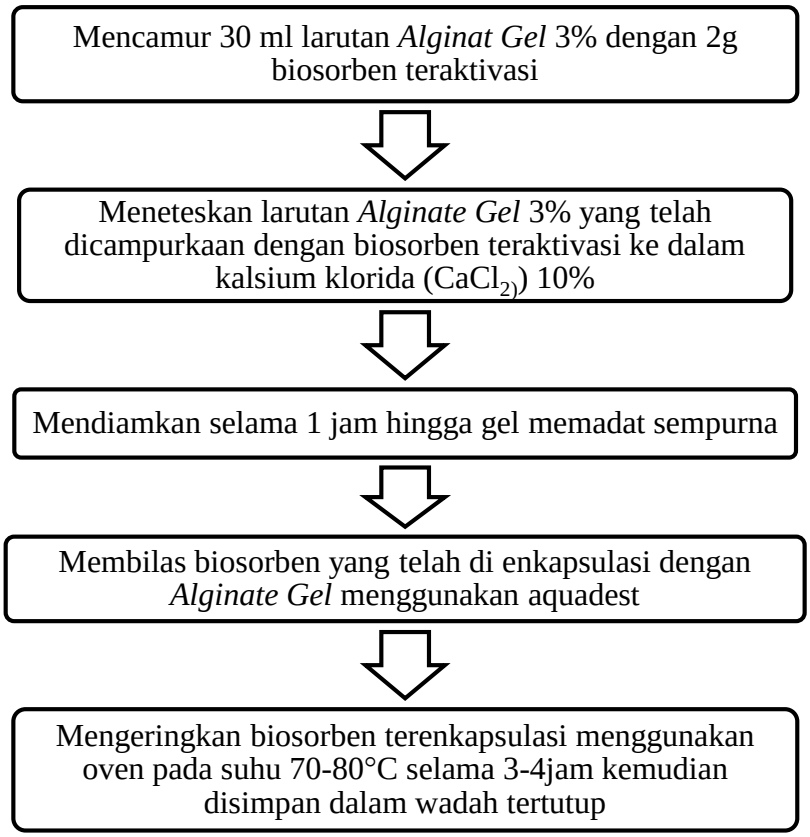
g. Uji Variasi Konsentrasi *Methylene Blue*



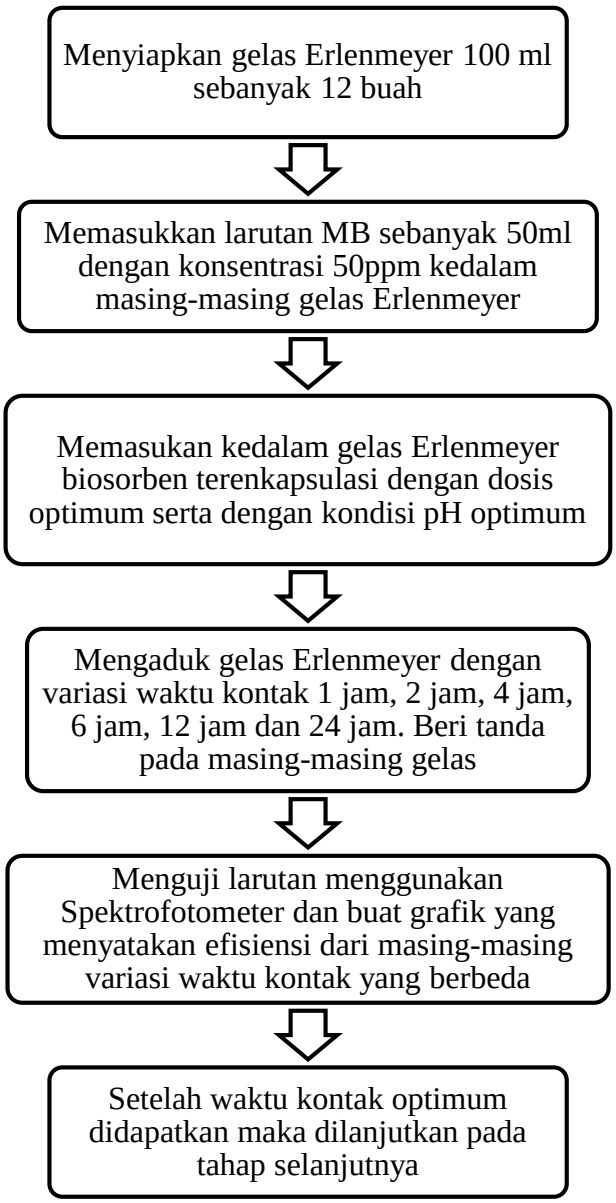
h. Pembuatan Larutan *Alginate Gel* 3%



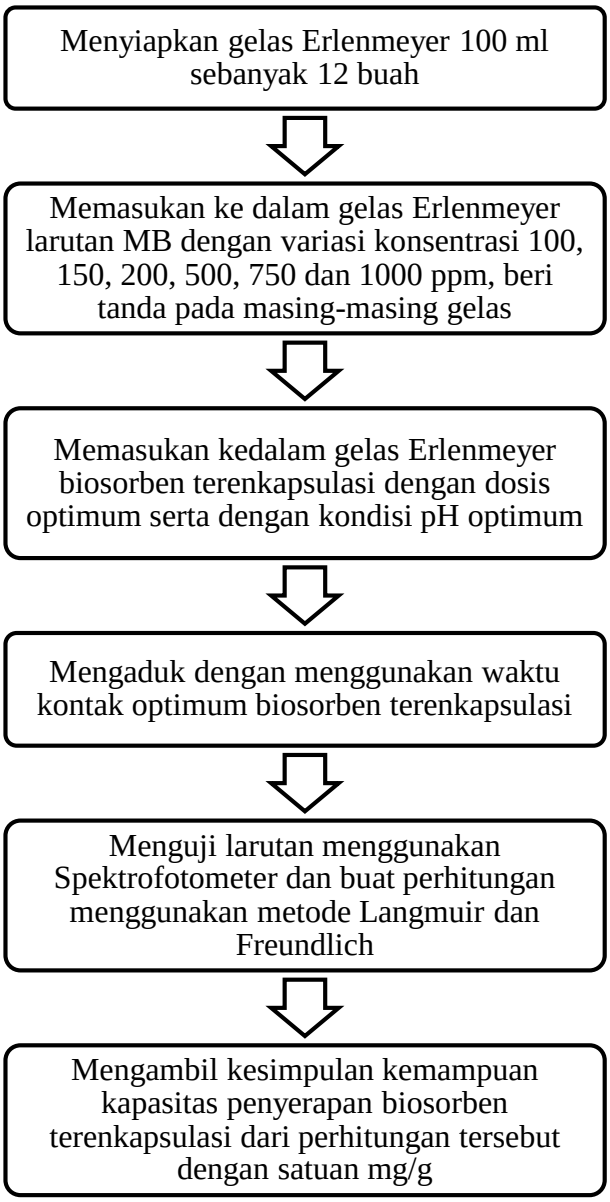
i. Enkapsulasi Biosorben *Baglog* dengan *Alginate Gel*



j. Penentuan Waktu Kontak Optimum Biosorben Terenkapsulasi



k. Uji Efisiensi Kemampuan Biosorben dengan *Alginate Gel*



LAMPIRAN II

GUGUS FUNGSI BIOSORBEN *BAGLOG*

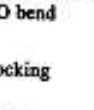
a. Tabel Korelasi Gugus Fungsi

Range (cm^{-1}) and Intensity[a]	Group and Class	Assignment and Remarks
3700–3600 (s)	—OH in alcohols and phenols	OH stretch (dil soln)
3520–3320 (m–s)	—NH_2 in aromatic amines, primary amines and amides	NH stretch (dil soln)
3420–3250 (s)	—OH in alcohols and phenols	OH stretch (solids & liquids)
3360–3340 (m)	—NH_2 in primary amides	NH_2 antisym stretch (solids)
3320–3250 (m)	—OH in oximes	O—H stretch
3300–3250 (m–s)	≡CH in acetylenes	≡CH—H stretch
3300–3280 (s)	—NH in secondary amides	NH stretch (solids); also in polypeptides and proteins
3200–3180 (s)	—NH_2 in primary amides	NH_2 sym stretch (solids)
3200–3000 (v br)	—NH_3^+ in amino acids	NH_3^+ antisym stretch
3100–2400 (v br)	—OH in carboxylic acids	H-bonded OH stretch
3100–3000 (m)	=CH in aromatic and unsaturated hydrocarbons	=C—H stretch
2990–2850 (m–s)	—CH_3 and —CH_2— in aliphatic compounds	CH antisym and sym stretching
2850–2700 (m)	—CH_3 attached to O or N	CH stretching modes
2750–2650 (w–m)	—CHO in aldehydes	overtone of CH bending (Fermi resonance)
2750–2350 (br)	—NH_3^+ in amine hydrohalides	NH stretching modes
2720–2560 (m)	—OH in phosphorus oxyacids	associated OH stretching
2600–2540 (w)	—SH in alkyl mercaptans	S—H stretch; strong in Raman
2410–2280 (m)	—PH in phosphines	P—H stretch; sharp peak
2300–2230 (m)	N≡N in diazonium salts	N≡N stretch, aq soln
2285–2250 (s)	N=C=O in isocyanates	N=C=O antisym stretch
2260–2200 (m–s)	C≡N in nitriles	C≡N stretch
2260–2190 (w–m)	C≡C in alkynes (disubst)	C≡C stretch; strong in Raman
2190–2130 (m)	C≡N in thiocyanates	C≡N stretch
2175–2115 (s)	N≡C in isonitriles	N≡C stretch
2160–2080 (m)	$N=\overset{+}{N}=\overset{-}{N}$ in azides	N=N=N antisym stretch
2140–2100 (w–m)	C≡C in alkynes (monosubst)	C≡C stretch
2000–1650 (w)	substituted benzene rings	several bands from overtone and combination bands
1980–1950 (s)	C=C=C in allenes	C=C=C antisym stretch
1870–1650 (vs)	C=O in carbonyl compounds	C=O stretch
1870–1830 (s)	C=O in β-lactones	C=O stretch
1870–1790 (vs)	C=O in anhydrides	C=O antisym stretch; part of doublet
1820–1800 (s)	C=O in acid halides	C=O stretch; lower for aromatic acid halides
1780–1760 (s)	C=O in γ-lactones	C=O stretch
1765–1725 (vs)	C=O in anhydrides	C=O sym stretch; part of doublet
1760–1740 (vs)	C=O in α-keto esters	C=O stretch; enol form
1750–1730 (s)	C=O in δ-lactones	C=O stretch
1750–1740 (vs)	C=O in esters	C=O stretch; 20 cm^{-1} lower if unsaturated
1740–1720 (s)	C=O in aldehydes	C=O stretch; 30 cm^{-1} lower if unsaturated
1720–1700 (s)	C=O in ketones	C=O stretch; 20 cm^{-1} lower if unsaturated
1710–1690 (s)	C=O in carboxylic acids	C=O stretch; fairly broad
1690–1640 (s)	C=N in oximes	C=N stretch; also imines
1680–1620 (s)	C=O and NH_2 in primary amides	two bands from C=O stretch and NH_2 deformation
1680–1635 (s)	C=O in ureas	C=O stretch; broad band
1680–1630 (m–s)	C=C in alkenes, etc.	C=C stretch
1680–1630 (vs)	C=O in secondary amides	C=O stretch (Amide I band)

[a] v = very, s = strong, m = medium, w = weak, br = broad.

Range (cm^{-1}) and Intensity[a]	Group and Class	Assignment and Remarks
1670–1640 (s–vs)	C=O in benzophenones	C=O stretch
1670–1650 (vs)	C=O in primary amides	C=O stretch (Amide I band)
1670–1630 (vs)	C=O in tertiary amides	C=O stretch
1655–1635 (vs)	C=O in β-ketone esters	C=O stretch; enol form
1650–1620 (w–m)	N—H in primary amides	NH deformation (Amide II band)
1650–1580 (m–s)	NH_2 in primary amines	NH_2 deformation
1640–1580 (s)	NH_3^+ in amino acids	NH_3 deformation
1640–1580 (vs)	C=O in β-diketones	C=O stretch; enol form
1620–1610 (s)	C=C in vinyl ethers	C=C stretch; doublet due to rotational isomerism
1615–1590 (m)	benzene ring in aromatic compounds	ring stretch; sharp peak
1615–1565 (s)	pyridine derivatives	ring stretch; doublet
1610–1580 (s)	NH_2 in amino acids	NH_2 deformation; broad band
1610–1560 (vs)	COO^- in carboxylic acid salts	antisym stretch
1590–1580 (m)	NH_2 primary alkyl amide	NH_2 deformation (Amide II band)
1575–1545 (vs)	NO_2 in aliphatic nitro compounds	NO_2 antisym stretch
1565–1475 (vs)	NH in secondary amides	NH deformation (Amide II band)
1560–1510 (s)	triazine compounds	ring stretch; sharp band
1550–1490 (s)	NO_2 in aromatic nitro compounds	NO_2 antisym stretch
1530–1490 (s)	NH_3^+ in amino acids or hydrochlorides	NH_3^+ deformation
1530–1450 (m–s)	N=N—O in azoxy compounds	N=N—O antisym stretch
1515–1485 (m)	benzene ring in aromatic compounds	ring stretch, sharp band
1475–1450 (vs)	CH_2 in aliphatic compounds	CH_2 scissors vibration
1465–1440 (vs)	CH_3 in aliphatic compounds	CH_3 antisym deformation
1440–1400 (m)	OH in carboxylic acids	in-plane OH bending
1420–1400 (m)	C—N in primary amides	C—N stretch (Amide III band)
1400–1370 (m)	*t*-butyl group	CH_3 deformations (two bands)
1400–1310 (s)	COO^- group in carboxylic acid salts	sym stretch; broad band
1390–1360 (vs)	SO_2 in sulfonyl chlorides	SO_2 antisym stretch
1380–1370 (s)	CH_3 in aliphatic compounds	CH_3 sym deformation
1380–1360 (m)	isopropyl group	CH_3 deformations (two bands)
1375–1350 (s)	NO_2 in aliphatic nitro compounds	NO_2 sym stretch
1360–1335 (vs)	SO_2 in sulfonamides	SO_2 antisym stretch
1360–1320 (vs)	NO_2 in aromatic nitro compounds	NO_2 sym stretch
1350–1280 (m–s)	N=N—O in azoxy compounds	N=N—O sym stretch
1335–1295 (vs)	SO_2 in sulfones	SO_2 antisym stretch
1330–1310 (m–s)	CF_3 attached to a benzene ring	CF_3 antisym stretch
1300–1200 (vs)	$\overset{+}{N}—\bar{O}$ in pyridine *N*-oxides	N—O stretch
1300–1175 (vs)	P=O in phosphorus oxyacids and phosphates	P=O stretch
1300–1000 (vs)	C—F in aliphatic fluoro compounds	C—F stretch
1285–1240 (vs)	Ar—O in alkyl aryl ethers	C—O stretch
1280–1250 (vs)	$Si—CH_3$ in silanes	CH_3 sym deformation
1280–1240 (m–s)	in epoxides	C—O stretch
1280–1180 (s)	C—N in aromatic amines	C—N stretch
1280–1150 (vs)	C—O—C in esters, lactones	C—O—C antisym stretch

Range (cm^{-1}) and Intensity[a]	Group and Class	Assignment and Remarks
1255–1240 (m)	*t*-butyl in hydrocarbons	skeletal vibration; second band near 1200 cm^{-1}
1245–1155 (vs)	SO_3H in sulfonic acids	S=O stretch
1240–1070 (s–vs)	C—O—C in ethers	C—O—C stretch; also in esters
1230–1100 (s)	C—C—N in amines	C—C—N bending
1225–1200 (s)	C—O—C in vinyl ethers	C—O—C antisym stretch
1200–1165 (s)	SO_2Cl in sulfonyl chlorides	SO_2 sym stretch
1200–1015 (vs)	C—OH in alcohols	C—O stretch
1170–1145 (s)	SO_2NH_2 in sulfonamides	SO_2 sym stretch
1170–1140 (s)	SO_2— in sulfones	SO_2 sym stretch
1160–1100 (m)	C=S in thiocarbonyl compounds	C=S stretch; strong in Raman
1150–1070 (vs)	C—O—C in aliphatic ethers	C—O—C antisym stretch
1120–1080 (s)	C—O—H in secondary or tertiary alcohols	C—O stretch
1120–1030 (s)	C—NH_2 in primary aliphatic amines	C—N stretch
1100–1000 (vs)	Si—O—Si in siloxanes	Si—O—Si antisym stretch
1080–1040 (s)	SO_2H in sulfonic acids	SO_2 sym stretch
1065–1015 (s)	CH—O—H in cyclic alcohols	C—O stretch
1060–1025 (vs)	CH_2—O—H in primary alcohols	C—O stretch
1060–1045 (vs)	S=O in alkyl sulfoxides	S=O stretch
1055–915 (vs)	P—O—C in organophosphorus compounds	P—O—C antisym stretch
1030–950 (w)	carbon ring in cyclic compounds	ring breathing mode; strong in Raman
1000–950 (s)	CH=CH_2 in vinyl compounds	=CH out-of-plane deformation
980–960 (vs)	CH=CH— in trans disubstituted alkenes	=CH out-of-plane deformation
950–900 (vs)	CH=CH_2 in vinyl compounds	CH_2 out-of-plane wag
900–865 (vs)	$CH_2=C(R)(R')$ in vinylidenes	CH_2 out-of-plane wag
890–805 (vs)	1,2,4-trisubst benzenes	CH out-of-plane deformation (two bands)
860–760 (vs, br)	R—NH_2 primary amines	NH_2 wag
860–720 (vs)	Si—C in organosilicon compounds	Si—C stretch
850–830 (vs)	1,3,5-trisubst benzenes	CH out-of-plane deformation
850–810 (vs)	Si—CH_3 in silanes	Si—CH_3 rocking
850–790 (m)	CH=$C(R)(R')$ in trisubst alkenes	CH out-of-plane deformation
850–550 (m)	C—Cl in chloro compounds	C—Cl stretch
830–810 (vs)	*p*-disubst benzenes	CH out-of-plane deformation
825–805 (vs)	1,2,4-trisubst benzenes	CH out-of-plane deformation
820–800 (s)	triazines	CH out-of-plane deformation
815–810 (s)	CH=CH_2 in vinyl ethers	CH_2 out-of-plane wag
810–790 (vs)	1,2,3,4-tetrasubst benzenes	CH out-of-plane deformation
800–690 (vs)	*m*-disubst benzenes	CH out-of-plane deformation (two bands)
785–680 (vs)	1,2,3-trisubst benzenes	CH out-of-plane deformation (two bands)
775–650 (m)	C—S in sulfonyl chlorides	C—S stretch; strong in Raman
770–690 (vs)	monosubst benzenes	CH out-of-plane deformation (two bands)
760–740 (s)	*o*-disubst benzenes	CH out-of-plane deformation
760–510 (s)	C—Cl alkyl chlorides	C—Cl stretch
740–720 (w–m)	—$(CH_2)_n$— in hydrocarbons	CH_2 rocking in methylene chains; intensity depends on chain length
730–665 (s)	CH=CH in cis disubst alkenes	CH out-of-plane deformation
720–600 (s, br)	Ar—OH in phenols	OH out-of-plane deformation

Range (cm^{-1}) and Intensity[a]	Group and Class	Assignment and Remarks
710–570 (m)	C—S in sulfides	C—S stretch; strong in Raman
700–590 (s)	O—C=O in carboxylic acids	O—C=O bending
695–635 (s)	C—C—CHO in aldehydes	C—C—CHO bending
680–620 (s)	C—OH in alcohols	C—O—H bending
680–580 (s)	C≡C—H in alkynes	C≡C—H bending
650–600 (w)	S—C≡N in thiocyanates	S—C stretch; strong in Raman
650–600 (s)	NO_2 in aliphatic nitro compounds	NO_2 deformation
650–500 (s)	Ar—CF_3 in aromatic trifluoro-methyl compounds	CF_3 deformation (two or three bands)
650–500 (s)	C—Br in bromo compounds	C—Br stretch
645–615 (m–s)	naphthalenes	in-plane ring deformation
645–575 (s)	O—C—O in esters	O—C—O bend
640–630 (s)	$=CH_2$ in vinyl compounds	$=CH_2$ twisting
635–605 (m–s)	pyridines	in-plane ring deformation
630–570 (s)	N—C=O in amides	N—C=O bend
630–565 (s)	C—CO—C in ketones	C—CO—C bend
615–535 (s)	C=O in amides	C=O out-of-plane bend
610–565 (vs)	SO_2 in sulfonyl chlorides	SO_2 deformation
610–545 (m–s)	SO_2 in sulfones	SO_2 scissoring
600–465 (s)	C—I in iodo compounds	C—I stretch
580–530 (m–s)	C—C—CN in nitriles	C—C—CN bend
580–520 (m)	NO_2 in aromatic nitro compounds	NO_2 deformation
580–430 (s)	ring in cycloalkanes	ring deformation
580–420 (m–s)	ring in benzene derivatives	in-plane and out-of-plane ring deformations (two bands)
570–530 (vs)	SO_2 in sulfonyl chlorides	SO_2 rocking
565–520 (s)	C—C=O in aldehydes	C—C=O bend
565–440 (w–m)	C_nH_{2n+1} in alkyl groups	chain deformation modes (two bands)
560–510 (s)	C—C=O in ketones	C—C=O bend
560–500 (s)	in amino acids	 rocking
555–545 (s)	$=CH_2$ in vinyl compounds	$=CH_2$ twisting
550–465 (s)	C—C=O in carboxylic acids	C—C=O bend
545–520 (s)	naphthalenes	in-plane ring deformation
530–470 (m–s)	NO_2 in nitro compounds	NO_2 rocking
520–430 (m–s)	C—O—C in ethers	C—O—C bend
510–400 (s)	C—N—C in amines	C—N—C bend
490–465 (variable)	naphthalenes	out-of-plane ring bending
440–420 (s)	Cl—C=O in acid chlorides	Cl—C=O in-plane deformation
405–400 (s)	S—C≡N in thiocyanates	S—C≡N bend

b. Gugus Fungsi Yang Terbaca Pada Biosorben *Baglog*

Dari grafik pada Gambar 4.1 dan Gambar 4.2, diperoleh data gugus berdasarkan tabel korelasi gugus fungsi (Lambert et al, 1987) seperti dibawah ini

Range Frekuensi (cm^{-}	Frekuensi (cm^{-1}) Baglog Tanpa Aktivasi	Frekuensi (cm^{-1}) Baglog	Gugus	Senyawa
3420-3250	3412,32	3430,38	O-H	Alcohol and Phenol
3520-3320			NH_2	Aromatic Amines
2990-2850	2920,36	2917,64	CH_3 and CH_2	Aliphatic Compounds
1690-1640	1641,31	1644,66	C=N	Oximes
1680-1620			C=O and NH_2	Primary Amides
1680-1635			C=O	Ureas
1680-1630			C=C	Alkenes
1680-1630			C=O	Secondary Amides
1670-1640			C=O	Benzophenones
1670-130			C=O	Tertiary Amides
1655-1635			C=O	β-ketone esters
1650-1620			N-H	Primary Amides
1650-1580			NH_2	Primary Amines
1565-1475	1507,89	1507,84	NH	Secondary Amdes
1550-1490			NO_2	aromatic nitro compounds
1530-1450			NH_3^+	amino acids orhydrochlorides
1530-1450			N=N-O	azoxy compounds
1515-1485			benzene ring	aromatic compounds
1440-1400	1425,1	1426,49	OH	carboxylix acid
1400-1370	1377,71	1378,72	t-butyl group	-
1400-1310			COO^-	carboxylix acid salts
1390-1360			SO_2	sulfonyl chlorides
1380-1370			CH_3	Aliphatic Compounds
1380-1360			isoropyl group	-
1285-1240	1241,17	1246,15	Ar-O	alkyl aryl ethers
1280-1240				epoxides
1280-1180			C-N	Aromatic Amines
1280-1150			C-O-C	esters, lactones
1255-1240			t-butyl	hydrocarbons
1245-1155			SO_3H	Sulfonic Acids
1120-1030	1058,48	1057,87	$C-NH_2$	Aliphatic Amines
1100-1000			Si-O-Si	Siloxanes
1080-1040			SO_3H	Sulfonic Acids
1065-1015			CH-O-H	cyclic alcohols
1060-1025			CH_2-O-H	primary alcohols
1060-1045			S=O	alkyl sulfoxides
760-510	612,76	611,04	C-Cl	Alkyl Chlorides
720-600			Ar-OH	Phenols
710-570			C-S	Sulfides
700-590			O-C=O	Carboxylic Acids
680-580			C=C-H	Alkynes
650-600			S-C=N	Thiocyanates
650-600			NO_2	Aliphatic Nitro Compounds
650-500			Ar-CF_3	Aromatic Trifluoro-Methyl Compounds
650-500			C-Br	Bromo Compounds
645-575			O-C-O	Esters
635-605			pyridines	-
630-570			N-C=O	Amides
630-565			C-CO-C	Ketones
615-535			C=O	Amides

LAMPIRAN III

PERHITUNGAN PENELITIAN

- **Perhitungan Pengujian Massa Adsorbent**

a. Hasil Uji Coba Variasi Massa Biosorben Non-Aktivasi

Diketahui : C. Inlet = 149,08 ppm

1. Sampel 50 mg

% Penyisihan = $\frac{(C.Inlet - C.Akhir)}{C.Inlet}$ x 100%

= $\frac{(149{,}08 - 47{,}685)ppm}{149{,}08\ ppm}$ x 100% = 68,01 %

2. Sampel 100 mg

% Penyisihan = $\frac{(149{,}08 - 11{,}315)ppm}{149{,}08\ ppm}$ x 100% = 92,41 %

3. Sampel 200 mg

% Penyisihan = $\frac{(149{,}08 - 6{,}129)ppm}{149{,}08\ ppm}$ x 100% = 95,89 %

4. Sampel 300 mg

% Penyisihan = $\frac{(149{,}08 - 4{,}475)ppm}{149{,}08\ ppm}$ x 100% = 97 %

5. Sampel 400 mg

% Penyisihan = $\frac{(149{,}08 - 4{,}208)ppm}{149{,}08\ ppm}$ x 100% = 97,18 %

b. Hasil Uji Coba Variasi Massa Biosorbent Aktivasi

Diketahui : C. Inlet = 149,08 ppm

1. Sampel 50 mg

% Penyisihan = $\frac{(149{,}08 - 39{,}195)ppm}{149{,}08\ ppm}$ x 100% = 73,73 %

2. Sampel 100 mg

% Penyisihan = $\frac{(149{,}08 - 9{,}13)ppm}{149{,}08\ ppm}$ x 100% = 93,88 %

3. **Sampel 200 mg**

% Penyisihan = $\frac{(149{,}08 - 2{,}237)ppm}{149{,}08\ ppm}$ x 100% = 98,50 %

4. **Sampel 300 mg**

% Penyisihan = $\frac{(149{,}08 - 0{,}859)ppm}{149{,}08\ ppm}$ x 100% = 99,42 %

5. **Sampel 400 mg**

% Penyisihan = $\frac{(149{,}08 - 0{,}696)ppm}{149{,}08\ ppm}$ x 100% = 99,53 %

- **Perhitungan Pengujian Variasi pH**

A. Hasil Uji Variasi pH larutan (Biosorben Non-Aktivasi)

Diketahui : C. Inlet = 149,08

1. **Sampel dengan pH 3**

% Penyisihan = $\frac{(149{,}08 - 69{,}179)ppm}{149{,}08\ ppm}$ x 100% = 53,6 %

2. **Sampel dengan pH 4**

% Penyisihan = $\frac{(149{,}08 - 35{,}7)ppm}{149{,}08\ ppm}$ x 100% = 76,05 %

3. **Sampel dengan pH 5**

% Penyisihan = $\frac{(149{,}08 - 19{,}516)ppm}{149{,}08\ ppm}$ x 100% = 86,91 %

4. **Sampel dengan pH 6**

% Penyisihan = $\frac{(149{,}08 - 14{,}832)ppm}{ppm}$ x 100% = 90,05 %

5. **Sampel dengan pH 7**

% Penyisihan = $\frac{(149{,}08 - 9{,}575)ppm}{149{,}08\ ppm}$ x 100% = 93,58 %

6. **Sampel dengan pH 8**

% Penyisihan = $\frac{(149{,}08 - 6{,}047)ppm}{149{,}08\ ppm}$ x 100% = 95,94 %

7. **Sampel dengan pH 9**

% Penyisihan = $\frac{(149{,}08 - 5{,}317)ppm}{149{,}08\ ppm}$ x 100% = 96,43 %

B. Hasil Uji Variasi pH larutan (Biosorben Aktivasi)

Diketahui : C. Inlet = 149,08

1. Sampel dengan pH 3

% Penyisihan = $\frac{(149{,}08-42{,}975)ppm}{149{,}08\ ppm}$ x 100% = 71,17 %

2. Sampel dengan pH 4

% Penyisihan = $\frac{(149{,}08-41{,}58)ppm}{149{,}08\ ppm}$ x 100% = 72,11 %

1. Sampel dengan pH 5

% Penyisihan = $\frac{(149{,}08-24{,}555)ppm}{149{,}08\ ppm}$ x 100% = 83,53 %

2. **Sampel dengan pH 6**

% Penyisihan = $\frac{(149{,}08-10{,}455)ppm}{149{,}08\ ppm}$ x 100% = 92,99 %

3. Sampel dengan pH 7

% Penyisihan = $\frac{(149{,}08-7{,}64)ppm}{149{,}08\ ppm}$ x 100% = 94,88 %

4. Sampel dengan pH 8

% Penyisihan = $\frac{(149{,}08-7{,}382)ppm}{149{,}08\ ppm}$ x 100% = 95,05 %

8. Sampel dengan pH 9

% Penyisihan = $\frac{(149{,}08-5{,}837)ppm}{149{,}08\ ppm}$ x 100% = 96,08 %

- **Perhitungan Pengujian Variasi Waktu Kontak**

A. Hasil Uji Variasi Waktu Kontak (Biosorben Non-Aktivasi)

Diketahui : C. Inlet = 149,08

1. Waktu Kontak 15 menit

% Penyisihan = $\frac{(149{,}08-11{,}543)ppm}{149{,}08\ ppm}$ x 100% = 92,26 %

2. Waktu Kontak 30 menit

% Penyisihan = $\frac{(149{,}08\ -10{,}199)ppm}{149{,}08\ ppm}$ x 100% = 93,16 %

3. Waktu Kontak 60 menit

% Penyisihan = $\frac{(149{,}08-10{,}048)ppm}{149{,}08\ ppm}$ x 100% = 93,26 %

4. Waktu Kontak 90 menit

% Penyisihan = $\frac{(149{,}08-9{,}849)ppm}{149{,}08\ ppm}$ x 100% = 93,39 %

5. Waktu Kontak 120 menit

% Penyisihan = $\frac{(149{,}08-10{,}361)ppm}{149{,}08\ ppm}$ x 100% = 93,05 %

B. Hasil Uji Variasi Waktu Kontak (Biosorben Aktivasi)

Diketahui : C. Inlet = 149,08

1. Waktu Kontak 15 menit

% Penyisihan = $\frac{(149{,}08-9{,}831)ppm}{149{,}08\ ppm}$ x 100% = 93,41 %

2. Waktu Kontak 30 menit

% Penyisihan = $\frac{(149{,}08-8{,}402)ppm}{149{,}08\ ppm}$ x 100% = 94,36 %

3. Waktu Kontak 60 menit

% Penyisihan = $\frac{(149{,}08-7{,}108)ppm}{149{,}08\ ppm}$ x 100% = 95,23 %

4. Waktu Kontak 90 menit

% Penyisihan = $\frac{(149{,}08-6{,}462)ppm}{149{,}08\ ppm}$ x 100% = 95,67 %

5. Waktu Kontak 120 menit

% Penyisihan = $\frac{(149{,}08-7{,}480)ppm}{149{,}08\ ppm}$ x 100% = 94,98 %

- **Perhitungan Pengujian Variasi Konsentrasi**

A. Hasil Uji Variasi Konsentrasi (Biosorben Non-Aktivasi)

1. Konsentrasi 100 ppm

Diket : C. Inlet = 93,42 ppm

% Penyisihan = $\frac{(93{,}42 - 1{,}40)ppm}{93{,}42\ ppm}$ x 100% = 98,50 %

2. Konsentrasi 150 ppm

Diket : C. Inlet = 142,67 ppm

% Penyisihan = $\frac{(142{,}67 - 2{,}75)ppm}{142{,}67\ ppm}$ x 100% = 98,07 %

3. Konsentrasi 200 ppm

Diket : C. Inlet = 196,72 ppm

% Penyisihan = $\frac{(196{,}72 - 4{,}13)ppm}{196{,}72\ ppm}$ x 100% = 97,90 %

4. Konsentrasi 500 ppm

Diket : C. Inlet = 468,49 ppm

% Penyisihan = $\frac{(468{,}49 - 246{,}6)ppm}{468{,}49\ ppm}$ x 100% = 47,36 %

5. Konsentrasi 750 ppm

Diket : C. Inlet = 722,83 ppm

% Penyisihan = $\frac{(722{,}83 - 443{,}75)ppm}{722{,}83\ ppm}$ x 100% = 38,61 %

6. Konsentrasi 1000 ppm

Diket : C. Inlet = 920,20 ppm

% Penyisihan = $\frac{(920{,}20 - 723{,}5)ppm}{920{,}20\ ppm}$ x 100% = 21,38 %

B. Hasil Uji Variasi Konsentrasi (Biosorben Aktivasi)

1. Konsentrasi 100 ppm

Diket : C. Inlet = 93,42 ppm

% Penyisihan = $\frac{(93{,}42 - 0{,}25)ppm}{93{,}42\ ppm}$ x 100% = 99,73 %

2. Konsentrasi 150 ppm

Diket : C. Inlet = 142,67 ppm

% Penyisihan = $\frac{(142{,}67 - 0{,}37)ppm}{142{,}67\ ppm}$ x 100% = 99,74 %

3. Konsentrasi 200 ppm

Diket : C. Inlet = 196,72 ppm

% Penyisihan = $\frac{(196{,}72 - 0{,}92)ppm}{196{,}72\ ppm}$ x 100% = 99,53 %

4. Konsentrasi 500 ppm

Diket : C. Inlet = 468,49 ppm

% Penyisihan = $\frac{(468{,}49 - 232{,}10)ppm}{468{,}49\ ppm}$ x 100% = 50,46 %

5. Konsentrasi 750 ppm

Diket : C. Inlet = 722,83 ppm

% Penyisihan = $\frac{(722{,}83 - 434)ppm}{722{,}83\ ppm}$ x 100% = 39,96 %

6. Konsentrasi 1000 ppm

Diket : C. Inlet = 920,20 ppm

% Penyisihan = $\frac{(920{,}20 - 684{,}25)ppm}{920{,}20\ ppm}$ x 100% = 25,64 %

C. Hasil Uji Variasi Konsentrasi (Biosorben Enkapsulasi)

1. Konsentrasi 100 ppm

Diket : C. Inlet = 93,42 ppm

% Penyisihan = $\frac{(93{,}42 - 24{,}21)ppm}{93{,}42\ ppm}$ x 100% = 74 %

2. Konsentrasi 150 ppm

Diket : C. Inlet = 142,67 ppm

% Penyisihan = $\frac{(142{,}67 - 40{,}55)ppm}{142{,}67\ ppm}$ x 100% = 72 %

3. Konsentrasi 200 ppm

Diket : C. Inlet = 196,72 ppm

% Penyisihan = $\frac{(196{,}72 - 93)ppm}{196{,}72\ ppm}$ x 100% = 53 %

4. Konsentrasi 500 ppm

Diket : C. Inlet = 468,49 ppm

% Penyisihan = $\frac{(468{,}49 - 252{,}3)ppm}{468{,}49\ ppm}$ x 100% = 46 %

5. Konsentrasi 750 ppm

Diket : C. Inlet = 722,83 ppm

% Penyisihan = $\frac{(722{,}83 - 505)ppm}{722{,}83\ ppm}$ x 100% = 30 %

6. Konsentrasi 1000 ppm

Diket : C. Inlet = 920,20 ppm

% Penyisihan = $\frac{(920{,}20 - 670)ppm}{920{,}20\ ppm}$ x 100% = 27 %

- **Perhitungan Pengujian Model Isotherm Langmuir dan Freundlich**

A. Biosorben Non-Aktivasi

1. Konsentrasi 100 ppm
   - x = ΔC x V
     = 92,021 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 4,601 mg
   - qe = $\frac{x}{m}$
     = ($\frac{4{,}601\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 46,011 mg/gr

2. Konsentrasi 150 ppm
   - x = ΔC x V
     = 139,921 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 6,996 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{6{,}996\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 69,961 mg/gr

3. Konsentrasi 200 ppm
   - x = ΔC x V
     = 192,588 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 9,629 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{9{,}629\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 96,294 mg/gr

4. Konsentrasi 500 ppm
   - x = ΔC x V
     = 221,885 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 1,109 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{1{,}109\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 110,943 mg/gr

5. Konsentrasi 750 ppm
   - x = ΔC x V
     = 279 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 1,395 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{1{,}395\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 139,540 mg/gr

6. Konsentrasi 1000 ppm
   - x = ΔC x V
     = 196,7 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 9,835 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{9{,}835\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 98,350 mg/gr

B. Biosorben Aktivasi

1. Konsentrasi 100 ppm
   - x = ΔC x V
     = 93,172 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 4,659 mg
   - qe = $\frac{x}{m}$
     = ($\frac{4{,}659\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 46,586 mg/gr

2. Konsentrasi 150 ppm
   - x = ΔC x V
     = 142,295 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 7,115 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{7{,}115\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 71,148 mg/gr

3. Konsentrasi 200 ppm
   - x = ΔC x V
     = 195,806 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 9,79 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{9{,}79\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 97,903 mg/gr

4. Konsentrasi 500 ppm
   - x = ΔC x V
     = 236,385 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 11,819 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{11{,}819\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 118,193 mg/gr

5. Konsentrasi 750 ppm
   - x = ΔC x V
     = 288,83 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 14,441 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{14{,}441\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 144,415 mg/gr

6. Konsentrasi 1000 ppm
   - x = ΔC x V
     = 235,95 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 11,797 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{11{,}797\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 117,975 mg/gr

C. Biosorben Enkapsulasi

1. Konsentrasi 100 ppm
   - x = ΔC x V
     = 69,21 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 3,46 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{3{,}46\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 34,605 mg/gr

2. Konsentrasi 150 ppm
   - x = ΔC x V
     = 102,118 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 5,105 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{5{,}105\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 51,059 mg/gr

3. Konsentrasi 200 ppm
   - x = ΔC x V
     = 126,722 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 6,336 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{6{,}336\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 63,361 mg/gr

4. Konsentrasi 500 ppm
   - x = ΔC x V
     = 216,185 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 10,809 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{10{,}809\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 108,093 mg/gr

5. Konsentrasi 750 ppm
   - x = ΔC x V
     = 217,83 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 10,891 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{10{,}891\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 108,915 mg/gr

6. Konsentrasi 1000 ppm
   - x = ΔC x V
     = 250,2 mg/l x (50 ml x $\frac{1\ l}{1000\ ml}$)
     = 12,51 mg
   - Qe = $\frac{x}{m}$
     = ($\frac{12{,}51\ mg}{100\ mg\ x\ \frac{1\ gr}{1000\ mg}}$)
     = 125,100 mg/gr