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Regional Case Study

Water Purification Using SPZ and SPA Filter Media to Improve the Water Quality of Sekar Lepen Keprabon River

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Abstract

The Sekar Lepen Keprabon River is one of the tributaries polluted by domestic waste. This study aims to determine the water quality of the Sekar Lepen Keprabon River before and after filtering using SPZ (coconut fiber, banana fronds, zeolite stone) and SPA (coconut fiber, banana fronds, coconut shell charcoal) filter media. This experiment uses SPZ and SPA filter media to purify water that is applied directly to the river. The methods used were primary and secondary data collection. The data obtained were analyzed using a descriptive quantitative approach and the effectiveness of each parameter was calculated. The results of this study indicate that the water quality before and after filtering with SPZ filter media obtained a fixed temperature value, pH increased, COD and TSS increased, and TDS decreased. Water quality before and after going through the SPA filter media obtained a fixed value in temperature, pH increased, COD and TSS decreased, and TDS increased. SPZ filter media in the water filtration process is more effective in increasing pH parameters and reducing TDS parameters in river water. In contrast, SPA filter media in the water filtration process is more effective in reducing COD and TSS parameters in river water.

Keywords: Effectiveness; filter; river; water

1. Introduction

Environmental pollution that occurs in several resource components, including water pollution, is caused by many factors, including the increasing number of people and their activities. According to Asrini et al. (2017), a decrease in water quality can affect productivity, designation functions, and the carrying capacity of these water resources. One of several water sources that are vulnerable to pollution is the river. The Sekar Lepen Keprabon River is a tributary that flows into the Pepe River. The river flows through densely populated settlements that have the potential to dump domestic waste or garbage into the river, making it quite vulnerable to water pollution. This is supported by IKLH Surakarta Document (2022), the results of monitoring the water quality of the Pepe River, Keprabon stream, with an IP of 3.67 or lightly polluted, which is dominated by domestic waste pollutant sources from urban residential areas and trade activities crossed by the flow of river water. Domestic waste is mainly from bathing, washing, and toilet activities that contain soap or detergent, so it can disturb organisms in the water because it can raise the pH of the water. In addition, in the Surakarta IKLH Document (2022), the results of water quality monitoring in 2021 by DLH Surakarta obtained the value of the COD parameter in the Pepe River Keprabon flow of 30-64 mg/L, as well as the value of the TSS parameter in January 2021 of 52 mg/L and February 2021 of 63 mg/L. Turbid river water quality will disturb the organisms in it and reduce the function of its designation (Iqbal et al., 2022). One way to overcome this can be done by treating river water through water purification using porous and fibrous media to filter out the components that cause turbid water (Ilyas et al., 2021). Materials that have pores and fibers include banana leaves, coconut husks, zeolite stone, and coconut shell charcoal. Dried banana fronds have a fibrous and porous texture (Rufaidah et al., 2021). Coconut fiber can be used as an adsorbent without charring because its structure is porous and fibrous and has cellulose and lignin content (Suprabawati and Dwikora, 2016). Zeolite stone has an open-pore structure that can filter or separate molecules of a certain size so that it can be used as a water filter (Alam et al., 2018). Coconut shell charcoal can be utilized as an adsorbent because it has many pores and considerable absorbing properties (Masriatini, 2019). This research uses a combination of filter media compositions from several SPZ (coconut fiber, banana fronds, and zeolite stone) and SPA (coconut fiber, banana fronds, and coconut shell charcoal) materials, with filter media applied directly to the Sekar Lepen Keprabon River water flow. Therefore, this research was conducted with the aim of purifying water using SPZ and SPA filter media to improve the water quality of the Sekar Lepen Keprabon River and this is a novelty brought to this research.

2. Methods

2.1. Research Time and Location

The research location was conducted in the Sekar Lepen Keprabon River area, Keprabon, Banjarsari, Surakarta with coordinates S 07º33.985' E 110º 49.558' which can be seen in Figure 1. Sekar Lepen Keprabon River water flows into the Pepe River. Temperature and pH parameters were measured directly in the field. COD, TSS, and TDS parameters were tested at the BBTKLPP Laboratory in Yogyakarta City. This research was carried out in approximately 4 (four) months starting from February to May 2023.

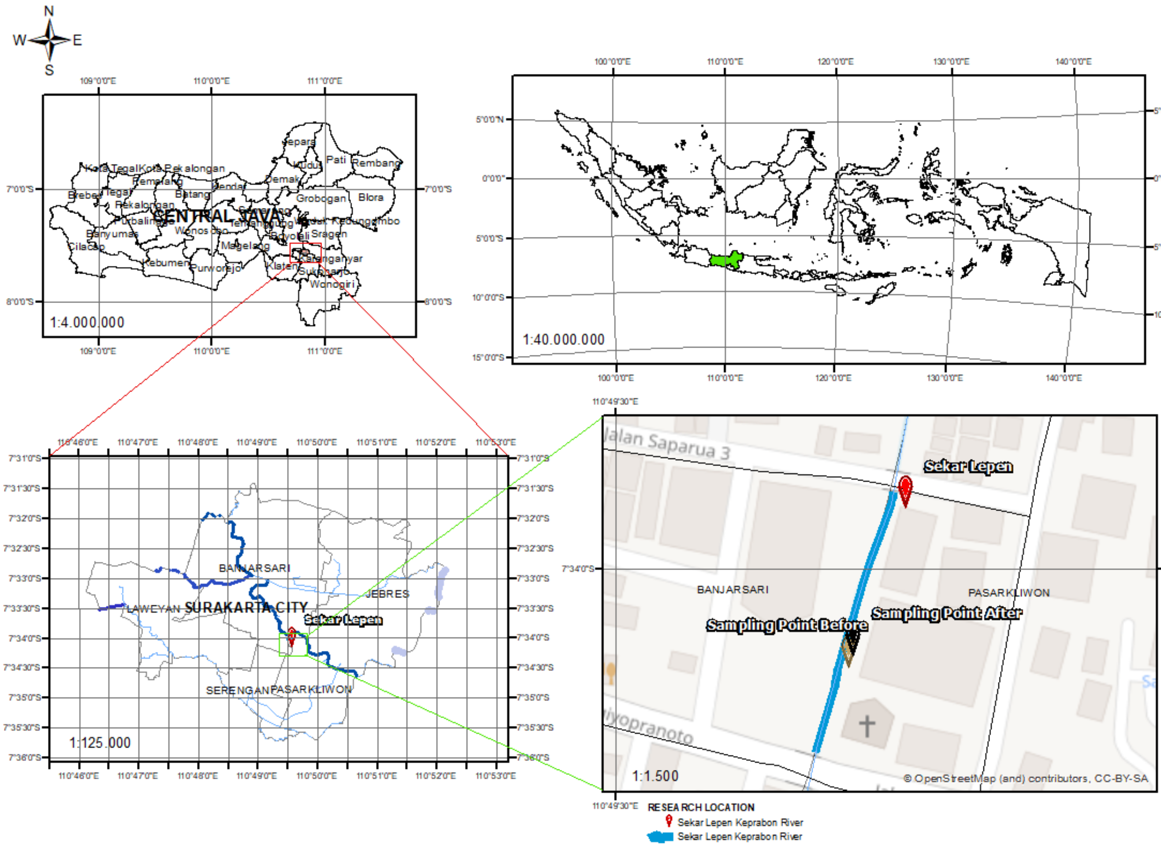

Figure 1. Research location

2.2. Materials

The tools used in this study are water sampling equipment, a thermometer, pH meter, test tube, beaker, gloves, mask, HDPE bottle, dipper, ping pong ball, stopwatch, roll meter, ice box or cooling box, Secchi disk, spectrophotometer, COD reactor or heater, volumetric flask, test tube, measuring cup, beaker glass, pipette, electric drill, roofing bolt lock, saw, pliers, hammer, scissors, and Microsoft Excel.

For the materials used in this study, namely the Sekar Lepen Keprabon river water sample, SPZ filter media (coconut fiber 5.5 kg, banana fronds 7.9 kg, zeolite stone 50 kg), SPA filter media (coconut fiber 5.9 kg, banana fronds 8.4 kg, coconut shell charcoal 18.7 kg), 24 bags of 1 mm filter net, 3 rolls of wire (18 meters), 8 poles of C channel mild steel, 355 roofing screws, 12 binabol screws, low concentration digestion solution, sulfuric acid reagent solution ($AgSO_4$ and H_2SO_4), labels, distilled water, and 1 pack of tissue.

2.3. Data Analysis

The work method of this research is to conduct a preliminary analysis to determine the initial conditions under study, prepare filter media, and analyze test parameters. Primary data in this study are the results of direct observations, making filter media frames and their application, and sampling river water. Secondary data in this study were obtained from DLH Surakarta, BBWS Bengawan Solo, and based on literature studies. This research is experimental in the field using SPZ (coconut fiber, banana fronds, zeolite stone) and SPA (coconut fiber, banana fronds, coconut shell charcoal) filter media as river water purification media which is then continued with field parameter measurements and laboratory testing. The data analysis carried out in this study is that the data that has been obtained is analyzed descriptively with a quantitative approach that refers to the quality standards of river water quality according to Government Regulation Number 22 of 2021 Appendix VI. Data analysis was carried out by calculating the effectiveness of increasing pH parameters and decreasing COD, TSS, and TDS parameters in river water before and after going through SPZ filter media and SPA filter media. The effectiveness value is expressed in percentage (%) using the following equation (1):

$$\text{Effectivity (\%)} = \frac{(n1-n2)}{n1} \times 100\% \quad (1)$$

Description:

n1 = parameter value before going through the filter media.

n2 = parameter value after going through the filter media.

2.4. Result and Discussion

2.4.1. Water Quality in Sekar Lepen Keprabon River Based on Temperature, pH, COD, TDS, and TSS Parameters Before and After through SPZ Filter Media

Data on the water quality results of the Sekar Lepen Keprabon River obtained before and after going through the SPZ filter media can be seen in Table 1. Data from the measurement of the quality of Sekar Lepen Keprabon river water samples before going through the SPZ filter media (coconut fiber, banana fronds, and zeolite stones) in Table 1. compared to the quality standards contained in Government Regulation No. 22 of 2021 Appendix VI concerning class II river water quality standards.

Table 1. Test results of Sekar Lepen Keprabon River Water before and after through spz filter media

Day	Discharge (m^3/s)		Temperature (°C)		pH		COD (mg/L)		TSS (mg/L)		TDS (mg/L)	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
1	0.118	0.119	22	22	6.02	7.16	15.2	24.8	6	4	245	242
2	0.089	0.092	22	22	6.57	7.04	33.7	15.6	15	3	245	244
3	0.109	0.136	22	22	6.26	7	25.2	26.3	12	27	238	240
Class II River Water Quality Standard			Degree of Deviation 3		6-9		25		50		1000	

Description:

: Increased.

: Not following Quality Standards.

: Increased and Not in Compliance with Quality Standards.

Figure 2. Installation of SPZ filter media: (a) rear view; (b) front view

Analysis results in the table above, show that the water quality of the Sekar Lepen Keprabon River before and after going through the SPZ filter media on trial days 1, 2, and 3 has changed for each parameter, except for the temperature parameter which has not changed between before and after going through the SPZ filter media. The results of this study follow the results of previous research by Tumimomor et al. (2020), namely that the filtration process does not affect changes in the value of temperature parameters in river water samples, which means that the value of temperature parameters is relatively fixed or unchanged, because water temperature parameters are influenced by surrounding environmental conditions such as air humidity, light intensity, water depth, and tree crowns (Hamuna et al., 2018). The filtration process using SPZ filter media can affect changes in the value of each parameter, such as coconut fiber and banana fronds which can affect changes in COD, TSS, and TDS levels. Zeolite stone also affects changes in pH, COD, and TDS levels. The amount of Sekar Lepen Keprabon river water discharge before going through the SPZ filter media from day 1 to day 3 ranged from 0.089 - 0.118 m^3/s. The measurement results of river flow discharge after going through the SPZ filter media have increased to range from 0.092 - 0.136 m^3/s. The increase shows that the condition of the river after the installation of the filter media becomes dammed so that the water flow discharge changes higher than the flow discharge before going through the SPZ filter media. The results of water discharge after filtering on day 3 changed the most compared to the previous days. This follows previous research statements by Muhajar and Togomi (2020), a large discharge causes less efficient functioning of the filter so the filtration process that occurs is not perfect due to the rapid flow of water through the filter media cavity.

The toxic level of chemical compounds in water is also influenced by pH. The pH parameter shows the good and bad of a water body. The water quality of the Sekar Lepen Keprabon River before going through the SPZ filter media for pH obtained values in the range of 6.02 - 6.57, meaning that this value is still following quality standards. The factor that causes high-low alkaline levels in river water based on observations during the study is the presence of MCK wastewater (bathing, washing, and latrines) entering the river. According to Setiawati and Ariani (2020), soap is a mixture of salts of weak acids and bases that have alkaline properties against aqueous solutions, so the alkaline levels in laundry water are caused by contamination with soap. The best increase in pH value was on experimental day 3 with a pH value of 7 which shows that after going through the SPZ filter media, the pH of the water becomes neutral. Water can be said to be neutral if the pH value is 7.00 (Supriatna et al., 2020).

The COD concentration of Sekar Lepen Keprabon river water before going through the SPZ filter media shown in Table 1. above on day 1 was low, and according to the results of observations of river conditions at the time of the study, there were few pollutants. The results of observations on that day revealed the presence of leaf litter, twigs, plastic packaging, and plastic bags. The concentration of COD before going through the SPZ filter media on day 2 was 33.7 mg/L and on day 3 was 25.2 mg/L, which means it exceeds the quality standards for class II river water. The high level of COD before filtering was due to the large amount of organic and inorganic materials contained in the water as seen from the results of naked observation at the time of the study, where the water conditions at that time were a lot of organic waste (such as leaf litter, twigs, leftover rice, vegetable scraps, cardboard, oil, and fat), inorganic waste (such as plastic bags, plastic packaging, and plastic bottles), and the presence of MCK waste entering the river. This is supported by the results of interviews conducted with the Sekar Lepen Keprabon River manager, who stated that three houses still dispose of toilet waste directly into the Sekar Lepen Keprabon River because they do not have septic tanks. Following the opinion of Fitria et al. (2020), domestic household waste or toilet waste affects COD levels in river water which are influenced by oxidation reactions that occur in water. According to Royani et al. (2021), high COD levels are due to the large number of chemical compounds that require oxygen to decompose the organic matter contained in them. The chemical compounds that cause high concentrations of COD come from the chemical content contained in soap (Fadhli, 2020).

Table 1. shows that after filtering Sekar Lepen Keprabon river water with SPZ filter media composition, the results for the COD chemical parameter on the 2nd day of the experiment were 15.6 mg/L. This value shows that the COD concentration has decreased and does not exceed the predetermined quality standards. Direct water treatment in the river through water purification can reduce the pollution that occurs. Meanwhile, on days 1 and 3 of the experiment after filtering the SPZ media, the COD levels increased to 24.8 mg/L and 26.3 mg/L, respectively. The increase in COD value after filtering on day 1 of the experiment is thought to be due to the presence of organic matter molecules that escape and are not adsorbed. Previous research by Azamia (2012), the results of his research stated that the COD concentration was still high after the filtration process with zeolite media due to the presence of unsaturated molecules that were easier to escape and caused organic matter to be incompletely adsorbed by zeolite adsorbents. The increase in the value of the COD parameter after filtering on day 3 of the experiment was due to the repeated use of banana leaflets which allowed the release of impurities from the banana leaflets as shown by the observation made during the study with the presence of foam on the banana leaflets. This statement is supported by the results of previous research by Kusumawardani et al

. (2019), which found that the measurement results of COD levels obtained increased on day 3 due to the influence of biological processes and the high organic matter from banana fronds which affected the increase in COD values. High organic matter or nutrients cause dissolved oxygen in the water to decrease, resulting in an increased COD concentration value (Putri, 2021). According to Kareliasari (2021), the COD value increases due to the high oxygen demand (O2) needed to decompose organic waste material, so the amount of organic waste material both dissolved and suspended in water will increase the TSS and TDS values.

The results of Table 1. show a decrease in TSS values on days 1 and 2 after going through the SPZ filter media with values of 4 mg/L and 3 mg/L respectively. These results mean that there is a decrease in the content of suspended solids in river water after going through the SPZ filter media and not exceeding the established quality standards. The use of coconut fiber material components can reduce TSS and turbidity in water because it has many entangling substances that can bind organic substances in water. This result is almost the same when compared to the results of previous research by Sabara et al. (2022), namely that coconut fiber containing trapping substances used as a graywater waste filter media is considered effective in reducing TSS parameters with the results of a decrease from 464.65 mg/L and 404.40 mg/L to 77.42 mg/L and 59.68 mg/L. The trapping substances in coconut fiber consist of lignin and tannin which can reduce TSS levels in water (Muharrami, 2021). The results on day 3 of the experiment showed that the value of the TSS parameter increased slightly after filtration, but the value also did not exceed the quality standard with a TSS standard of 50 mg/L. The increase in TSS was due to the increase in flow discharge in the river after filtering. Following the opinion of Yulianti (2019), an increase in water discharge results in the stirring of bottom sediments which causes the TSS content to increase, so the low TSS value is also caused by the low flow rate in the river. According to Pinandari et al. (2011), the increase in TSS value after filtration is caused by the short contact time of water with filtration media and the distribution of adsorbate molecules that enter the filtration media particles as adsorbents are not maximally absorbed.

The results of TDS values on days 1 and 2 after filtering through SPZ filter media have decreased. The TDS value obtained before and after going through the SPZ filter media in each experiment shows that it is still far below the quality standard with a standard of 1000 mg/L. On day 3 the TDS value after filtering obtained a value of 240 mg/L which means an increase from the TDS value before going through the SPZ filter media. The increase in TDS value in experiment 3 was due to the release of non-metal ions from zeolite stones, thus increasing TDS levels after filtering (Magdalena and Heriansyah, 2022). The increase in TDS value is also due to the adsorption media used being saturated during filtration so that the process of absorbing pollutants becomes less than optimal (Nurhayati et al., 2018). The adsorbent saturation period is due to the high level of pollutants in the water which makes the adsorbent absorb a lot of pollutants, causing the adsorbent to function less and the material absorbed by the adsorbent to be released again (Tumimomor et al., 2020). The TDS value presented in Table 1. shows that the water condition has a low dissolved solids content. TDS content in waters at high concentrations can cause water pollution, the death of organisms in them, and reduce the function of the water in maintaining its ecosystem (Ilyas et al., 2013).

Figure 3. Water samples before and after going through SPZ filter media: (a) trial day 1; (b) trial day 2; (c) trial day 3.

In the results of the physical comparison of Sekar Lepen Keprabon river water samples before and after going through the SPZ filter media in Figure 3., changes in the quality of river water can be seen both in terms of color and material contained in the water. In plain view, river water samples taken before going through the SPZ filter media tend to be darker and dirty, and water samples taken after going through the SPZ filter media tend to be brighter and clearer. The results of previous research by Sari (2015) also show that filtration with zeolite, pottery, and activated carbon components can reduce turbidity content which affects the clarity of river water. The TSS value affects the level of turbidity and clarity of water, so the lower the TSS value, the clearer the water conditions (Yulianti, 2019).

2.4.2. Water Quality in the Sekar Lepen Keprabon River Based on Temperature, pH, COD, TDS, and TSS Parameters Before and After Going through the SPA Filter Media

The results of the water quality of the Sekar Lepen Keprabon River before and after going through the SPA filter media can be seen in Table 2. The data from the measurement of the quality of the Sekar

Lepen Keprabon river water samples before and after going through the SPA filter media (coconut fiber, banana fronds, and coconut shell charcoal) were also compared with the quality standards contained in Government Regulation No. 22 of 2021 Appendix VI concerning class II river water quality standards.

Table 2. Test results of Sekar Lepen Keprabon river water before and after through SPA filter media

Day	Discharge (m^3/s)		Temperature (°C)		pH		COD (mg/L)		TSS (mg/L)		TDS (mg/L)	
	Before	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**	**Before**	**After**
1	0.102	0.147	22	22	5.73	6.81	6.7	5.6	3	2	238	240
2	0.146	0.17	21	21	6.6	7.06	19.8	18.7	11	4	236	237
3	0.103	0.11	21	21	6.54	7.07	32.1	2.1	5	2	248	245
Class II River Water Quality Standard			Degree of Deviation 3		6-9		25		50		1000	

Description:
: Increased.
: Not following Quality Standards.

Figure 4. Installation of SPA filter media: (a) rear view; (b) front view

The analysis results in Table 2. show that the water quality of the Sekar Lepen Keprabon River before and after going through the SPA filter media on trial days 1, 2, and 3 of each filtering parameter changes in value that are not much different. The filtration process using coconut shell charcoal can affect changes in pH values, COD, TSS, and TDS levels. The results of Table 2. show the Sekar Lepen Keprabon river water discharge obtained before going through the SPA filter media from day 1 to day 3 ranged from 0.102 - 0.146 m^3/s. The measurement results of river flow discharge after going through the SPA filter media have increased to range from 0.147 - 0.17 m^3/s. Similar to filtration using SPZ filter media, the temperature parameter in the filtration process before and after going through the SPA filter media also did not change. The measurement results of the Sekar Lepen Keprabon river water quality parameters before going through the SPA filter media in Table 2. show that the pH value is obtained in the range of 5.73 - 6.6. The pH value of 5.73 obtained from the measurement results on day 1 shows that the water is slightly acidic and this value is below the range of class II river water quality standards, namely 6 - 9. pH with a value below 6 includes a low pH which indicates that the waters are acidic, where the pH value of a body of water that is below or above the quality standard range affects the life of organisms in it (Yulis, 2018). Factors that cause high-low acid levels in river water based on observations are influenced by rainwater that occurred before the study. Data collection on day 1 was after rain on the previous day which was supported by BBWSBS data on April 2, 2023, when there was rain with a bulk of 11 mm/day. Carbon dioxide (CO_2) in the air can dissolve in rainwater and produce acidic compounds so that rainwater is naturally acidic with a pH of 5.6 (Wardhani et al., 2015). CO_2 gas emissions are caused by vehicle traffic activities that pass around the Sekar Lepen Keprabon River. The decomposition of organic matter from food waste causes an increase in H+ ions in water so that the pH becomes low or acidic (Arifan et al., 2020). The implementation of water filtering according to Table 2. from day 1 to day 3 shows that the use of SPA filter media can increase the pH value of Sekar Lepen Keprabon river water to be stable or neutral. As supported by research by Jamilatun and Setyawan (2014), the use of coconut shell charcoal infiltration can increase the pH value of water due to the presence of cations in charcoal dissolved in water.

The measurement results of Sekar Lepen Keprabon river water before going through the SPA filter media in the table above show the highest COD level obtained on day 3 of 32.1 mg/L which means it exceeds the quality standard with a standard value of 25 mg/L. The results of the high COD content before filtering on day 3 are supported based on observations during the study which are indicated by the presence of a lot of organic waste (leaves, twigs, leftover content, oil), inorganic waste (plastic, styrofoam used food, cardboard cigarette packs), and toilet waste in Sekar Lepen Keprabon River water. According to Kavitha et al. (2013), oil content affects the content of COD, TSS, and TDS parameters in a water body. High COD levels are due to the large amount of organic waste as the dominant pollutant and the slow river water discharge factor (Sara et al., 2018). Meanwhile, the value of COD levels obtained before going through the SPA filter media on days 1 and 2 shows that it does not exceed the quality standards. Based on the results of observations on day 1, a small amount of waste was found in the form of leaves, twigs, plastic bags, used bottles, oil, and toilet waste. On day 2, waste was found in the form of plastic waste, used bottles, plastic soap packaging, plastic cups of beverage packaging, leaves, twigs, rice crackers, oil, silica gel chemicals, and toilet waste. Table 2. also shows that the results of Sekar Lepen Keprabon river water after being filtered with the composition of SPA filter media for COD levels from each experiment days 1, 2, and 3 have decreased. The largest decrease in COD levels occurred on day 3 with a value of 2.1 mg/L. These results indicate that the use of coconut shell charcoal in the SPA filter media component can help reduce the COD concentration of river water after filtration. The results of this study are research by Sirajuddin (2020), in his research the COD value before filtering was 4743.6 mg/L and after filtering with coconut shell charcoal the best reduction result was 1031.41 mg/L or 77.78% removal. According to Razif (2011), this is because coconut shell charcoal has a large pore surface that can reduce the concentration of large chemical compounds.

In Table 2., the physical parameter TSS before going through the SPA filter media from days 1, 2, and 3 obtained low results, namely a range of 3 - 11 mg/L, meaning that it does not exceed the quality standards set with a standard value of 50 mg/L. In research by Sari et al. (2021), the TSS content of river water in the rainy season is lower than in the dry season which has a high TSS content. Then, the TSS results after going through the SPA filter media both from day 1, day 2, and day 3 experiments obtained values ranging from 2 - 4 mg/L. In previous research by Rusdianto et al. (2022), the results were obtained that adsorption using coconut shell charcoal was able to reduce the content of TSS levels in detergent liquid waste samples with a reduction efficiency of 60%. Coconut shell charcoal has a larger surface area, and a higher micropore density, and emits negative ions that can absorb pollutant particles so that toxic particles in water flowing through the charcoal will be absorbed (Matana and Mashud, 2006). According to Subekti et al. (2021), the cellulose content in banana leaves can filter impurities, and the hygroscopic content in it is also able to absorb harmful inorganic chemicals in water so that it can reduce the TSS and TDS content in water.

Another physical parameter is TDS. From Table 2., it can be seen that the results of TDS levels before going through the SPA filter media on days 1, 2, and 3 were 238 mg/L; 236 mg/L; and 248 mg/L, respectively. These results indicate that at the time of the study, the dissolved solids content in the river water was low and still far below the class II river water quality standards. After going through the SPA filter media on days 1 and 2 experiments experienced a slight increase. The increase is thought to be the effect of charcoal at the beginning of the filtering experiment day 1 and day 2 of the release of impurities. According to Magdalena and Heriansyah (2022), impurities from the influence of charcoal in the form of minerals cause the mineral content in water to increase so the TDS content also increases. Meanwhile, on day 3 of the experiment, the TDS value after going through the SPA filter media decreased slightly to 245 mg/L. The decrease in TDS levels on day 3 of the experiment was due to no contamination of mineral release from coconut shell charcoal and when filtration occurs, the coconut shell charcoal adsorbent will absorb some ions contained in river water so that there is a decrease in TDS levels in river water (Tumimomor et al., 2020). The pore size of coconut shell charcoal ranges from 5 nm to 50 nm making it suitable and more efficient as an adsorbent in the water purification process to remove small molecules absorb chemicals, and absorb organic pollutants (Ikhwan, 2014). The large surface area of coconut shell charcoal and the content of lignin and cellulose result in the absorption of impurities or metals in water when water passes through the coconut shell charcoal adsorbent, causing a decrease in the TDS value in water (Nisah et al., 2023). The results of Sekar Lepen Keprabon river water samples before and after going through the SPA filter media physically can be seen in Figure 5.

a)
b)
c)

Figure 5. Water samples before and after going through the SPA filter media: (a) trial day 1; (b) trial day 2; (c) trial day 3

2.4.

The observation results from Figure 5. show the results of a physical comparison of Sekar Lepen Keprabon river water samples before and after going through the SPA filter media. From this figure, it can be seen that river water samples taken before going through the SPA filter media tend to be darker and dirtier because there are still many suspended solids. On day 2, the TSS value shown in Table 2. before going through the filter media was the highest among others. Based on direct observation shown in Figure 5b. of the day 2 experiment, it can be seen that the Sekar Lepen Keprabon River water before going through the SPA filter media contains physically and visibly suspended solids containing oil. The results of water samples after filtering using SPA filter media, both physically and with the naked eye, tend to be brighter and clearer.

2.4.3. Effectiveness of SPZ dan SPA Filter Media in Water Purification of the Sekar Lepen Keprabon River

2.4.1.1. Effectiveness of SPZ and SPA Filter Media on pH Parameters

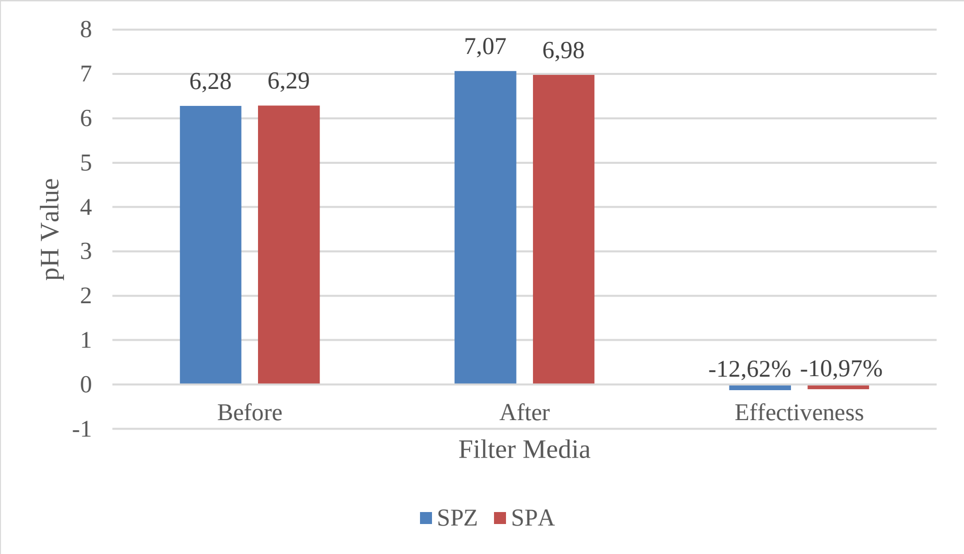

Figure 6. Graphic effectiveness of SPZ and SPA filter media on pH value

The value of acidity or pH has a major influence on adsorption because the pH value determines the ionization level of the solution so that it can affect weakly acidic or basic organic compounds, where an increase in pH value will make the charcoal surface better at adsorbing pollutants in water (Nurmaja et al., 2014). Based on the graph shown in Graphic 6., it can be concluded that the pH value of the filtering results with SPZ filter media in Sekar Lepen Keprabon River water increases with an average effectiveness level of -12.62%, which means that it is more effective against the pH parameter because it can neutralize the pH of the water. Water with a pH value of 7 is neutral. These results are better when compared to previous research by Adak et al. (2021) with banana leaf filter media producing an average effectiveness of pH levels of -5.09% which shows that after filtration there is an increase in pH value close to neutral, namely 7. Previous research by Nilasari et al. (2016), obtained research results with the pH value of water after the filtration process using zeolite increased the average pH by 2% so that the pH value became 7.6. Research by Nasution (2019), states that the value of the pH parameter of the results after filtration using zeolite stones will be stable or neutral by the established quality standards. According to Rahayu et al. (2015), when filtering water using zeolite stones, there is a separation of organic and inorganic substances which causes changes in the pH of the water. The opinion of Sumarli et al. (2016), states that this is due to the capture and absorption of organic and inorganic materials by the surface of zeolite stones to change the condition of the water to alkaline and the longer the contact time of river water with alkaline filter media such as zeolite, the pH of the water will be towards alkaline properties. Similar to the opinion of Hilwani et al. (2022), which states that the addition of zeolite to the filter shows the results of a better pH increase ability compared to filters that do not add zeolite, because zeolite stones contain alkaline materials that are released during ion exchange when water passes through zeolite media so that it can neutralize the pH of water. This is also supported by research by Haribowo et al. (2019), the increase in pH concentration obtained after filtering occurs because it is influenced by the process of neutralizing the negative charge of carbon by nitrogen ions in zeolite. The opinion of Resky et al. (2022) in their research also states that in alkaline conditions, coconut shell charcoal will have a net negative charge. The large number of hydroxide ions (OH^-) causes surface ligands to tend to be deprotonated, so at the same time, there is a relationship between surface ligands and the number of OH^- ions with metal cations.

2.4.1.2 Effectiveness of SPZ and SPA Filter Media on COD Parameters

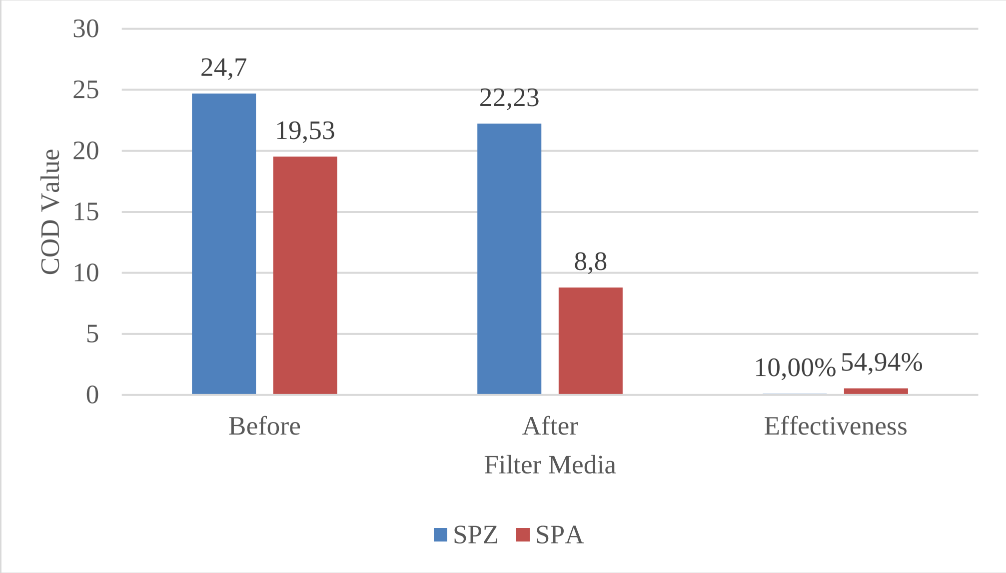

Figure 7. Graphic effectiveness of SPZ and SPA filter media on COD values

Figure 7 also shows the level of effectiveness of the filtering results for each filter media. The average results of the effectiveness of the Sekar Lepen Keprabon River water samples obtained after going through the SPZ filter media decreased on the COD parameter with a decrease of 10.00%. The presence of coconut fiber material components in the SPZ filter media can reduce the COD content in water. According to Novirina and Febriana (2022), the addition of coconut fiber media can reduce the COD of wastewater by 92.86%. This is because organic pollutants in water will be attached to the surface of coconut fibers and at the same time as dissolved oxygen, the organic pollutants will be broken down by microorganisms so that COD levels in the water will decrease.

The graph in Graphic 7., it can be concluded that the filtering results of the SPA filter media on Sekar Lepen Keprabon River water have an average effectiveness level of 54.94%, which means that it is more effective against COD parameters because it can reduce COD concentrations in water. These results follow the statement of Darmayanti et al. (2011), where filter media using a combination of coconut shell charcoal, bricks, sand, and fiber fibers can reduce COD concentrations more than other filter media variations with the percentage effectiveness value obtained in reducing COD averaging 73.5%. The decrease in COD concentration in water that occurs in the filtration process is due to the pores and surface area of charcoal which are large enough so that pollutant molecules can be absorbed on the carbon surface, it is also due to the process of decomposing pollutants by microorganisms in the layer on the surface of charcoal (Nurmaja et al., 2014). The results of the decrease in COD levels in this study are by previous research by Hidayat (2021), which states that the ability of coconut shell charcoal to reduce COD concentration values in the filtration process increases if the surface area of coconut shell charcoal has not experienced saturation and there is still a surface available that can increase the adsorption power of organic matter in water. The longer use of coconut shell charcoal can also cause a decrease in the ability to absorb organic matter caused by coconut shell charcoal experiencing saturation (Siregar et al., 2015). According to Alimsyah and Damayanti (2013), the decrease in COD concentration from the filtration process using coconut shell charcoal media is due to the surface of coconut shell charcoal being able to adsorb organic matter, where the ability to adsorb organic matter depends on the polar chain of polluting substances contained in water or the more organic a substance is, the easier the polar chain will be broken down.

2.4.1.3. Effectiveness of SPZ and SPA Filter Media on TSS Parameters

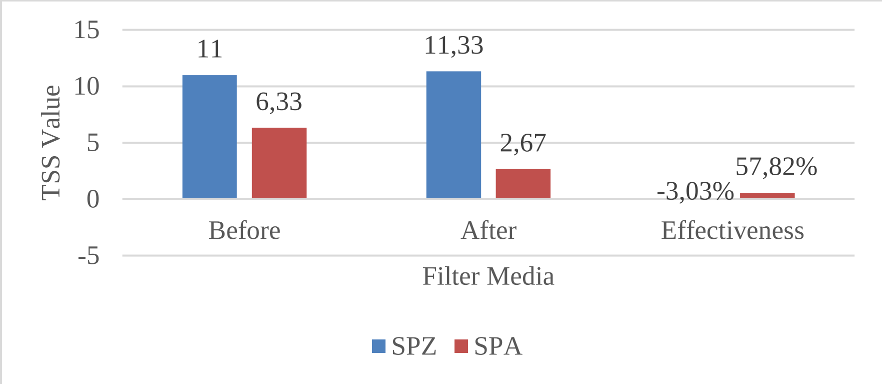

Figure 8. Graphic effectiveness of SPZ and SPA filter media on TSS values

The results in Figure 8. show that the average effectiveness level of the TSS value of water filtering results using SPZ filter media obtained an increase of 3.03% which means that there is a slight increase in the level of undissolved solids. Meanwhile, the average result of the TSS parameter value of Sekar Lepen Keprabon river water from the filtering results through the SPA filter media has decreased with an average effectiveness level of 57.82%. The results of this study are better when compared to the results of previous research by Gultom et al. (2018), namely that filter media with coconut shell charcoal are more effective in reducing the value of total suspended solids (TSS) with a decrease in effectiveness of 8-17% which is thought to be due to the carbon content in coconut shell charcoal which functions as an adsorbent to absorb suspended substances or solids.

The graph above shows the effectiveness of the filtering results of both the SPZ filter media and the SPA filter media. The filtering results of the SPA filter media were able to reduce TSS levels in Sekar Lepen Keprabon River water. This value can be interpreted as indicating that the SPA filter media in this study is a more effective medium for reducing more than half of the TSS content of river water. This is thought to be due to the addition of the coconut shell charcoal component. Coconut shell charcoal media has a large surface area that can function as an adsorbent (Primawati and Suparno, 2016). Coconut shell charcoal in water treatment has the advantage of functioning to purify and absorb bacteria in water (Sari et al., 2022). In the filtration process, coconut shell charcoal micropores will capture residual oil carried by river currents and reduce TSS content (Muhardi and Nurhadi, 2022). The adsorption process with coconut shell charcoal can remove colloidal particles and separate solids from liquids so that the TSS content will be trapped in the pores of the adsorbent and the longer it takes, the more it can cause the adsorbent to become saturated (Alimsyah and Damayanti, 2013).

2.4.1.4. Effectiveness of SPZ and SPA Filter Media on TDS Parameters

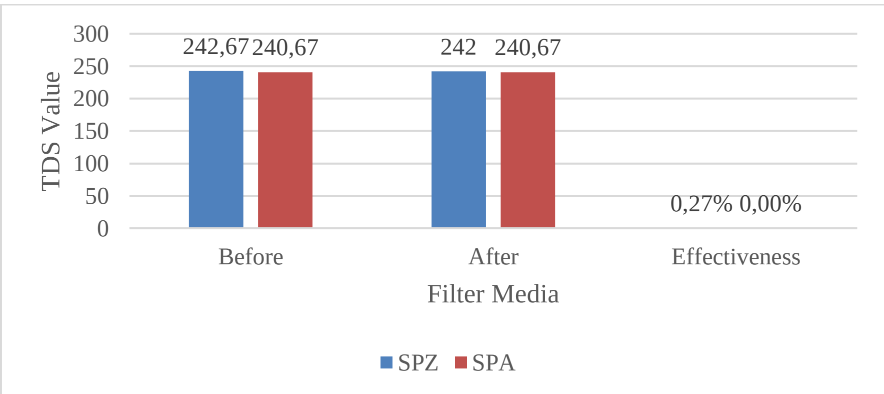

Figure 9. Graphic effectiveness of SPZ and SPA filter media on TDS values

The average effectiveness value of the water filtering results using the SPA filter media shown in Graphic 9. obtained a value of 0.00%. This value shows that there is no change before and after filtering using SPA filter media. Meanwhile, the results of the average TDS parameter value for Sekar Lepen Keprabon river water obtained after going through the SPZ filter media on experimental days 1 and 2 decreased, except for experimental day 3 which experienced an increase in the TDS parameter value. According to Tumimomor (2020), the increase in TDS levels obtained after filtering is due to the presence of dissolved material from the adsorbent that is dissolved in water due to the washing process on the adsorbent is not optimal. Hence, there are still impurities that are dissolved in the filtration process and contribute to the less-than-maximum decrease in TDS value in water.

The graph in Graphic 9. above shows that the results of filtering from SPZ media on Sekar Lepen Keprabon River water are considered more effective against TDS parameters with an effectiveness level of 0.27% to reduce the content of solutes in the water. In the study, Nisah et al. (2023), obtained the value of the TDS parameter after the filtration process from coconut waste consisting of coconut fiber showed a pretty good decrease with an average percentage of 32.05% because coconut fiber has a fibrous and elongated texture that can capture solid particles in water. Zeolite has a negative charge as a natural ion exchanger (alkaline cation) which functions to bind E. coli bacteria in water, remove chemical pollutants, and reduce TDS content in water (Endarko et al., 2013). According to Nugroho and Purwoto (2013), zeolite has a hollow structure so that when water passes through a zeolite stone filter, it causes anions or molecules smaller or equal to the cavity to enter and get trapped on the zeolite surface. The surface of zeolite stone can absorb pollutants well so it has a high absorption capacity (Apriyani and Novrianti, 2020). In addition, zeolites have a function to absorb cations that can reduce metal content in water (Sumarli et al., 2016).

3. Conclusions

Based on the results of the study, it can be concluded that the water quality of the Sekar Lepen Keprabon River before and after going through the SPZ filter media for temperature is relatively fixed, pH increases, the average COD and TSS values increase, and the TDS value decreases. The water quality of the Sekar Lepen Keprabon River before and after going through the SPA filter media is that the temperature does not change, the pH increases, the average COD and TSS values decrease, and the TDS value increases. SPZ filter media in the water filtration process in the Sekar Lepen Keprabon River is more effective in increasing the pH parameter and decreasing the TDS parameter in river water. Meanwhile, SPA filtration media in the water filtration process is more effective in reducing COD and TSS parameters in river water.

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