ATTACHMENT

Attachment 1. Preparation of H_2SO_4 Solution

Calculation:

- Preparation of H_2SO_4 70% for 200 mL

The pure H_2SO_4 concentration = 97%

$$M_1 \cdot V_1 = M_2 \cdot V_2$$

$$97\% \cdot V_1 = 70\% \cdot 200 \text{ mL}$$

$$V_1 =$$

$$V_1 = 144 \text{ mL}$$

The carbon weight for activation: 15 gram

Attachment 2. Preparation of Remazol Brilliant Blue R dye for Calibration curve

- Make an initial solution for RBBR 100 mg/L

RBBR 100 mg/L = 100 mg/L

Make a RBBR solution for 100 mL

$$\frac{100 \text{ mg}}{x} = \frac{1000 \text{ mL}}{100 \text{ mL}}$$

$$\frac{100 \text{ mg}}{x} = 10$$

$$x = 10 \text{ mg}$$

Mass of RBBR for mother solution = 10 mg

- Prepared RBBR for 10 mg/L, 20 mg/L, 30 mg/L, 40 mg/L, 50 mg/L

10 mg/L

$$M1 \times V1 = M2 \times V2$$

$$100 \text{ mg/L} \times V1 = 10 \text{ mg/L} \times 20 \text{ mL}$$

$$V1 = \frac{10\ x\ 20}{100}$$

$$V1 = 2\ mL$$

20 mg/L

$$M1 \times V1 = M2 \times V2$$

$$100\ mg/L \times V1 = 20\ mg/L \times 20\ mL$$

$$V1 = \frac{20 \times 20}{100}$$

$$V1 = 4\ mL$$

30 mg/L

$$M1 \times V1 = M2 \times V2$$

$$100\ mg/L \times V1 = 30\ mg/L \times 20\ mL$$

$$V1 = \frac{30 \times 20}{100}$$

$$V1 = 6\ mL$$

40 mg/L

$$M1 \times V1 = M2 \times V2$$

$$100\ mg/L \times V1 = 40\ mg/L \times 20\ mL$$

$$V1 = \frac{40 \times 20}{100}$$

$$V1 = 8\ mL$$

50 mg/L

$$M1 \times V1 = M2 \times V2$$

$$100\ mg/L \times V1 = 50\ mg/L \times 20\ mL$$

$$V1 = \frac{50 \times 20}{100}$$

$$V1 = 10 \text{ mL}$$

Attachment 3. Preparation of RBBR Dye Solution for Determine Optimum Contact Time, pH, and Concentration Adsorption

1. Preparation of Remazol Brilliant Blue R dye solution for the optimum contact time determination

Make an initial solution for RBBR 100 mg/L

RBBR 100 mg/L = 100 mg/L

Make a RBBR solution for 400 mL

$$\frac{100 \text{ mg}}{x} = \frac{1000 \text{ mL}}{400 \text{ mL}}$$

$$\frac{100 \text{ mg}}{x} = 2.5$$

$$x = 40 \text{ mg}$$

Mass of RBBR for mother solution = 40 mg

Prepared RBBR for 100 mg/L, the solution will be utilized for three times experiments.

2. Preparation of Remazol Brilliant Blue R dye solution for the optimum pH determination

Make an initial solution for RBBR 100 mg/L

RBBR 100 mg/L = 100 mg/L

Make a RBBR solution for 400 mL

$$\frac{100 \text{ mg}}{x} = \frac{1000 \text{ mL}}{400 \text{ mL}}$$

$$\frac{100 \text{ mg}}{x} = 2.5$$

$$x = 40 \text{ mg}$$

Mass of RBBR for mother solution = 40 mg

Prepared RBBR for 100 mg/L, the solution will be utilized for three times experiments.

pH parameter adjusting:

The acid pH utilized H_2SO_4 and for alkaline pH using NaOH.

3. Preparation of Remazol Brilliant Blue R dye solution for the optimum concentration determination

Make an initial solution for RBBR 100 mg/L

RBBR 140 mg/L = 140 mg/L

Make a RBBR solution for 100 mL

$$\frac{140\ \text{mg}}{\text{x}} = \frac{1000\ \text{mL}}{400\ \text{mL}}$$

$$\frac{140\ \text{mg}}{\text{x}} = 2.5$$

$$\text{x} = 56\ \text{mg}$$

Mass of RBBR for mother solution = 56 mg

- Prepared RBBR for 60 mg/L, 80 mg/L, 100 mg/L, 120 mg/L, 140 mg/L

60 mg/L

Each concentration will be utilized for three experiments. For each tube will be add by 25 mL of RBBR solution

$$M1 \times V1 = M2 \times V2$$

$$140\ \text{mg/L} \times V1 = 60\ \text{mg/L} \times 100\ \text{mL}$$

$$V1 = = \frac{60\ x\ 100}{140}$$

$$V1 = 42.8\ \text{mL}$$

80 mg/L

$$M1 \times V1 = M2 \times V2$$

$$140\ mg/L \times V1 = 80\ mg/L \times 100\ mL$$

$$V1 = \frac{80 \times 100}{140}$$

$$V1 = 57.1\ mL$$

100 mg/L

$$M1 \times V1 = M2 \times V2$$

$$140\ mg/L \times V1 = 100\ mg/L \times 100\ mL$$

$$V1 = \frac{100 \times 100}{140}$$

$$V1 = 71.4\ mL$$

120 mg/L

$$M1 \times V1 = M2 \times V2$$

$$140\ mg/L \times V1 = 120\ mg/L \times 100\ mL$$

$$V1 = \frac{120 \times 100}{140}$$

$$V1 = 85.7\ mL$$

140 mg/L

$$M1 \times V1 = M2 \times V2$$

$$140\ mg/L \times V1 = 140\ mg/L \times 100\ mL$$

$$V1 = \frac{140 \times 140}{140}$$

$$V1 = 100\ mL$$

Attachment 4. Determination of Optimum Contact Time

Absorbance	Time (min)				
	30	60	90	120	150
1	0.14	0.146	0.136	0.162	0.191
2	0.123	0.184	0.199	0.172	0.169
3	0.138	0.195	0.2	0.204	0.184
Average	0.13367	0.175	0.17833	0.17933	0.181333333

Time (min)	Absorbance	C_0	C_e	C Adsorption
30	0.1336667	99.9254	9.28856	90.636816
60	0.175	99.9254	12.3731	87.552239
90	0.1783333	99.9254	12.6219	87.303483
120	0.1793333	99.9254	12.6965	87.228856
150	0.1813333	99.9254	12.8458	87.079602

From the calculation results, it can be seen that the highest adsorption value was at 30 minutes. The following is a calculation of the adsorption efficiency at 30 minutes.

$$E\ (\%) = \frac{C_0 - C_e}{C_0} \times 100$$

$$E\ (\%) = \frac{99.9254 - 9.28856}{99.9254} \times 100$$

$$E\ (\%) = 90.7\%$$

Attachment 5. Determination of Optimum pH

Absorbance	pH 1	pH 3	pH 5	pH 7	pH 9
1	0.235	0.253	0.182	0.25	0.2
2	0.251	0.164	0.254	0.237	0.267
3	0.142	0.202	0.247	0.247	0.278
Average	0.20933	0.20633	0.22767	0.24467	0.24833

pH	pH average	C_0	C_e	C Adsorption
1	0.209333333	106.64	14.9353	91.704677
3	0.206333333	106.64	14.7114	91.928557
5	0.227666667	106.64	16.3035	90.336517
7	0.244666667	106.64	17.5721	89.067861
9	0.248333333	106.64	17.8458	88.794229

From the calculation results, it can be seen that the highest adsorption value was at pH 3. The following is a calculation of the adsorption efficiency at pH 3 for 30 minutes.

$$E\ (\%) = \frac{C_0 - C_e}{C_0} \times 100$$

$$E\ (\%) = \frac{106.64 - 14.7114}{106.64} \times 100$$

$$E\ (\%) = 86.2\%$$

Attachment 6. Determination of Optimum Concentration

	Concentration (mg/L)				
Absorbance	60	80	100	120	140
1	0.053	0.095	0.176	0.143	0.214
2	0.091	0.143	0.206	0.267	0.295
3	0.047	0.175	0.183	0.233	0.289
Average	0.063666667	0.13766667	0.188333	0.214333	0.266

Concentration (mg/L)	Absorbance	C_0	C_e	C Adsorption
60	0.06366667	59.88889	4.064677	55.82421227
80	0.13766667	79.95556	9.587065	70.36849088
100	0.18833333	99.86667	13.36816	86.49850746
120	0.21433333	119.9333	15.30846	104.6248756
140	0.266	139.8444	19.16418	120.6802653

From the calculation results, it can be seen that the highest adsorption value was at Concentration = 60mg/L. The following is a calculation of the adsorption efficiency at 30 minutes, pH 3, and Concentration = 60 mg/L.

$$E\ (\%) = \frac{C_0 - C_e}{C_0} \times 100$$

$$E\ (\%) = \frac{59.88889 - 4.064677}{59.88889} \times 100$$

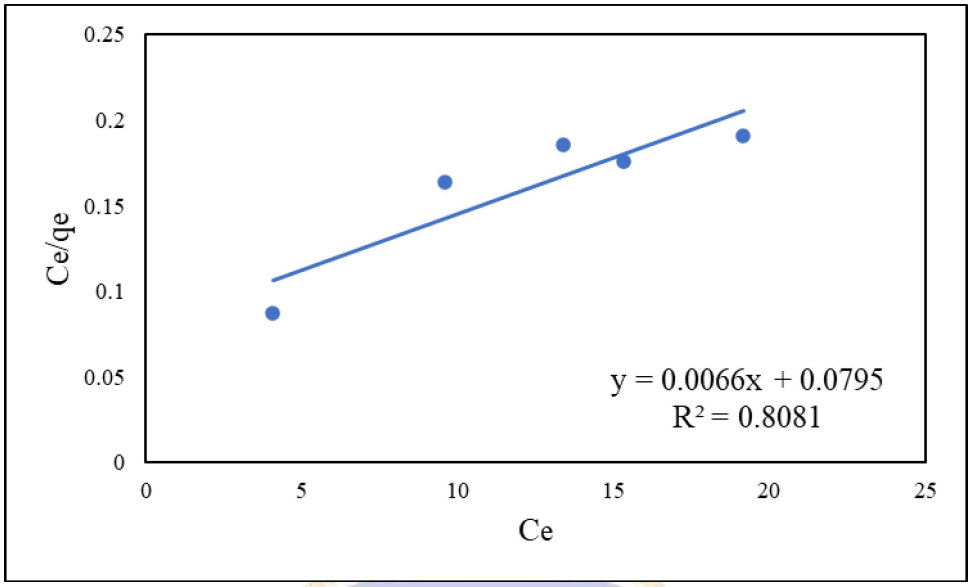
$$E\ (\%) = 93.2\%$$

Attachment 7. Determination of Adsorption Isotherm Pattern

pH	Mass of AC (mg)	Time (min)	Concentration (mg/L)			q_e
			C_0	Ce	C_0-Ce	
3	30	30	59.88889	4.064677	55.82421	46.52018
3	30	30	79.95556	9.587065	70.36849	58.64041
3	30	30	99.86667	13.36816	86.49851	72.08209
3	30	30	119.9333	15.30846	104.6249	87.1874
3	30	30	139.8444	19.16418	120.6803	100.5669

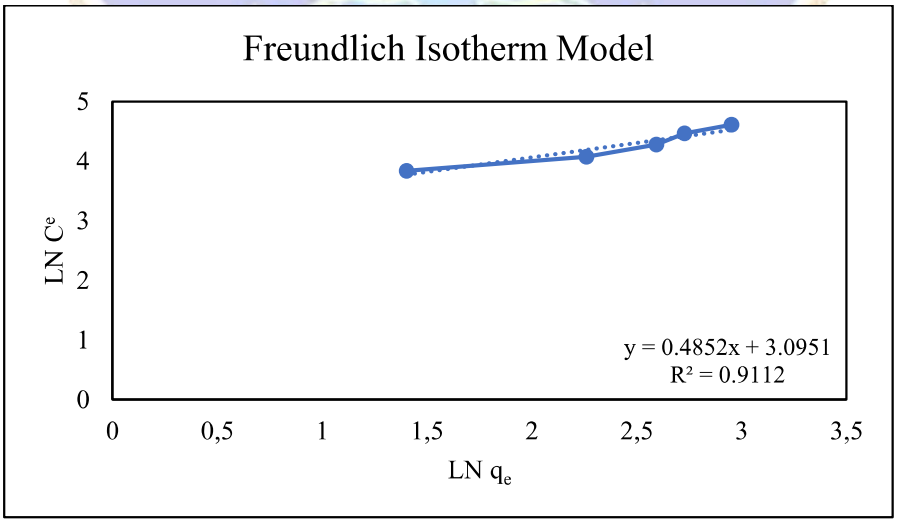
Determination of Langmuir Isotherm Model

C_e	C_e/q_e
4.064677	0.087374
9.587065	0.163489
13.36816	0.185457
15.30846	0.175581
19.16418	0.190562



Determination of Freundlich Isotherm Model

LN C_e	LN q_e
1.402334	3.839886
2.260415	4.071424
2.592876	4.277806
2.728405	4.46806
2.953043	4.610823



Attachment 8. Determination of Adsorption Capacity

Determination of the Adsorption Capacity using Langmuir Equation

Slope, $\frac{1}{q_m . K_L}$	0.0066
Intercept, $1/q_m$	0.0795

$$\frac{1}{q_m . K_L} = 0.0066$$

$$0.0795 \; . \; K_L = 0.0066$$

$$K_L = 0.083 \text{ mg/g}$$

The adsorption capacity = 0.083 mg/g

Determination of the Adsorption Capacity using Freundlich Equation

Slope, 1/n	0.4852
Intercept, Log K_F	3.0951

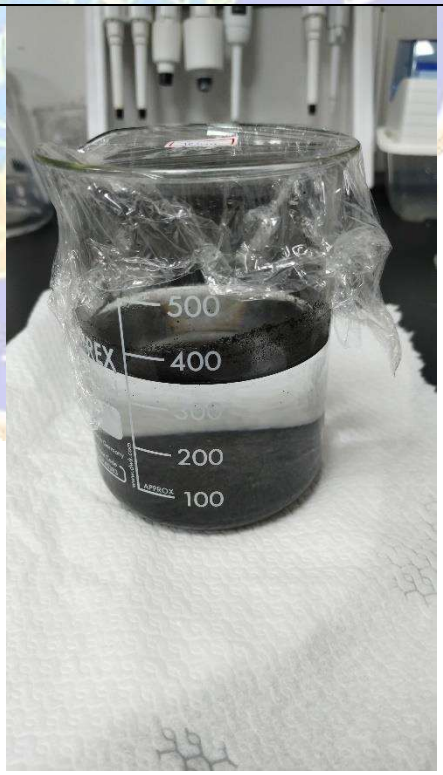
$$\text{Log } K_F = 3.0951$$

$$K_F = e^{3.0951}$$

$$K_F = 22.0894$$

The adsorption capacity = 22.0894 mg/g

Attachment 9. Documentation

Weighing the carbon	
Carbon activation	

	
RBBR Calibration Curver determination	 

Adsorption	
SEM Analysis