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Using Coagulant Aid, Poly Polypropylene Sediment, Ferrolite, Manganese Greensand, Cation Resin, and Anion Resin in Modified Water Treatment

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Abstract
Decrease of mineral content in water as drinking water quality parameters can be performed by using modified filtration materials in water treatment, zeolith, silica sand, coagulant aid, active carbon, poly propylene sediment, ferrolite, manganese greensand, and ion exchanger.The findings of related previous research in terms of decreased water quality parameters performed by Coagulant Aid, Silica Sand, Ferrolite, Manganese Greensand, Synthetic Resins, and RO membrane indicated a decrease in water quality parameters in the following readings: Turbidity 150.85 NTU scale for turbidity, 148 PtCo for color, 8.71 mg/L Fe for iron, 71.43 mg/L $CaCO_3$ for total hardness, 0.07 mg/L Zn for zinc, 24.08 mg L SO_4 for sulphate, 0.29 mg/L LAS for detergent, in particular for the total coliform decrease of 600 MPN.The method employed in the present study as follows: the raw materials for water were processed starting with Sucolite SP 211 as Coagulant Aid, then filtration treatment using poly propylene sediment (SPP). Next was the following successive treatments; Ferrolite, Manganese Greensand, anion resin, and cation resin.In conclusion, the treatment of coagulant aid, poly propylene sediment, ferrolite, manganese greensand, cation resin, and anion resin in water treatment can decrease water quality parameters in the following readings: 1.360 mg/L for Total Dissolved Solid (TDS), 6.3 NTU scale for turbidity, 0.497 unit PtCo for color, 0.019 mg/L F for Fluoride, Total hardness 265.634 mg/L $CaCO_3$, 292.878 mg/L Cl for Chloride, Mangan 1.235 mg/L Mn, Nitrat 6.355 mg/L NO_3-N, 0.01 mg/L Zn for Zn, 0.001 mg/L CN for cyanide, 95.565 mg/L SO_4 for sulfate, 0.029 mg/L LAS for detergent, and 3.140 MPN/100 mL for total coliform.
Keywords: coagulant, ferrolite, manganese greensand, anion cation resin.

1. INTRODUCTION

Purwoto et al., (2017) suggested that the reduction of water quality parameters performed by the treatment of coagulant aid, silica sand, ferrolite, manganese greensand, synthetic resins, and RO membrane resulted in decreasing water parameters consecutively: 150.85 NTU scale for turbidity, 148 units of PtCo for color, 8.71 mg/L Fe for iron, 71.43 mg/L $CaCO_3$ for total hardness, 0.07 mg/L Zn for zinc, 24.08 mg/L SO_4 for sulphate, 0.29 mg/L LAS for detergent, specifically for the total coliform decrease of 600 MPN.

Sucolite SP 211 as coagulant aid; Water from natural sources usually contains many soluble and suspended solids. Large suspended particles such as sand called discrete particles can be treated by sedimentation or filtration. The smaller suspended membranes that are not easily deposited are called colloids. Colloidal particles can be treated with addition of chemicals, one of which is Sucolite SP 211 then deposited on sedimentation and filter. The Poly Propylene (SPP) Sediment serves as a water filter from the content of mud, sand, soil and other water soluble solid particles to produce clear, clean water free from contamination of dissolved solids in water. Ferrolite to remove high iron content (Fe), strong iron odor, manganese (Mn^{2+}), yellow color in groundwater (Purwoto, 2016).

Removal of Mn^{2+} can be performed with adsorbs by manganese oxide in manganese oxide coated zeolite (MOCZ) (Taffarel, 2010).

Ion exchange resin: Chemicals with certain organic functional groups that can act as ion exchangers between the cations in the resin with the anions present in the treated solution (Montgomery, 2005).

According to Purwoto (2009) brackish water desalination can be carried out by ion exchange with synthetic resin pairs of cations and anions either *individually* and *combined* in the *treatment*.

Poly propylene sediment, carbon block, manganese zeolite, ion exchange, and reverse osmosis (RO) for reference to clean water requirements can reduce the burden of several parameters, including; 2686 ppm for Total Dissolved Solid (TDS), 371.43 mg/L $CaCO_3$ for Total Hardness, 1144 ppm for chloride, coliform total of 4 MPN/100 mL, 0.18 ppm for iron, 737.70 ppm for sodium, 0.08 ppm for zinc, 24.56 ppm for sulfate,15.03 mg/L $KMnO_4$, organic substance and detergent of 0.10 mg/L LAS (Purwoto, et al., 2014). Nurhayati et al. (2014)

concluded that removal of water quality parameters by combining coagulant aid treatment, filtration of poly propylene sediment, and manganese greensand absorbtion, followed by ion exchanger, 2028 ppm for chloride, iron of 0.22 ppm, 3366 ppm for total dissolved solid (TDS), 621.43 mg/L for total hardness $CaCO_3$, organic 19.84 mg/L $KMnO_4$, 0.08 ppm for Zinc, 40.46 ppm for sulfate, and 0.12 mg/L LAS detergent.

2. Materials and Methods

The water treatment constituting the modified treatment poly propylene sediment, ferrolite, manganese greensand, cation resin, and anion resin is present in Figure 1.

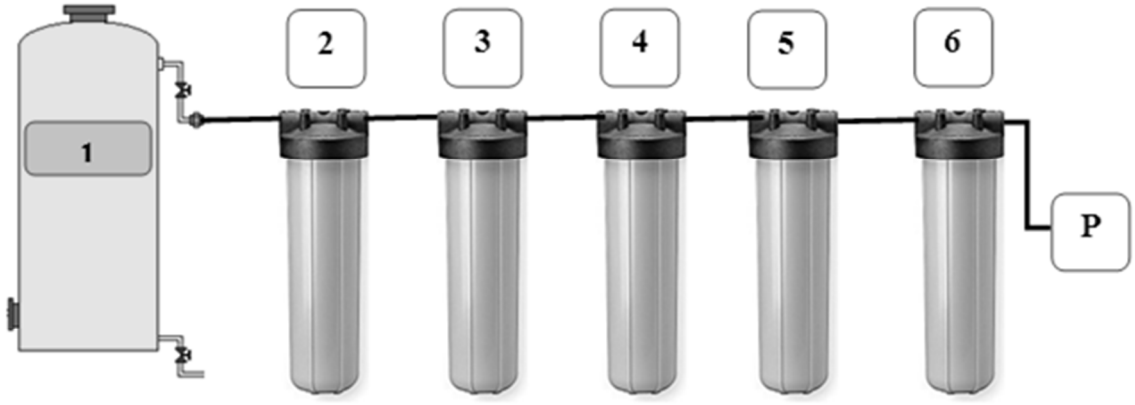

Figure 1. Water Treatment Model

Notes:
(1) = coagulant aid treatment in the reactor tank
(2) = filtration treatment using poly propylene sediment (SPP) in the housing filter
(3) = ferrolite treatment in the housing filter
(4) = manganese greensand treatment on the housing filter
(5) = treatment of anion resin in the housing filter
(6) = treatment of cation resin in the housing filter
(P) = product

The water treatment process flow:
Process Flow Treatment:
The water sample processing begins with Sucolite SP 211 as coagulant aid in reactor tank (1), then the filtration treatment using poly propylene sediment (SPP) in the housing filter (2). Next was the following consecutive treatments: ferrolite (3) and manganese greensand in the housing filter (4), anion resin (5), and cation resin (6).

3. Result and Discussion

3.1. Research result

The raw water samples after the modified coagulant aid treatment, poly propylene sediment, ferrolite, manganese greensand, cation resin, and anion resin resulted in the data as presented in Table 1.

Table 1. Treatment Result Parameters

No	Parameter	Unit	Sample	Treatment Results
A. PHYSICS				
1	Total Dissolved Solid (TDS)	mg/L	6,520,000	5,160,000
2	Turbidity	NTU scale	6.650	0.350
3	Color	PtCo unit	1.514	1.018
B. CHEMISTRY				
a. Anorganic				
4	Fluoride	mg/L F	0.671	0.652
5	Total turbidity	mg/L $CaCO_3$	1,631,750	1,366,116
6	Chloride	mg/L Cl	2,782,340	2,489,462
7	Manganese	mg/L Mn	1.512	0.277
8	Nitrate	mg/L NO_3-N	17.485	11.130
9	Zinc	mg/L Zn	0.029	0.019
10	Cyanide	mg/L CN	0.003	0.002
11	Sulphate	mg/L SO_4	465.325	369.760
b. Organic				
12	Detergent	mg/L LAS	0.034	0.005
C. Bacteriology				
13	Total Coliform	MPN/100 mL	5,200,000	2,060,000

3.2. Discussion

The declining parameters are presented in Table 2.

Table 2. Removal of water treatment parameter

No	Parameter	Unit	Removal
1	Total Dissolved Solid (TDS)	mg/L	1,360,000
2	Turbidity	NTU scale	6.300
3	Color	PtCo unit	0.497
4	Fluoride	mg/L F	0.019
5	Total Hardness	mg/L $CaCO_3$	265.634
6	Chloride	mg/L Cl	292.878
7	Manganese	mg/L Mn	1.235
8	Nitrate	mg/L NO_3-N	6.355
9	Zinc	mg/L Zn	0.010
10	Cyanide	mg/L CN	0.001
11	Sulphate	mg/L SO_4	95.565
12	Detergent	mg/L LAS	0.029
13	Total Coliform	MPN/100 mL	3,140,000

The removal of chloride in this study in amount of 292.878 mg/L Cl (i.e. from 2,782,340 to 2,489,462 units). This was possible because of the performance of the resin, wherein the cation and anion were removed from the water and the solid resin released H^+ ions to exchange with the cation, and OH^- was exchanged with anions from the water so that the cation and anion content in water got reduced or lost (Montgomery, 2005).

The decreased total hardness of 265,634 mg/L $CaCO_3$ was the result of absorbent by the manganese greensand, while the ferrolite was capable of removing manganese (Mn) of 1.235 mg/ L Mn.

Referring to the raw water sample according to Purwoto (2014) as shown in Table 3, it indicated that the water contained the total coliform of 1,100 units decreased by 1067 units to 33 units; whereas the total coliform removal in this study amounted to 3.140 units. Thus if the treatment as what this study performed was conducted for the water samples containing e coli of 1,100 units such as water of the sample then the e coli could be removed entirely.

The treatment results of coagulant aid, poly propylene sediment, ferrolite, manganese greensand, cation resin, and anion resin as one in this study were able to decrease TDS from 6.520 mg/L to 5.160 mg/L. The findings by Purwoto (2014) as illustrated in Table 3 indicated the amount TDS of raw water of 1240 units. Thus, if the treated water contained TDS as well as the water samples, the total TDS could be decreased completely.

Table 3. Lab Test Results of Standard Water Samples and Treatment Results

No	Parameter	unit	Lab test results	
			Standard water samples	Treatment results
1.	Total Disolved Solid (TDS)	mg/L	1240	66
2.	Turbidity	NTU scale	3.4	0.15
3.	Temperature	^oC	25	25
4.	Color	PtCo	15	0
5.	Electrical conductivity (DHL)	mhos/cm	2070	51
6.	Arsenic	mg/L As	0	0
7.	Iron	mg/L Fe	0.25	0.05
8.	Fluoride	mg/L F	0.76	0.22
9.	Cadmium	mg/L Cd	0	0
10.	Total Turbidity	mg/L $CaCO_3$	200	21.43
11.	Chloride	mg/L Cl	620	36
12.	Chromium, Valence 6	mg/L Cr^{6+}	0	0
13.	Manganese	mg/L Mn	1.84	0
14.	Natrium	mg/L Na	384.8	12.3
15.	Nickel	mg/l Ni	0	0
16.	Nitrate	mg/L NO_3-N	3.04	0.38
17.	pH	-	7.45	8.1
18.	Zinc	mg/L Zn	0.12	0.02
19.	Cyanide	mg/L CN	0	0
20.	Sulphate	mg/L SO_4	75.06	0
21.	Organic substances	mg/L $KMnO_4$	3.92	3.01
22.	Detergent	mg/L LAS	0.08	0
23.	Total Coliform	MPN/100 mL	1100	33

Source: Purwoto, Sopandi, & Nurcahyanie, (2014)

Other parameter declines included: turbidity of 6.3 NTU scale, color of 0.497 PtCo unit, fluoride 0.019 mg/L F, nitrate of 6.355 mg/L NO_3-N, zinc of 0.01 mg/L Zn, cyanide of 0.001 mg/L CN, sulfate of 95.565 mg/L SO_4, and detergent of 0.029 mg/L LAS.

4. CONCLUSION

To conclude, the treatment of coagulant aid, poly propylene sediment, ferrolite, manganese greensand, cation resin, and anion resin in water treatment can decrease these parameters: 1.360 mg/L for Total Dissolved Solid (TDS), 6.3 NTU scale for turbidity, 0.497 unit PtCo for color, 0.019 mg/L F for Fluoride, Total hardness 265.634 mg/L $CaCO_3$, 292.878 mg/L Cl for Chloride, Mangan 1.235 mg/L Mn, Nitrat 6.355 mg/L NO_3-N, 0.01 mg/L Zn for Zn, 0.001 mg/L CN for cyanide, 95.565 mg/L SO_4 for sulfate, 0.029 mg/L LAS for detergent, and 3.140 MPN/100 mL for total coliform.

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