

## PROCESSING OF COAGULATION FLOCCULATION SEQUENCING BATCH REACTOR (SBR) IN KEBON AGUNG RIVER AS CLEAN WATER

Pinasthika Almira Wildanum<sup>1\*</sup>, Novirina Hendrasarie<sup>2</sup>

<sup>1</sup> Environmental Engineering Study Program, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya No. 1, Gunung Anyar, Kota Surabaya 60294, Indonesia

<sup>2</sup> Environmental Engineering Study Program, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Jl. Rungkut Madya No. 1, Gunung Anyar, Kota Surabaya, 60294 Indonesia

\*corresponding Email: [novirina@upnjatim.ac.id](mailto:novirina@upnjatim.ac.id)

### ABSTRACT

River water treatment uses a Sequencing Batch Reactor (SBR) with cassava peel adsorbents, meranti wood powder, and PAC. After going through the Sequencing Batch Reactor, (SBR), it will give disinfection to reduce the levels of E. Coli and total coliform in the water. It is expected to be able to set aside levels of turbidity, color, TDS, taste, odor, total coliform, E.Coli, nitrate, nitrite, hardness, and organic matter (KMnO<sub>4</sub>). The river water to be treated comes from the coagulation-flocculation process. Making variations of HRT and adsorbent. The hydraulic retention time variations compared were 6, 9, and 12 hours. There are 3 reactors with 1 control reactor, which includes a control reactor without adsorbent and one with PAC adsorbent. The conditions chosen at the reaction stage are aerobic. The removal efficiency of the color parameter is 8.4%, the total coliform parameter is 94.6%, the parameter e.coli 95.2%, the nitrate parameter is 52.6%, the nitrite parameter is 14.3%, and the organic matter parameter is 7.8%. At the same time, the parameters have increased by 2%. The best HRT in reducing pollutant levels in this study was 12 hours HRT for the SBR reactor with cassava peel adsorbent sowing placement, 6 hours HRT for the SBR reactor with meranti wood powder adsorbent sowing placement, and 6 hours HRT for the SBR reactor with top placement PAC adsorbent. The best effectiveness of the Sequencing Batch Reactor (SBR) in treating Kebon Agung River water is by adding meranti wood powder adsorbent by placing sprinklers.

**Keywords:** *SBR, Coagulation, Flocculation, Cassava Peel, Meranti Wood Powder*

### 1. INTRODUCTION

Kebon Agung River is located in front of the Campus UPN "Veteran" East Java and is a water channel that can be used as raw water as clean water. Geographically, Kebon Agung

River is located in the southern part of Surabaya Jambangan District and empties into the seaside of East Surabaya at Rungkut District. Kebon Agung River has a length of 11 kilometers, about 7-12 meters wide (Pitaloka & Lasminto, 2017). Several factors can pollute the Kebon Agung River, such as laundry activities, domestic activities, and several industries around the Kebon Agung River.

Based on previous research, Sequencing Batch Reactor (SBR) is a cyclical process. Each cycle consists of phases charging, reaction, settling, draining, and phase preparation. SBR has the effectiveness of removing organic materials on domestic waste in the form of a total N reached 84.30%. (Febriana and Hendrasarie, 2022). While on the color parameter, SBR has the efficacy of eliminating The color parameter in batik industrial waste comes to 87.9% (Hendrasarie and Pratama, 2021).

There is a preliminary study in this study; namely, river water is processed first using flocculation coagulation to reduce water pollutant levels. The flocculation coagulation process is one method to separate suspended solids and colloidal particles. The coagulant used in this study was Poly Aluminum Chloride (PAC). PAC will be effective in pH 6-9 (Andriani *et al.*, 2017). In contrast to alum coagulant, excessive use of PAC will not cause the water to become cloudy (Jadid *et al.*, 2019).

Based on this background, this research is about a water treatment river using a Sequencing Batch Reactor (SBR) with cassava peel adsorbent, meranti wood powder, and Powder Activated Carbon (PAC) as a control. There is preliminary research using coagulation and flocculation to reduce water pollutant levels. After going through SBR will be given disinfection to reduce levels of E.Coli and total coliform in water. With this research, it is expected to be able to set aside levels of turbidity, color, TDS, taste, odor, total coliform, E.Coli, nitrate, nitrite, hardness, and organic matter (KMnO<sub>4</sub>) in Kebon Agung River water.

### 2. METHOD

#### Preparation of Tools and Materials

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Tools: Jar test, Reactor, and Laboratory instruments

Materials: River water, PAC coagulant, adsorbent (cassava peel, meranti wood powder, and PAC), Chlorine disinfectant.

The adsorbent is made from cassava peel and sawdust meranti with a particle size of 100 mesh. In its manufacture, each adsorbent is activated in different ways. And there are Powder Activated Carbon acts as a control for both adsorbent variations in this study.

According to Nisya *et al.* (2022), before making the cassava peel into activated carbon, the cassava peel was cleaned, cut into small pieces, and dried in the sun to dry for 2 days. After drying, please put it in the oven for 3 hours at a temperature of 105°C. After drying, the cassava peel was crushed to a 100 mesh sieve and put into a glass beaker containing 2% H<sub>3</sub>PO<sub>4</sub> solution to be soaked for 24 hours. The cassava peel soak was then washed with distilled water to neutralize the pH and returned to the oven at 105°C for 3 hours.

Activated carbon is inserted into the reactor between the fill phase and the aeration phase (reaction) with a dose of 4 g/L with a volume of treated water of 6 L. In this study, the adsorbent mass determined is 0.6 g/L with a volume of treated water 5L. The design of the SBR reactor used to treat the water of Kebon Agung River is as follows.

Table 1. SBR Reactor Diameter Design

No.	Design	Unit	Score
<b>Reactor Volume</b>			
1	total volume	L	6
	Working volume	L	5
	mud volume	L	2
	Wastewater volume	L	3
<b>Reactor Dimensions</b>			
2	Diameter	cm	20
	T all	cm	20
3	<b>Residence Time</b>	o'clock	1 1 ; 1.5; 2

The SBR design and reactor arrangement scheme used are as follows:

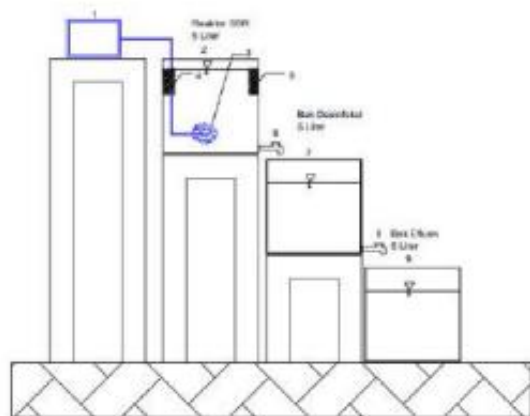


Figure 1. Schematic of the Reactor Arrangement (Source : Research, 2022)

Information:

1. Air pump
2. 5 liter SBR reactor
3. Aerators
4. Adsorbent laying on the left side
5. Adsorbent laying on the right side
6. Reactor outlet to disinfection basin
7. Disinfection
8. Disinfection bath outlet to effluent bath
9. Treated water effluent bath

### Initial Characteristic Test

Initial testing of river water was carried out in order to determine the characteristics and content values of each test parameter.

Table 2. Analysis Result

No.	Parameter	Score
1.	Turbidity	12.5 NTUs
2.	Color	40.1 TCU
3.	Dissolved solids (Total Dissolved Solid)	398 mg/l
4.	Temperature	28°C
5.	Flavor	Tasteless
6.	Smell	Smell
7.	pH	7,2
8.	Total coliforms	1.83 x 10 <sup>7</sup> CFU/100 ml
9.	E.Coli	1.83 x 10 <sup>7</sup> CFU/100 ml
10.	Hardness (CaCO <sub>3</sub> )	186.3 mg/l
11.	Nitrate	0.19 mg/l
12.	Nitrite	0.014 mg/l
13.	Organic matter (KMnO <sub>4</sub> )	9.33 mg/l
14.	Dissolved Oxygen(DO)	1.2 mg/l

### Flocculation Coagulation

The dose of coagulant in this study was varied, namely 60, 70, and 80 mg/L. The fast stirring time was varied for 30 seconds, 45 seconds, and 60 seconds with a stirring speed of 140 rpm. As for the old stirring, variations were carried out for 10 minutes, 15 minutes, and 20 minutes with a stirring speed of 20 rpm. The best result from the above variation will be used as the influent SBR.

### Main Research

The primary research is carried out after the coagulation-flocculation process ends. In this study, the reactor used was 5 L. Furthermore, the research was carried out by varying the HRT and adsorbent mass. The variations of hydraulic retention time compared were 6 hours, 9 hours, and 12 hours.

After the effluent water is removed, it enters the disinfection stage to remove E.Coli levels in the water.

Table 3. HRT Timing

Stage	Distribution of time per HRT (minutes)			Information aeration
	6 hours	9 hours	12 hours	
Fill	15	15	15	On
react	275	415	555	On
Settle	40	60	80	off
Draw	10	10	10	off
Idle	20	40	60	On
Total	6 hours	9 hours	12 hours	-

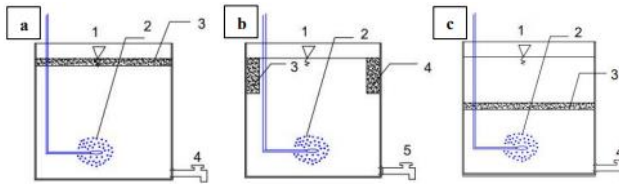


Figure 2. Placement of Adsorbent: (a) Surface of SBR, (b) Right and Left Side of SBR, (c) Sprinkled on In SBR (Source: Research, 2022)

Information 2.a:

- 1. 5 liter SBR reactor
- 2. Aerators
- 3. Adsorbents
- 4. Reactor outlet to disinfection basin

Information 2.b:

- 1. 5 liter SBR reactor
- 2. Aerators
- 3. Adsorbent laying on the left side
- 4. Adsorbent laying on the right side
- 5. Reactor outlet to disinfection basin

Information 2.c:

- 1. 5 liter SBR reactor
- 2. Aerators
- 3. Adsorbents
- 4. Reactor outlet to disinfection basin

**Advanced Research**

The addition of disinfection in the form of chlorine in this study was based on research conducted by Agustina and Komala (2014), adding chlorine at a dose of 0.5 mg/L and a contact time of 30 minutes. The elimination of E. Coli bacteria was 100%, and residual chlorine was 0.2 mg/L, while the efficiency of E.Coli bacteria in water samples was 99.61% with residual chlorine of 0 mg/L.

The following is a matrix of variables in preliminary research, and it can be seen in Table 4

Table 4. Preliminary Research Variable Matrix

Coagulation-flocculation independent variable			
PAC concentration	1 minute coagulation & 10 minute flocculation	2 min & 15 min flocculation	3 min & 20 min flocculation
60mg/L	JartestA1	JartestA2	JartestA3
70 mg/L	JartestB1	JartestB2	JartestB3
80 mg/L	JartestC1	JartestC2	JartestC3

After the preliminary research was carried out, the best decrease in TDS and turbidity levels was obtained, followed by the

Table 9. Result of Analysis of Calculation of Optimum Coagulant Dosage and Stirring Time of Pre-Treatment Process Turbidity Parameters

Stirring time (minutes)	Initial rate (NTU)	Turbidity						Clean water quality	Drinking water quality
		PAC Dosage (mg/l)							
		60		70		80			
		Effluent	% removal	Effluent	% removal	Effluent	% removal	Information	Information

main research using the best effluent from the preliminary research which can be seen in tables 5, 6, 7, and 8.

Table 5. Main Research Variable Matrix (Adsorbent mass and HRT)

SBR independent variable			
Type of adsorbent	HRT 6 hours	HRT 9 hours	HRT 12 hours
Cassava peel	A1 reactor	A2 . reactor	A3 reactor
Meranti Wood Powder	Reactor B1	B2 . reactor	B3 reactor
PACs (control)	C1 reactor	C2 . reactor	C3 reactor

Table 6. Main Research Variable Matrix (Table 5 and Adsorbent placement)

SBR independent variable			
Adsorbent placement	A1	A2	A3
On	A1-1 . reactor	A2-1 reactor	A3-1 . reactor
Right & left side	A1-2 . reactor	A2-2 reactor	A3-2 . reactor
sown	A1-3 . reactor	A2-3 . reactor	A3-3 . reactor

Table 7. Main Research Variable Matrix (Table 5 and Adsorbent placement)

SBR independent variable			
Adsorbent placement	B1	B2	B3
On	B1-1 . reactor	B2-1 . reactor	B3-1 reactor
Right & left side	B1-2 . reactor	B2-2 . reactor	B3-2 . reactor
sown	B1-3 reactor	B2-3 . reactor	B3-3 reactor

Table 8. Main Research Variable Matrix

SBR independent variable			
Adsorbent placement	C1	C2	C3
On	C1-1 reactor	C2-1 reactor	C3-1 . reactor
Right & left side	C1-2 reactor	C2-2 reactor	C3-2 reactor
sown	C1-2 reactor	C2-2 reactor	C3-2 reactor

**3. RESULT AND DISCUSSION**

Before the primary research was carried out, a preliminary study, namely coagulation-flocculation, was conducted to reduce the pollutant parameters. The best results of the coagulant variation and the best stirring time on the TDS and turbidity parameters will be used for the coagulation-flocculation process on other parameters. The table below shows the results of the percentage removal for the turbidity and TDS parameters as follows:

	rate (NTU)		rate (NTU)		rate (NTU)		standard (NTU)	standard (NTU)			
1 minute coagulation	12.5	8.6	31.2%	8.22	34.2%	7.77	37.8%	25	Fulfill	5	Not eligible
10 minutes flocculation											
2 minutes coagulation	12.5	8.41	32.7%	8.14	34.9%	6.4	48.8%	25	Fulfill	5	Not eligible
15 minutes flocculation											
3 minutes coagulation	12.5	8.4	32.8%	7.65	38.8%	5.77	53.8%	25	Fulfill	5	Not eligible
20 minutes flocculation											

Table 10. Result of Analysis of Calculation of Optimum Coagulate Dosage and Stirring Time of Pre-Treatment Process TDS Parameters

Stirring time (minutes)	Initial level (mg/l)	TDS						Clean water quality standard (mg/l)	Information	Drinking water quality standard (mg/l)	Information
		PAC Dosage (mg/l)									
		60		70		80					
Effluent level (mg/l)	% removal	Effluent level (mg/l)	% removal	Effluent level (mg/l)	% removal	Effluent level (mg/l)	% removal				
1 minute coagulation	398	113.62	71.5%	108.77	72.7%	104.02	73.9%	1000	Fulfill	500	Fulfill
10 minutes flocculation											
2 minutes coagulation	398	110.51	72.2%	107.22	73.1%	100.82	74.7%	1000	Fulfill	500	Fulfill
15 minutes flocculation											
3 minutes coagulation	398	110.42	72.3%	105.62	73.5%	85.22	78.6%	1000	Fulfill	500	Fulfill
20 minutes flocculation											

The effluent from the coagulation-flocculation process will be used as an influent in the Sequencing Batch Reactor (SBR) unit as the primary research of this

research. The following is a table of the results of the percentage of removal parameters for color, temperature, taste, odor, total coliform, e.coli, nitrate, nitrite, hardness, and organic matter (KMnO<sub>4</sub>) as follows

Table 11. Coagulation Flocculation Analysis Results with 80 mg/l PAC Coagulant with a stirring time of 3 minutes coagulation and 20 minutes flocculation on Parameters Color, Temperature, Taste, Odor, Total Coliform, E.Coli, Nitrate, Nitrite, Hardness, and Organic Substances (KMnO<sub>4</sub>)

Coagulants PAC dose 80 mg/l, 3 minutes coagulation 20 minutes flocculation										
No.	Parameter	Initial Rate	Final Rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information		
1.	Color (TCU)	43.8	40.1	8.40%	50	Fulfill	15	Not eligible		
2.	Temperature (°C)	28	28	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill		
3.	Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill		
4.	Smell	Smell	Smell	-	No smell	Not eligible	No smell	Not eligible		
6.	Total coliform (CFU/100ml)	18,300,000	988,200	94.60%	50	Not eligible	0	Not eligible		
7.	E.Coli (CFU/100ml)	18,300,000	878,400	95.20%	0	Not eligible	0	Not eligible		
8.	pH	7.2	7.3	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill		
9.	Total hardness (mg/l)	186.3	190	-2%	500	Fulfill	500	Fulfill		
10.	Nitrates (mg/l)	0.19	0.09	52.60%	10	Fulfill	3	Fulfill		
11.	Nitrite (mg/l)	0.014	0.012	14.30%	1	Fulfill	50	Fulfill		
12.	Organic Substance (mg/l)	9.33	8.6	7.80%	10	Fulfill	10	Fulfill		

The data in table 11 shows the optimal HRT with cassava peel adsorbents for the parameters after going through the Sequencing Batch Reactor (SBR) process. The data in table 11 shows the results of the research parameter removal resulting from the coagulation and flocculation process with a dose of Poly Aluminum Chloride

(PAC) 80 mg/l with a stirring time of 3 minutes coagulation and 20 minutes flocculation. The parameters of turbidity, color, TDS, total coliform, E. Coli, nitrate, nitrite, and organic matter decreased. While in the entire hardness parameter, there is an increase of 2%.

Table 12. Optimal HRT of Cassava Peel Adsorbent Against Parameters Turbidity, Color, TDS, Temperature, Taste, Odor, Total Coliform, E. Coli, pH, Total Hardness, Organic Substances, and DO

Cassava skin 12 hours, sow placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	Drinking water quality standards	Information
Turbidity (NTU)	5.77	2.87	23.20%	25	Fulfill	5	Fulfill
Color (TCU)	40.1	17.8	55.60%	50	Fulfill	15	Not eligible
Total Dissolved Solids(TDS) (mg/l)	85.22	68.59	24.20%	1000	Fulfill	500	Fulfill
Temperature(°C)	28	27.3	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill
Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill
Smell	smelled	No smell	-	No smell	Fulfill	No smell	Fulfill
Total coliform (CFU/100ml)	988,200	15811	98.4%	50	Not eligible	0	Not eligible
E.Coli (CFU/100ml)	878,400	11419	98.7%	0	Not eligible	0	Not eligible
pH	7.2	7.3	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill
Total hardness (mg/l)	190	84	55.79%	500	Fulfill	500	Fulfill
Organic Substance (mg/l)	8.6	6.2	27.91%	10	Fulfill	10	Fulfill
Dissolved Oxygen(DO) (mg/l)	1.2	7.14	-	≥4	Fulfill		

The data in table 12 shows the optimal HRT with meranti wood powder as an adsorbent on the parameters of turbidity, color, TDS, temperature,

taste, odor, total coliform, e.coli, pH, total hardness, organic matter (KMnO<sub>4</sub>) and DO after going through the Sequencing Batch Reactor (SBR) process.

Table 13. Optimal HRT of Meranti Wood Powder Adsorbent Against Parameters Turbidity, Color, TDS, Temperature, Taste, Odor, Total Coliform, E.Coli, pH, Total Hardness, Organic Substances, and DO

Meranti Wood Powder 6 hours, sow placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	Drinking water quality standards	Information
Turbidity (NTU)	5.77	2.24	61.20%	25	Fulfill	5	Fulfill
Color (TCU)	40.1	12.3	64.1%	50	Fulfill	15	Fulfill
Total Dissolved Solids(TDS) (mg/l)	85.22	28.83	66.20%	1000	Fulfill	500	Fulfill
Temperature(°C)	28	27.3	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill
Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill
Smell	smelled	No smell	-	No smell	Fulfill	No smell	Fulfill
Total coliform (CFU/100ml)	988,200	6917	99.3%	50	Not eligible	0	Not eligible
E.Coli (CFU/100ml)	878,400	7466	99.15%	0	Not eligible	0	Not eligible
pH	7.2	7.1	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill
Total hardness (mg/l)	190	50	73.68%	500	Fulfill	500	Fulfill
Organic Substance (mg/l)	8.6	4.58	46.74%	10	Fulfill	10	Fulfill
Dissolved Oxygen(DO) (mg/l)	1.2	8.568	-	≥4	Fulfill		

The data in table 13 shows the optimal HRT with PAC adsorbents for the parameters of turbidity, color, TDS, temperature, taste, odor,

total coliform, e.coli, pH, total hardness, organic matter (KMnO<sub>4</sub>) and DO after going through the Sequencing Batch Reactor (SBR) process.

Table 14. Optimal HRT of PAC Adsorbent Against Parameters Turbidity, Color, TDS, Temperature, Taste, Odor, Total Coliform, E.Coli, pH, Total Hardness, Organic Substances, and DO

Powder Activated Carbon (PAC) 6 hours, top placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	Drinking water quality standards	Information
Turbidity (NTU)	5.77	4.05	29.80%	25	Fulfill	5	Fulfill
Color (TCU)	40.1	20.8	48.10%	50	Fulfill	15	Does not meet the
Total Dissolved Solids(TDS) (mg/l)	85.22	56.02	34.30%	1000	Fulfill	500	Fulfill
Temperature(°C)	28	27.4	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill
Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill
Smell	No smell	No smell	-	No smell	Fulfill	No smell	Fulfill
Total coliform (CFU/100ml)	988,200	15317	98.5%	50	Not eligible	0	Not eligible

E.Coli (CFU/100ml)	878,400	13176	98.50%	0	Not eligible	0	Not eligible
pH	7.2	7.3	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill
Total hardness (mg/l)	190	76	60.00%	500	Fulfill	500	Fulfill
Organic Substance (mg/l)	8.6	6.12	28.80%	10	Fulfill	10	Fulfill
Dissolved Oxygen(DO) (mg/l)	1.2	7.34	-	≥4	Fulfill		

For various types of cassava peel adsorbent, the best HRT was obtained, namely 12 hours with the placement of the sowing adsorbent. For multiple types of meranti sawdust adsorbent, the best HRT

was received, namely, 6 hours with the order of sowing adsorbent. Whereas in the Powdered Activated Carbon (PAC) adsorbent variation, the best HRT was 6 hours with the top adsorbent placed.

### The optimal HRT Sequencing Batch Reactor (SBR) for nitrate and nitrite parameters

The following is a decrease in nitrate and nitrite

parameters produced during the SBR operating process with optimal HRT which is presented in the table below.

Table 15. Optimal HRT with Cassava Peel, Meranti Wood Powder, and PAC Against Nitrate and Nitrite Parameters Against Nitrate and Nitrite Parameters

Cassava peel 9 hours, top placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information
Nitrates (mg/l)	0.09	0.0068	92.4%	10	Fulfill	3	Fulfill
Nitrite (mg/l)	0.012	0.0068	43.3%	1	Fulfill	50	Fulfill
Meranti Wood Powder 12 hours, sow placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information
Nitrates (mg/l)	0.09	0.003	96.7%	10	Fulfill	3	Fulfill
Nitrite (mg/l)	0.012	0.0057	52.8%	1	Fulfill	50	Fulfill
Powder Activated Carbon (PAC) 12 hours, side placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information
Nitrates (mg/l)	0.09	0.007	92.2%	10	Fulfill	3	Fulfill
Nitrite (mg/l)	0.012	0.0102	15.0%	1	Fulfill	50	Fulfill

In the nitrification process, ammonium decomposes into nitrites and nitrates. The nitrification process is divided into two stages, namely nitritation and nitrification. At the nitrating stage, ammonium ions ( $\text{NH}_4^+$ ) oxidation will occur to nitrite ions ( $\text{NO}_2^-$ ). While in the nitrification stage, the oxidation of nitrite ions to nitrate ions ( $\text{NO}_3^-$ ) will occur. The denitrification process is a process of reducing nitrate compounds to nitrogen gas. The process of

nitrification and denitrification requires sufficient oxygen supply. A lack of oxygen supply makes it insufficient to oxidize ammonium to nitrate. With the presence of anaerobic and aerobic reactions, where aerobic reactions take longer than anaerobic reactions, the number of microorganisms for denitrification is very small, so they cannot compete with autotrophic microorganisms or microorganisms in the nitrification process.

### The Best Variable from Preliminary, Main, and Research Variables Advanced

Based on several variables in this study, the best variables were in preliminary, main, and follow-up research. Table 4.16 Table of the Best

Variables from Preliminary Research Variables, table 4.17 Table of the Best Variables from Main Research Variables, and 4.18 Tables of Best Variables from Variables for Follow-up Research along with the outputs of the research.

Table 16. Table of the Best Variables from Preliminary Research Variables

PAC Coagulant Dose 80 mg/l, 3 minutes coagulation 20 minutes flocculation							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	Drinking water quality standards	Information
Turbidity (NTU)	12.5	5.77	53.80%	25	Fulfill	5	Not eligible
Color (TCU)	43.8	40,1	8.40%	50	Fulfill	15	Not eligible
Total Dissolved Solids(TDS) (mg/l)	398	85.22	78.60%	1000	Fulfill	500	Fulfill

Temperature(°C)	28	28	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill
Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill
Smell	smelled	smelled	-	No smell	Not eligible	No smell	Not eligible
Total coliform (CFU/100ml)	18,300,000	988,200	94.60%	50	Not eligible	0	Not eligible
E.Coli (CFU/100ml)	18,300,000	878,400	95.20%	0	Not eligible	0	Not eligible
pH	7.2	7.3	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill
Total hardness (mg/l)	186.3	190	-2%	500	Fulfill	500	Fulfill
Organic Substance (mg/l)	9.33	8.6	7.80%	10	Fulfill	10	Fulfill
Nitrate	0.19	0.09	52.60%	10	Fulfill	3	Fulfill
Nitrite	0.014	0.012	14.30%	1	Fulfill	50	Fulfill

Based on table 16, Table of the Best Variables of Preliminary Research Variables, the optimal dose for preliminary research (coagulation-flocculation) is 80 mg/l with a stirring time of 3 minutes coagulation and 20 minutes of flocculation. Followed by the primary research, namely Sequencing Batch Reactor (SBR) with

Hydraulic Retention Time (HRT) variations of 6, 9, and 12 hours with the addition of 3 variations of adsorbents, namely cassava peel, meranti sawdust, and PAC and placement variations, namely top, side right and left, and sow. The following is table 17, The best Variable Table of the Main Research Variables.

Table 17. The best Variable Table of the Main Research Variables

Meranti Wood Powder 6 hours, sow placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	Drinking water quality standards	Information
Turbidity (NTU)	5.77	2.24	61.20%	25	Fulfill	5	Fulfill
Color (TCU)	40.1	12.3	64.1%	50	Fulfill	15	Fulfill
Total Dissolved Solids(TDS) (mg/l)	85.22	28.83	66.20%	1000	Fulfill	500	Fulfill
Temperature(°C)	28	27.3	-	Air temperature ±3	Fulfill	Air temperature ±3	Fulfill
Flavor	Tasteless	Tasteless	-	Tasteless	Fulfill	Tasteless	Fulfill
Smell	smelled	No smell	-	No smell	Fulfill	No smell	Fulfill
Total coliform (CFU/100ml)	988,200	6917	99.3%	50	Not eligible	0	Not eligible
E.Coli (CFU/100ml)	878,400	7466	99.15%	0	Not eligible	0	Not eligible
pH	7.2	7.1	-	6.5 - 8.5	Fulfill	6.5 - 8.5	Fulfill
Total hardness (mg/l)	190	50	73.68%	500	Fulfill	500	Fulfill
Organic Substance (mg/l)	8.6	4.58	46.74%	10	Fulfill	10	Fulfill
Dissolved Oxygen(DO) (mg/l)	1.2	8.568	-	≥4	Fulfill		

Meranti Wood Powder 12 hours, sow placement							
Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information
Nitrates (mg/l)	0.09	0.003	96.7%	10	Fulfill	3	Fulfill
Nitrite (mg/l)	0.012	0.0057	52.8%	1	Fulfill	50	Fulfill

After the primary research, followed by further research, namely the addition of chlorine or disinfection, whose function is to reduce the content of e.coli and total coliform. In this study, the best variation was a chlorine dose of 3 mg/l with a contact time of 30 minutes. In addition, there is an

inspection of residual chlorine in the influent and effluent so that the water is safe to use as clean water. The following table18, Table of the Best Variables of Advanced Research Variables from the two best variations of the primary research added with disinfection.

Table 18. The best Variable Table of the Advanced Research Variables

Chlorine dose 3 mg/l, contact time 30 minutes HRT 6 hours Powdered Meranti Wood Sow Placement							
Parameter	Influent	Effluent	% removal	Clean water	Information	drinking water	Information

				quality standard		quality standard	
Total coliform (CFU/100ml)	6900	0	100%	50	Fulfill	0	Fulfill
E.Coli (CFU/100ml)	7500	0	100%	0	Fulfill	0	Fulfill
Residual Chlorine	0	0.2				0,2-0,5	Fulfill

Chlorine dose 3 mg/l, contact time 30 minutes  
HRT 12 hours Powdered Meranti Wood Sow Placement

Parameter	Initial rate	Final rate	% removal	Clean water quality standard	Information	drinking water quality standard	Information
Total coliform (CFU/100ml)	14800	0	100%	50	Fulfill	0	Fulfill
E.Coli (CFU/100ml)	9400	0	100%	0	Fulfill	0	Fulfill
Residual Chlorine	0	0.2				0,2-0,5	Fulfill

In table 4.14, the Best Variable Table of Continuing Research Variables, it can be concluded that all of the effluents do not contain E.Coli and total coliform

levels, so they meet the quality standards for clean and drinking water. As well as residual chlorine by drinking water quality standards

Table 19. Residual Chlorine Table

Parameter	Type of adsorbent	Adsorbent placement	HRT (hours)	Effluent (mg/l)			
Residual chlorine	Cassava peel	Top	6	0			
		Right & left side		0			
		Sprinkle		0			
		Top	9	0			
		Right & left side		0			
		Sprinkle		0			
		Top	12	0			
		Right & left side		0			
		Sprinkle		0			
		Top	6	0			
		Right & left side		0			
		Sprinkle		0			
	Meranti Wood Powder	Cassava peel	Top	9	0		
			Right & left side		0		
			Sprinkle		0		
			Top	12	0		
			Right & left side		0		
			Sprinkle		0		
		PAC	Cassava peel	Top	6	0	
				Right & left side		0	
				Sprinkle		0	
			PAC	PAC	Top	9	0
					Right & left side		0
					Sprinkle		0
PAC	PAC	Top	12	0			
		Right & left side		0			
		Sprinkle		0			

**Results of Scanning Electrone Microscope (SEM) Analysis**

Scanning Electron Microscope (SEM) analysis was performed to determine the surface structure of each adsorbent. SEM analysis was carried out at the Instrument Laboratory of UPN "Veteran" East Java, the following are the results of SEM analysis on cassava peel adsorbents, meranti wood powder, and Powder Activated Carbon (PAC).

Figure 39 (a) and (b) are the results of SEM analysis on cassava peel adsorbents before treatment. While in Figures 39 (c) and (d) are the results of SEM analysis on cassava peel adsorbent after treatment as an adsorbent on SBR to set aside water pollutant parameters.

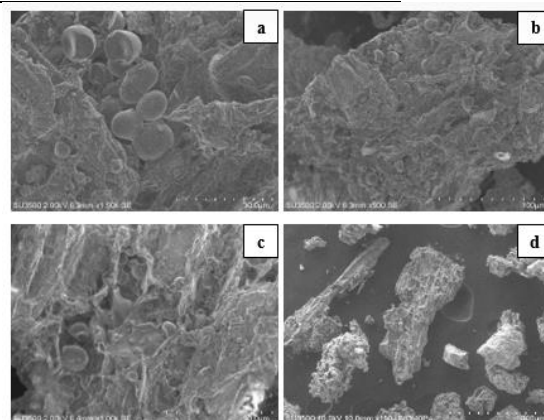


Figure 39. SEM analysis results of cassava peel adsorbent: (a) front view of cassava peel adsorbent before treatment, (b) side view of cassava peel adsorbent before treatment, (c) front view of cassava peel adsorbent after treatment, and (d) side view of cassava peel adsorbent after treatment



(Source : Research Documentation, 2022)

Based on the SEM analysis results above, the morphological structure of cassava peel before treatment as an adsorbent on SBR has irregular pore shape characteristics. So the role of water pollutant removal could be more optimal. Figures 39 (c) and (d) show that the pores covered by the adsorbate are microscopic. This is caused by 7.2% lignin, 13.8% cellulose, and 11% hemicellulose. Hemicellulose and lignin are impurities that cover.

Figure 40 (a) and (b) are the results of SEM analysis on meranti wood powder adsorbent before treatment. While in Figure 40 (c) and (d) are the results of SEM analysis on meranti wood powder adsorbent after treatment as an adsorbent on SBR to set aside water pollutant parameters.

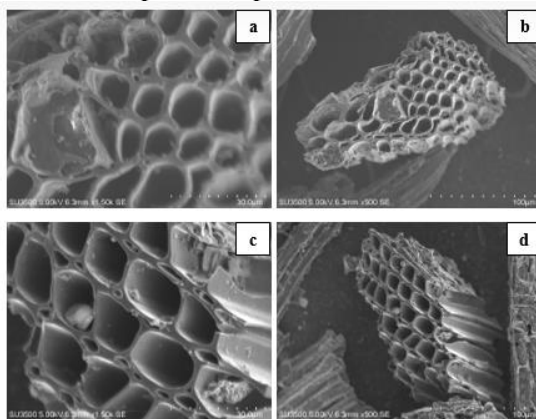


Figure 40. Meranti wood powder adsorbent SEM analysis results: (a) front view of meranti wood powder adsorbent before treatment, (b) side view of meranti wood powder adsorbent before treatment, (c) front view of meranti wood powder adsorbent after treatment, and (d) side view of meranti wood powder adsorbent after treatment.

(Source : Research Documentation, 2022)

The porous structure of meranti wood powder is like a wasp's nest and is regular and has a uniform shape. Based on the SEM analysis that has been carried out, the surface morphology and pore area of meranti wood powder before and after the adsorption process have differences, namely the meranti wood powder adsorbent that has gone through the pore adsorption process is smoother and cleaner, and has no spots on its surface compared to the wood powder adsorbent. Meranti, the pore surface area of the meranti wood powder adsorbent has a smaller size than the pore surface area of the meranti wood powder adsorbent before the adsorption process. In removing pollutant parameters, the adsorbent of meranti wood powder tends to be better than the adsorbent of meranti wood powder.

Figure 41 (a) and (b) are the results of SEM analysis on Powdered Activated Carbon (PAC) adsorbents before treatment. Whereas in Figure 41 (c) and (d) are the results of SEM analysis on the Powdered Activated Carbon (PAC) adsorbent after treatment as an adsorbent on SBR to set aside water

pollutant parameters.

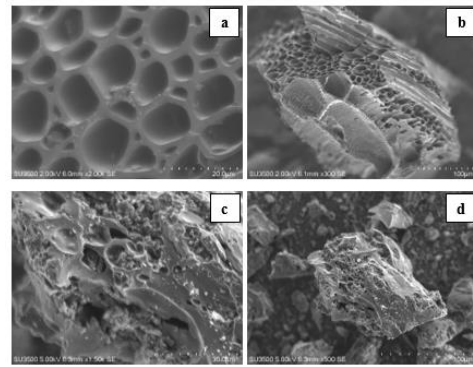


Figure 41. SEM analysis results of PAC adsorbent: (a) PAC adsorbent front view before treatment, (b) PAC adsorbent side view before treatment, (c) PAC adsorbent after treatment, and (d) PAC adsorbent after treatment

(Source : Research Documentation, 2022)

The surface pore size of the PAC after adsorption has smaller pore characteristics than before the adsorption process. This is because PAC absorbs the adsorbate in the adsorption process. In this study, the PAC structure was more irregular than the PAC adsorbent so that the removal of several parameters was not superior to PAC. There are several possibilities such as the quality of the PAC and the expiration time of the PAC.

#### 4. CONCLUSION

1. The coagulant dose and the best mixing time for coagulation-flocculation in reducing turbidity and TDS levels were 80 mg/l with a stirring time of 3 minutes of coagulation and 20 minutes of flocculation, with a percentage of 53.8% and 78.6%, respectively. The coagulant dose and exciting time were selected to reduce the levels of other parameters. The removal efficiency of the color parameter is 8.4%, the total coliform parameter is 94.6%, the parameter e.coli 95.2%, the nitrate parameter is 52.6%, the nitrite parameter is 14.3%, and the organic matter parameter is 7.8%. In comparison, the parameters have increased by 2%.
2. Hydraulic Retention Time(HRT) is the best in reducing pollutant levels of turbidity, color, TDS, taste, odor, total coliform, e.coli, total hardness, and organic matter in this study at 12 hours HRT for the SBR reactor with cassava peel adsorbent placed sow, 6 hours HRT for the SBR reactor with meranti wood powder adsorbent, and 6 hours HRT for the SBR reactor with PAC adsorbent. Top placement. This is obtained from achieving the highest percentage decrease in parameters from each SBR reactor. While the effective HRT for reducing nitrate and nitrite parameters was 9 hours HRT for the SBR reactor with the top placement of cassava peel adsorbent, 12 hours HRT for the SBR reactor with meranti wood powder adsorbent placed sow, and 12

hours HRT for the SBR reactor with side placement PAC adsorbent.

3. The best type of adsorbent in reducing pollutant levels in the 6-hour HRT was meranti sawdust for sowing. At 9 hours HRT, the type of adsorbent that effectively reduced pollutant levels was meranti wood powder adsorbent for sowing placement. At 12 hours HRT, sawdust placement of meranti had the highest removal efficiency. While the best placement of adsorbents in reducing pollutant levels at 6 hours HRT was the placement of sows with meranti sawdust adsorbent. At 9 hours HRT, placement of sow with meranti sawdust had the highest removal efficiency. At 12 hours HRT, placement of sow with meranti sawdust adsorbent had the highest removal efficiency.

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