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The Effect of Activated Carbon and Coagulants from Papaya Seeds in Improving the Water Quality of Well Water PT X

Amiliza Miarti[a]*, Indah Pratiwi[b]

Abstract. Solid waste from papaya seeds which contains a water content of 7,29% and ash content of 7,55% has the potential to be processed into coagulants and activated carbon. Well water at PT X has high levels of turbidity, pH and COD. This study aims to compare the effectiveness of activated carbon and coagulant from papaya seeds in improving the well water quality of PT X, based on the parameters of pH, TSS, TDS, Turbidity, and COD. Doses of coagulant and activated carbon were used (1, 2, 3) grams and contact time (48 and 60) minutes respectively. The research showed that activated carbon at the dose of 1 gram, contact time 60 minutes was able to reduce TSS 97,08%, TDS 72%, Turbidity 89,68%, and COD 54%. While the coagulant dose of 1 gram, contact time 60 minutes can reduce TSS 88,39%, TDS 64%, Turbidity 72,45% and COD 80%. The percentage decrease in TSS, TDS, Turbidity and COD values in the use of activated carbon from was more effective to reduce pollutant levels of well water at PT X.

Keywords : Papaya Seeds, Activated Carbon, Coagulant, Well Water

[a]*Politeknik Akamigas Palembang, Jl. Kebon Jahe, Komp. PERTAMINA RU III Plaju, Palembang, Indonesi, 30268*
[b]*Politeknik Negeri Sriwijaya, Jl. Srijaya Negara Bukit Besar Palembang, Sumatera Selatan, Indonesia, 30139*
Correspondence and requests for materials should be addressed to Amiliza Miarti (email: amilizamiartirozie@gmail.com).

Introduction

The high level of well water pollution at PT X is currently greatly affecting human life and the surrounding environment, especially in the use of clean water, the quality of which is decreasing over time, while the well water is used for drinking, washing and so on by local residents. The contamination of the well water is due to the proximity of the well to the septic tank, it being made too shallow, and the presence of rubbish. As a result of this waste, the color of the water changes to yellowish and cloudy. This is due to the presence of pollutants such as minerals which make the water taste, smell and contain lots of bacteria which, if used for bathing or washing cooking utensils, is very risky of causing disease.

Further treatment is not carried out, in a relatively short time it will cause a foul smell from H_2S, ammonia or phosphine gas as a result of organic fermentation in the well water. The decay process will cause an unpleasant odor, especially in the dry season with reduced water discharge, the physical, chemical and biological environmental imbalance of the well water will decrease and will have a bad impact on the environment and disrupt the health of the local community. This research was conducted to overcome the problem of well water in the PT Staff Settlement. X is by means of coagulant and activated carbon treatment. This pollution is estimated by the author to be caused by waste resulting from the production process of PT X, and because the Staff residence is close to the production work area, the waste pollutes the surrounding environment. One way that can be used to treat well water is the coagulation - flocculation process and using activated carbon. Coagulation and flocculation are processes of colloidal particles clumping together to form a precipitate. One raw material that can potentially be used as a coagulant is papaya seeds (carica papaya L.). Papaya seeds contain several active compounds such as alkaloids, flavonoids, glycosides anthraquinone, tannin,triterpenoids/steroids and saponi[1] The protein content in papaya seeds acts as a coagulant used to reduce dyes in textile dyeing liquid waste. According to [2] stated that the natural coagulant contained in papaya seed powder can reduce turbidity by up to 53,85%. The largest percentage reduction in water turbidity is the use of natural coagulant from papaya seeds which can reduce turbidity by up to 99,6% with a papaya seed mass of 2,5 grams and a NaCl concentration of 0,1 M [3]. On the other hand, activated carbon can also be used. To improve the quality of well water, it has very large pores and surface area (500-1500 m2/g) which allows interaction between pollutant molecules and the surface of activated carbon [4]. One abundant, renewable and cheap carbon source is rice husks. Much research has been carried out on papaya seed charcoal as an absorbent, including the chemical composition of cellulose which can be converted into charcoal [3]. The charcoal (carbon) produced is around 1,33%.

Further research has been carried out by [5] the content of charcoal produced is around 66,19%, the longer the time and the higher the carbonization temperature, the lower the yield produced. [3] stated that activated charcoal from papaya seeds has the potential to absorb phenolic compounds in industrial waste. So that between the two methods, a comparison can be made of which method is more effective in improving the quality of well water based on the parameters pH, TSS, TDS, Turbidity and COD.

Experimental

The Tools and materials

Papaya seeds are the material used to make active carbon and coagulant in this research, with well water samples [6] while the additional materials for making active carbon are sodium hydroxide (NaOH), phosphoric acid (H_3PO_4), distilled water and the equipment is a furnace, beaker glass, funnel, analytical balance, stirrer, spatula, measuring pipette, oven desiccator, sieve shaker, aluminum cup, filter paper, barrel crucible. To make coagulant, the equipment used is a Test Jar, Aluminum Cup, Oven, Analytical Balance, 80 mesh Sieve Shaker and Desiccator. Meanwhile, for testing analysis of processed water from activated carbon and coagulants using a pH meter, Turbidity Meter and Glass Tube Cell, Whatman paper and reflux equipment.

Water Sample Preparation

The sample used in this research was turbid water obtained from the well water of PT employees. X. then took the sample to the laboratory for further measurements and analysis. Before working on the sample, measure the pH, TSS (Total Suspended Solid), TDS (Total Dissolved Solid), Turbidity and COD first.

Preparation of Activated Carbon and Coagulants

The process of making activated carbon goes through three stages, namely the dehydration stage, carbonization stage and activation stage [5]. The first stage is the dehydration stage, by drying the papaya seeds in the sun to remove the water content contained in them. Next, in the carbonization stage, put the papaya seeds into the furnace to be carbonized for 1 hour at a temperature of 300 °C. then grind it using a mortar and filter the finely ground papaya seed charcoal using an 80 mesh sieve and then collect the papaya seed charcoal. Next, the activation stage is by weighing 50 grams of papaya seed charcoal, then adding 150 ml of phosphoric acid and soaking for 1 hour in a closed position, filtering the charcoal, then washing alternately using distilled water and NaOH to get papaya seed charcoal with a neutral pH. , then dry using an oven at a temperature of 105 °C for ± 1 hour and put into a desiccator for cooling. Meanwhile, to make coagulant, you need to separate the papaya seeds from the flesh and wash them so they don't stick and dry the papaya seeds in the sun until they dry for ± 3 days. Then dry again using the oven at 105 °C for 1 hour. Next, smooth it using a blender and pound using a porcelain mortar until smooth. Then sift it using an 80 mesh sieve shaker and the powder obtained is stored in a closed plastic bag.

Determination of Water Content of Activated Carbon and Coagulants

Take 1 gram of activated carbon sample and place it in a watch glass of known dry weight. The watch glass containing the sample is dried in an oven at a temperature of 105 °C - 110 °C for ± 1 hour until the weight is constant and then cooled in a desiccator for about 15 minutes and then weighed. The final concentration is calculated using the formula [7]:

$$Water\ Content\ (\%) = \frac{W2-W3}{W2-W1} x\ 100\% \qquad (1)$$

Description: W_1 is the mass of empty cup (g); W_2 is the cup mass + initial sample (g); W_3 is the cup mass + final sample (g).

Determination of Active Carbon Ash and Coagulant Content

Take 1 gram of papaya seed activated carbon sample into a porcelain cup of known weight and place the cup containing the sample into a furnace at a temperature of 600 oC for 1 hour or until the sample completely turns to ash then cool for ± 10 minutes then put it in a desiccator for cooling. samples. Next, calculate the ash content. Ash content is calculated using the formula[7]:

$$Ash\ Content\ (\%) = \frac{W2-W3}{W2-W1} x\ 100\% \qquad (2)$$

Description: W1 is the mass of empty cup (g); W2 is the cup mass + initial sample (g); W3 is the cup mass + final sample (g).

PT X Well Water Treatment Process with Papaya Seed Activated Carbon Using Jar Test

PT different, namely 1 gram, 2 grams and 3 grams, then stir at 150 rpm for 3 minutes then reduce the stirring speed by 60 rpm for 15 minutes and 27 minutes. Next, leave the sample for 30 minutes. The total contact time varies, namely 48 minutes and 60 minutes [5]. After that, take measurements of pH, TDS, TSS, Turbidity and COD.

Coagulation-Flocculation Process with papaya seed coagulant Using Jar Test

The flocculation coagulation process uses a Jar Test by pouring 500 ml of each PT well water sample. X into 3 beakers and label them. Then add papaya seed coagulant with varying doses of 1 g, 2 g, and 3 grams in a glass beaker and turn on the test jar. Next, place each sample into the test equipment with the paddle submerged in the sample and a distance of 6,4 mm from the wall of the beaker and set the stirring speed to 150 rpm (coagulation) and wait for 3 minutes, then reduce the stirring speed to 60 rpm (flocculation) and wait for 15 and 27 minutes then leave the sample for 30 minutes so that the floc particles settle [8]. After that, take measurements of pH, TDS, TSS, Turbidity and COD.

pH Testing

pH (power of Hydrogen) is the degree of acidity which is used to express the level of acidity or alkalinity in water. The number of H+ ions and OH^- ions in water can be used to determine the pH of the water, the more H+ ions, the stronger the acidic properties, conversely, the more OH^- ions, the stronger the basic properties [9]. In this case, the pH testing process for PT. take a sample of well water to be tested, then measure the pH then read and record the results whether it is acidic, alkaline and neutral. Next, do it in triplicate to increase the accuracy of the experiment.

TDS (Total Dissolved Solid) Testing

Total Dissolved Solid (TDS) is a dissolved solid object which contains all minerals, salts, metals and cations dissolved in water. By general, concentration things congested dissolvedis the number of cations and anions in water [10]. TDS is measured in Parts per Million (ppm) or weight ratio to water [6]. The testing process for TDS in PT. Cup empty, take notesas the previous weight, then take a sample of 100 ml of well water as needed. then filter the sample using Whatman filter paper and take 10 ml of the sample then put it in a petri dish and put it in the oven, wait until it dries. After drying, put it in a desiccator for 30 minutes then weigh the petri dish after evaporating it in the oven using an analytical balance and record the final results, and record the weight after [8].

$$TDS\ (mg/l) = \frac{W1-W0}{V} x\ 1000 \qquad (3)$$

Description: W0 is the mass of the cup after oven (g); W1 is the mass of empty cup (g); V is the sample volume (ml).

TSS (Total Suspended Solid) Testing

TSS (Total Suspended Solid) is a solid that causes water turbidity, is not dissolved and cannot settle immediately, consisting of particles that are smaller in size and weight than sediment, for example clay, certain organic materials, cells of microorganisms and so on[8]. The process is weighing the watch glass + filter paper, recording the weight beforehand, then taking a sample of 100 ml of well water as needed. filter using Whattman filter paper then put the watch glass + filter paper into the oven for 1 hour at 105 oC. then put it in a desiccator for 30 minutes. Then weigh the watch glass + filter paper after heating in the oven using an analytical balance and record the final result, record it as weight after [8]. Calculations based on eq 4.

$$TSS\ (mg/l) = \frac{W1-W0}{V} x\ 1000 \qquad (4)$$

Description: W0 is the mass of initial filter paper (g); W1 is the mass of final filter paper (g); V is the volume of test sample (ml).

Turbidity Testing (Turbidity)

Turbidity is a condition where the transparency of a liquid is reduced due to the presence of insoluble substances. As we know, cloudy water is one of the characteristics of water that is unclean and unhealthy. Cloudy water is caused by the presence of colloidal grains of clay. The more colloid content, the more turbid the water will be [11]. Turbidity testing uses a Turbidity Meter and a Glass Tube Cell. The procedure is pressing ON, rinsing the glass tube cell with the water sample to be analyzed then inserting a 10 ml water sample into the glass tube cell and drying the glass tube cell with tissue. Then insert the sample glass tube cell into the holder then press Enter until the results are displayed on the monitor.

Chemical Oxygen Demand (COD) Testing

COD is the total amount of oxygen needed to chemically oxidize organic substances [6]. COD or chemical oxygen demand is the amount of oxygen needed so that the organic waste in PT. , Concentrated sulfuric acid containing 1% silver sulfate 4, Ferroin indicator, Ammonium ferrous sulfate 0,1 N or 0,025 N, Boiling stone. Then the working process is to take a 100ml sample filtrate, then take 5 mL, dilute it with distilled water to make 50 ml, add 10 ml of K_2Cr_2O7 1M, homogenize it, add 10 ml of H_2SO4 10 ml, then heat for about 30 minutes, then add distilled water until it becomes 100 ml, add 5 drops of ferroin indicator, then titrate. with ammonium sulfate until it turns black and record the titrant volume and calculate the COD value [12].

$$COD\ (mg/l) = \frac{(A-B)\ x\ 0{,}025\ x\ ¼\ 32\ x\ 1000}{V} \qquad (5)$$

Description: A is volume of FAS solution used to titrate the blank (ml); B is volume of FAS device used to titrate the sample (ml); V is the volume of test sample (ml).

Result and Discussion

pH Analysis (Power of Hydrogen)

pH (power of Hydrogen) is the degree of acidity which is used to express the level of acidity or alkalinity in water. The number of H^+ ions and OH^- ions in water can be used to determine the pH of the water, the more H^+ ions, the stronger the acidic properties, conversely, the more OH^- ions, the stronger the basic properties [10].

From the graph above it can be seen that the pH content rises towards normal, in accordance with the quality standard, namely 6,5–8,5, except for the contact time of 48 minutes with a dose of 1 gram, which is 6,13, slightly short of reaching the

quality standard [13]. This is because it is possible that the activated carbon contact time will be more effective if it is longer than 48 minutes. Most of this process can be stated that activated carbon from rice husks is declared effective for use as an ingredient in PT staff well water treatment. X which can raise pH levels towards normal in accordance with the quality standards of the Minister of Health.

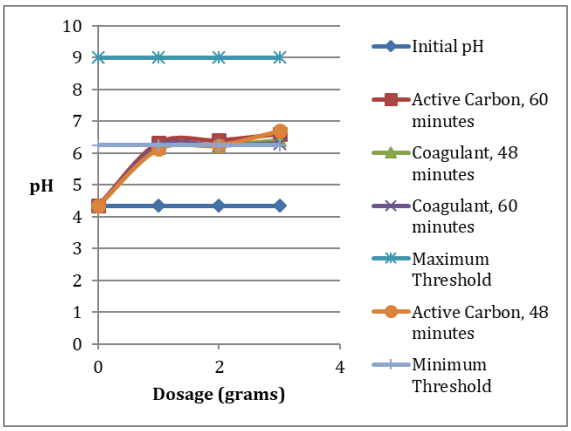

Figure 1. Graph of pH Analysis Results from Well Water Treatment with Activated Carbon and Coagulant from Papaya Seeds

From the graph above, it is also found that the pH results from processing with coagulants from papaya seeds have increased towards the quality standard, although most have not been able to reach levels according to the desired quality standard, except at doses of 2 grams and 3 grams with a contact time of 60 minutes. So from this research it can be concluded that processing with coagulants from papaya seeds greatly influences the dose of coagulant used and the length of contact time. The longer the contact time, the more effective the processing with coagulants will be. [8] The longer the flocculation contact time, the more floc coalescence occurs. This floc fusion is influenced by contact time and slow stirring [6].

Overall, this processing process can be concluded that a more effective process in treating well water to raise the pH value to closer to normal is to use activated carbon. This is because in the adsorption process, metal elements in water will be broken down into metal ions and hydroxide ions (OH^{-}). Metal ions will be attracted by activated carbon with Van der Waals forces so that what is left behind are (OH^{-}) ions [15]. Activated carbon also functions as an absorbent for organic materials contained in well water samples. Organic materials can be contained in well water. Water containing dissolved organic compounds causes the water to be acidic [16]. Therefore, with the absorption of organic materials by active carbon, the pH value can increase [5]. Apart from that, it can be seen that increasing the dose of activated carbon can increase the pH level as the length of contact time increases.

TSS (Total Suspended Solid) Analysis

TSS (Total Suspended Solid) is a solid that causes water turbidity, is not dissolved and cannot settle immediately, consisting of particles that are smaller in size and weight than sediment, for example clay.

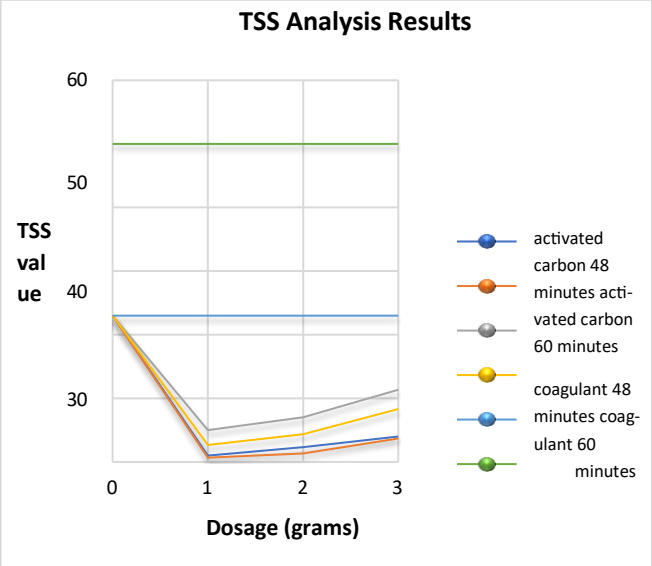

Figure 2. Graph of TSS Analysis Results from Well Water Treatment with Activated Carbon and Coagulant from Papaya Seeds

From the graph above, it can be seen that the initial TSS content is 23 mg/l, which meets the standard [13], namely that it should not be more than 50 mg/L. Meanwhile, by using activated carbon and coagulant from papaya seeds, it can be seen that the TSS content drops significantly. The decline that occurred can be seen in the Table 1.

From the table above it can be seen that the greater the dose of activated carbon and coagulant from papaya seeds, the decrease the TSS number is getting lower and lower. This is also confirmed by research [17] that adding too much dose causes the solution to experience a saturation point so that the adsorption process becomes lower. This is also confirmed by [2] that the process of adsorption of excess cations by colloidal particles in water can cause deflocculation or restabilization of the colloid.

From these two processes it can be saidable to reduce the TSS content of well water PT X Staff,

it's just that this well water treatment will be more effective with processing using activated carbon at a dose of 1 gram at 60 minutes of contact, which is 97,09 %.

Table 1. Percentage Decrease in TSS Value after Adding Active Carbon and Coagulant from Papaya Seeds

Dosage (grams)	Activated Carbon		Coagulant	
	48 minutes (%)	60 minutes (%)	48 minutes (%)	60 minutes (%)
1	95,65	97,09	78,26	88,39
2	89,83	94,17	69,57	81,13
3	82,61	84,04	50,70	63,91

TDS (Total Dissolved Solid) Analysis

Total Dissolved Solid (TDS) are dissolved solid objects in the form of minerals, salts, metals and cations dissolved in water. In general, concentration of things congested dissolved is the amount of cations and anions in water [11].

From the graph above, it can be seen that the initial TDS content is 250 mg/l, which meets the quality standards [13], namely it should not be more than 500 mg/l. Meanwhile, with the use of activated carbon and coagulant from papaya seeds, it can be seen that the TDS content has decreased from the initial level of 250, with the exception of activated carbon from rice husks and coagulant from papaya seeds at doses of 2 grams and 3 grams at a contact time of 48 minutes and 60 minutes. increased from its initial value. This is because the dose used is too large and excessive so that the solution will reach a saturation point. A dose of 1 gram is actually enough for activated carbon from rice husks and coagulant from papaya seeds to reduce TDS levels. This is also confirmed by research [12] that the higher the dose of activated carbon, the smaller the ability of activated carbon to adsorb because the more dose used, the solution will experience a saturation point.

Table 2. Percentage Decrease in TDS Value after adding Active Carbon and Coagulant from Papaya Seeds

Dosage (grams)	Activated		Coagulant	
	48 minutes (%)	60 minutes (%)	48 minutes (%)	60 minutes (%)
1	68	72	29,2	64
2	60	65,2	*	*
3	56	62,66	*	*

*At doses of 2 grams and 3 grams, 48 minutes and 60 minutes after adding coagulant from papaya seeds, there was no decrease from the initial level value.

From table 2, it can be seen that the use of activated carbon from rice husks is able to reduce the TDS content of PT Staff well water. X While from the coagulant from papaya seeds only at a dose of 1

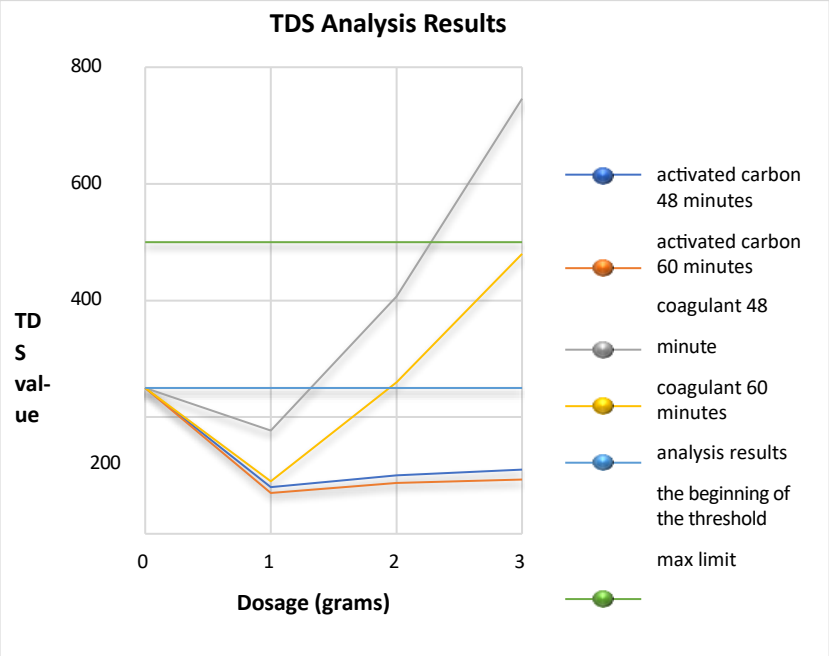

Figure 3. Graph of TDS Analysis Results from Well Water Treatment with Activated Carbon and Coagulant from Papaya Seeds

gram with contact time of 48 minutes and 60 minutes that can reduce the TDS content, the greatest decrease occurs at a dose of 1 gram at the time of contact 60 minutes from activated carbon which is 72 % so it can be said to be the most effective for treating PT well water. X. In general, only processes using rice husks can reduce the TDS value from the initial level value.

This is also confirmed by [18] that the addition of excess coagulant can re-form colloidal particles in the solution due to deflocculation, so that TDS levels rise. The decline that occurred can be seen in the table 2.

Turbidity(Turbidity)

Turbidity is a condition where the transparency of a liquid is reduced due to the presence of insoluble substances. Cloudy water is caused by the presence of colloidal grains of clay. The more colloid content, the more turbid the water will be [18].

From the graph above it can be seen that the initial turbidity content is 7,08 NTU, this result exceeds the quality standard [13] that is, it cannot be more than 5 NTU. Therefore, a further processing process is needed, in this case the researchers used activated carbon and coagulant from papaya seeds, until results were obtained according to the graph above, namely a decrease from the initial level results. The percentage of decline that occurred can be seen in the following table 3.

Table 3. Percentage Decrease in Turbidity Value after Adding Active Carbon and Coagulant from Papaya Seeds

Dosage (grams)	Activated Carbon		Coagulant	
	48 minutes (%)	60 minutes (%)	48 minutes (%)	60 minutes (%)
1	87,57	89,69	48,59	72,46
2	81,64	82,20	24,15	62,43
3	75,85	76,84	12,43	47,88

From the table above it can be seen that the use of coagulant activated carbon from papaya seeds is able to reduce the turbidity content of PT X Staff well waterX, the biggest decrease occurs at a dose of 1 gram and a contact time of 60 minutes from activated carbon is 89,69 % so that it can be said to be the most effective for the water treatment of PT X.

In general, these two processes are able to reduce the turbidity value to meet the quality standard [13], namely 5 NTU. With the exception of doses of 2 grams and 3 grams with a contact time of 48 minutes from the coagulant, the results have passed the quality standard, this is possibly due to the longer contact time required, but in fact this has been able to reduce turbidity from the initial level value.

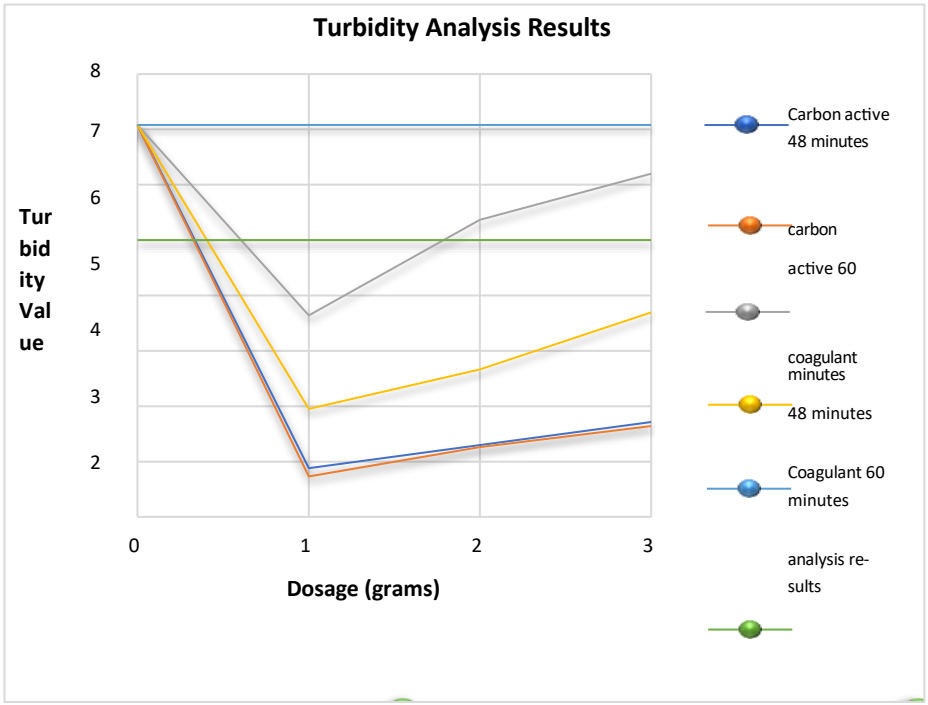

Figure 4. Analysis Results Graph Turbidity from Well Water Treatment with Activated Carbon and Coagulant from Papaya Seeds

Chemical Oxygen Demand (COD)

Chemical oxygen demand (COD) is the amount of oxygen needed to decompose all organic materials contained in water.

Table 4. Percentage Decrease in COD Value after adding Active Carbon and Coagulant from Papaya

Dosage (grams)	Activated Carbon		Coagulant	
	48 minutes (%)	60 minutes (%)	48 minutes (%)	60 minutes (%)
1	44,22	54,73	60,45	80,73
2	39,21	50,01	55,23	74,68
3	32,80	42,01	50,91	68,02

From the table above it can be seen that the use of activated carbon and coagulant from papaya seeds is able to reduce the COD content of PT X Staff's well water X, the biggest decrease occurs at a dose of 1 gram and a contact time of 60 minutes from the coagulant is 80,73 % so that it can be said to be the most effective for the water treatment of PT X.

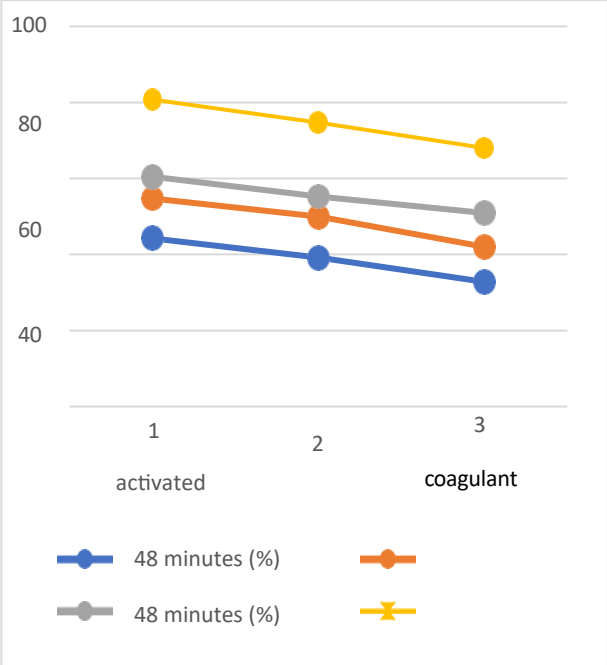

Figure 5. Analysis Result Graph COD from Well Water Treatment with Activated Carbon and Coagulant from Papaya Seeds

The graph above shows that activated carbon media has a lower level of effectiveness in processing PT. This is because the longer contact time allows the process of diffusion and attachment of the adsorbate molecules to take place better. The concentration of organic substances will decrease if the contact time is sufficient [4]. The adsorption that occurs is due to the force field on the surface of the adsorbent (activated carbon) which attracts the molecules in the well water. In this process, particles or molecules of pollutant material will stick to the surface of the activated carbon due to the weak charge difference (van der Waals force) between the two (attraction between the positive charge of the active carbon and the carboxyl group on the negatively charged pollutant material), so that forms a thin layer of fine particles on the surface of activated carbon [6].

After carrying out both processing processes (coagulation and adsorption with activated carbon from papaya seeds), the coagulation processing of papaya seeds resulted in better quality well water with COD reaching 80.73%. From these results it can be concluded that the concentration of organic matter in well water has decreased, so that both processes are effective in reducing COD and organic pollutants in well water at PT.

Conclusion

Based on research conducted at the Akamigas Palembang Polytechnic Laboratory, it can be concluded that : 1) The effect of activated carbon can be seen from the calculation of the effectiveness of the reduction percentage showing that activated carbon from papaya seeds has a greater reduction percentage at a dose of 1 gram with a contact time of 60 minutes for the TSS parameter of 97,09 %, TDS 72%, Turbidity 89,69% and COD 54%, compared with coagulant from papaya seeds at a dose of 1 gram with a contact time of 60 minutes for TSS parameters 88,39%, TDS 64 %, Turbidity 72,46 % and COD 80%; 2) Papaya seed activated carbon has a better ability to reduce the TSS (Total Suspended Solid), TDS (Total Dissolved Solid), Turbidity value and can increase the pH value according to quality standards in the well water of PT employees. X is more effective than coagulant from papaya seeds; 3) Papaya seed coagulant has a better ability to reduce the COD content in the well water of PT employees. X is more effective than activated carbon from papaya seeds.

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