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Research Article

Textile Industrial Liquid Treatment with Activated Carbon

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ABSTRACT
The processing technology and enhanced industrial sector will affect the environment, positively or negatively. Based on the activity, the textile industry of PT. Sinar Surya Indah Telukan Grogol, Sukoharjo produced liquid waste which above quality standard. Therefore, it is needed to process the wastewater. The objective of the research are (a) to know the quality of liquid waste fro, textile industry and (b) to know the effectiveness of active carbo thickness for the reduction of liquid waste concentration with parameters BOD_5, COD, Chrom (Cr), TSS (Total Suspended Solid) and pH. The thickness of active carbon was 0 cm; 5 cm; 7 , 5 cm; 10 cm; 12.5 cm; and 15 cm. The parameters to be analyzed were BOD_5, COD, Chrom (Cr), TSS and pH. A laboratory test was done in the central laboratory of MIPA, Sebelas Maret University. The result shows that there was a significant reduction od wastewater quality after processed using active carbon, the percentage of reduction was as follows: COD (83.86%), BOD_5 (79.14%), TSS (46.09%)) and Chrom (0%). The thickness for effective active carbon on 15 cm with waste volume as 1,5 litre; diameter 9 cm and height 40 cm.

Keywords: liquid waste, Active Carbon, Efficiency, Absorption.

INTRODUCTION
The very rapid development of technology, especially in the industrial sector, has resulted in the increased exploitation of natural resources. Builds up question number of industry types, air an RTI increase need for raw materials derived from nature (natural resources). Attempts to overcome the dangers that would threaten areas result of advances in science and technology uncontrollable need to be improved. One effort that is very pen ting is to conduct regulation on land use and environmental management (Gutti et al., 2012). This arrangement aims to ensure the preservation, capacity and carrying capacity of the environment, and to maximize the involvement of all parties in environmental management and development. Increasing the industrial sector will have impacts, both positive and negative. The positive impact of the promotion of the industrial sector is the absorption of work calm, increasing foreign exchange income to the government which in turn can improve the welfare of the people in general. Besides the positive impacts also need attention and watch out for any negative impacts by the process and the rest of the production, which can contaminate the surrounding environment. These pollutants can be in the form of solid waste (solid wastes), liquid waste (liquid wastes) and waste gases (gaseous wastes) (Mitkus & Šostak, 2009; Riyadi, 1984).

Likewise, with the development of the textile industry, pollution and disturbances caused by the textile industry also increase, because the production process requires a large amount of water, so the by-products of the production process in the form of liquid waste are also a lot. The industrial area in Sukoharjo Regency has been developing in line with the growing market needs. Investors responded positively to this in order to meet the market's needs. Therefore, many entrepreneurs enlarge their businesses by adding the necessary machines. Waste industry textiles if not managed in properly can lead to the occurrence of environment pollution and of course must already comply Materials Quality Waste Liquid (BMLC) (Subramanian & Labs, 2018; Moertinah et al., 2010). With these consequences, before the liquid waste enters or flows into the receiving water body, it must be treated first. This management aims to minimize environmental pollutants in order to comply with the predetermined quality standards for liquid waste (Bolanca, 2000).

Management of waste liquid in the process of production is intended to minimize the waste that is produced, the volume of waste minimal with concentration and toxicity were also minimal. Management of waste after the process of

production intended to eliminate or decrease the levels of material contaminants are contained in it until the waste liquid fill requirement to be discarded (meet the standard of quality that is defined) (Krinitsyn et al., 2003; Dean, 2006). In the management of the waste liquid to get the results that effectively and efficiently needs to be done rare-step management are implemented in an integrated starting with efforts to minimize waste (waste minimization), processing of waste (waste treatment), until the disposal of the waste (disposal). In some factories, the way it was continued by skipping water waste by zeolite (a rock natural) and charcoal active (carbon active) (Anonymous, 2005b). Carbon active is a form of charcoal that has been activated by the substance activator chemistry so that the pores open and with such power, adsorption is much higher (Talekar & Mahajani, 2008; Jacobs, 1958).
Based on the description in the above push needed undertaking research by using activated carbon that binds elements of pollutants in the water industry wastewater, the processing that leads to decreased levels of liquid waste textile industry ie BOD $_5$, COD, chromium, suspended solids (TSS) and pH using activated carbon.

THEORETICAL REVIEW

Literature review

Relevant researches have conducted the investigation on the activated carbon has been carried out. Purwaningsih (2000) explored the usage activated charcoal palm shells as an adsorbent in liquid waste plywood has obtained results that the treatment is the administration of activated charcoal to changes kaulitas water is very positive, it is shown by the administration of activated charcoal was able to lower BOD, COD, TSS and phenol, Ph wastewater has increased very little. The results of the research obtained BOD values from 51.51 mg / l to 38.53 mg/ l, COD from 933.8 mg / l to 426.87 mg / l, Ph from 8.37 to 8.94, TSS from 132.00 mg / l to 78.33 mg / l, phenol from 0.412 mg / l to 0.165 mg / l and color from 37 Pt. Co becomes 366.67 Pt.Co because the activated charcoal needed with NaOh will increase Ph, the colour change is not visible at all, because specifically, the colour change needs to be studied in more depth, for example, the centrifugal method, filtering, absorption and other methods.
Peni (2001) conducted a research in 2001 on the comparison of the level of p enyerapan activated charcoal, breccia buoyant and peanut shells to dye wastewater batik industry shows that the smaller granules and the higher the pile thickness (adsorbent) so that the contact time is getting longer and results in the absorption of the dye higher. The color absorption efficiency was 98.19% with activated carbon, 70.12% with floating breccia adsorbent and 62.59% with peanut shell adsorbent. The highest absorption efficiency is using activated charcoal adsorbent.
Charcoal active are in use k 's in the study (Pratiwi, Kamal and Juhanda, 2019) with the title Analysis of Effects of Time Activation and Adsorption in Utilization of Carbon Active from Shavings Wood became Adsorbent Waste Liquid. The goal is to determine p engaruh quality carbon activated from shavings of wood have been tested by time of activation and power adsorption of waste liquid. Activated carbon is made through pyrolysis until it reaches a temperature of 5000C with a size of 100-150 mesh and is activated with 10% H3PO4 for 6 hours, 12 hours, and 18 hours. Carbon active which is produced is used as adsorbent and tested on a waste liquid substance the colour of textiles Sumikaron Yellow Brown S-2RL. Adsorption is done with a variation of 1 hour, 2 hours and 3 hours. Subsequently a solution of substance the color that has been sequestered by carbon activated analyzed using a spectrophotometer with a Long wave 480nm. Based on the absorbance or concentration (%) reduction in colour which is calculated using ANOVA with software Minitab 17, the effect of which is more significant in the use of carbon activated from the shavings of wood that is at the time of activation of 12 hours and the time of adsorption of 3 hours. Carbon active of waste shavings timber capable of reducing the waste liquid substance colour of 98, 2519 %. Results of tests preliminary to calculate the number of iodine from the adsorbent carbon activated which has been activated for 12 hours into a state best to absorb iodine as many as 144, 8961 mg / g.
Mizwar & Dienes (2012) presented the research result on allowance on the colour of the waste liquid industry Sasirangan by adsorption of Carbon Active concluded that the effectiveness of the provision for colour in the waste liquid industrial sasirangan by using carbon active commercial (no brand) which is made from the shell of coconut shaped powder is at 20.75% ± 39.16% at the time of contact optimum 60 minutes. The pattern of adsorption of color by carbon active in research is more inclined to follow the model isotherms, Langmuir, with a capacity of adsorption maximum of 29,412mg/g.
At last, Pranoto et al, (2002: 16) investigated a research on reducing the levels of lead and textile dyes in solution using bagasse activated carbon showed testing with red textile dye waste, showing that the optimum absorption strength of bagasse activated carbon was 2.160 mg/g (34.31%),

while for green textile dyes the absorption was 2 , 4585 mg/g (3.31%). 16

The objective of the research are (a) to know the quality of liquid waste fro, textile industry and (b) to know the effectiveness of active carbo thickness for the reduction of liquid waste concentration with parameters BOD_5, COD, Chrom (Cr), TSS (Total Suspended Solid) and pH. The thickness of active carbon was 0 cm; 5 cm; 7, 5 cm; 10 cm; 12.5 cm; and 15 cm. The parameters to be analyzed were BOD_5, COD, Chrom (Cr), TSS and pH. A laboratory test was done in the central laboratory of MIPA, Sebelas Maret University.

Liquid Waste and Industrial Wastewater

Waste is substances which presence at a certain time and place is not desired by the environment because it has no economic value. Waste contains toxic and dangerous pollutants (Ginting, 1995) Liquid waste is a variety of substances that endanger human life or other living creatures and generally originate from human actions, including from industrial activities (Daryanto, 1995:37). Wastewater is liquid that flows into a channel, which includes household wastewater, industrial wastewater, and surface water that can enter the channel. Wastewater is liquid that is discharged in a channel, which includes household wastewater, industrial wastewater, and surface water that can enter the channel (Cobb et al., 2012; Alearts, 1984) .

Sources of liquid waste come from various sources, generally as activities of humans and technological advances. In industrial and technology activities, water that has been used (industrial waste water) should not be disposed of immediately because it can cause pollution (Chang, 1998; Wardhana, 2004). Indicators that the environmental water has been polluted is a change or sign that can be observed through: (1) a change in temperature (2) a change in PH or hydrogen ion concentration (3) a change in colour, smell, and taste (4) the appearance of sediment, material late. Textile industry wastewater parameters are total suspended solids, BOD, COD, total chromium, phenol and pH. Colour is perhaps an important parameter in textile waste, because of its visible impact. The water rate and waste load of the textile industry depend on the process used and the type of goods produced. Liquid waste discharged into river bodies can cause water pollution, so it is necessary to treat liquid waste before discharging it into water bodies. According to the nature of waste, liquid waste treatment processes can be classified into 3 parts, namely physical processes, chemical processes and biological processes. This process does not run independently but sometimes must be carried out in combination with one another. The purpose of textile industrial wastewater treatment is to reduce organic and inorganic pollutants, suspended solids, and heavy metal colors before being discharged into water bodies (Ike et al., 2019; Sajidan, 2006).

Common waste treatments can be classified into mechanical and biological treatment. In order to obtain low levels of BOD, COD, suspended solids, Cr, TSS and other parameters, superior processing using activated carbon, sand filters, ion exchange and chemical purification has been used (Anonymous, 2005). Treatment with activated carbon is a process of filtering wastewater, especially after experiencing a biological or physical-chemical process. Natural activated carbon is carbon granules and carbon powder for wastewater treatment and after use, it needs to be reactivated. Carbon processing is used through the manufacture of charcoal from wood or coal. This material is then burned until it is red (Muñoz, 2005). The source of the raw material for activated carbon consists of wood, bagasse, fruit skins, coconut shells, lignite coal, remaining fuel oil (Susanto, 2000). Wastewater treatment using activated carbon is usually used as a continuous process of biological wastewater. In this event, it is used to reduce the levels of certain organic carbons that exist. This process is usually used to complement the biological processing of industrial waste whose biological process is not continuous so that it still has problems with wastewater (Devi et al., 2019; Sugiharto, 1987).

METHODS

This research was conducted at PT. Sinar Surrya Indah Telukan Grogol Sukoharjo and in the laboratory of the Central MIPA University Sebelah Maret Surakarta, for the manufacture of installations and laboratory tests. As the object is processing waste liquid industrial textiles by using a carbon activated. The data obtained for research are primary data. Primary data is data obtained from direct research results, in this case, data obtained from the field and laboratory analysis results of the MIPA Center, Sebelas Maret University, Surakarta. Methods of taking liquid waste are: (1) Samples were taken from the inlet tank of PT. SSI Telukan Grogol Sukoharjo using plastic jerry cans; (2) The jerry cans are cleaned inside by rinsing using liquid waste which will be taken three times; (3) The jerry cans are filled with liquid waste from the inlet directly by using a bucket slowly so that there is no turbulence in the jerry can; (4) When it is full, the jerry cans are closed and used as a material to be filtered; and (5) Samples were taken three times, on different days , then disbursement and laboratory examinations were carried out. The variables examined in this study include 2 variables, namely: The independent variable is the thickness of the activated carbon filter media, with a thickness of 0 cm; 5 cm; 7.5 cm; 10 cm; 12.5 cm; and 15 cm. BOD $_5$, COD, Chrom (Cr), suspended solids (TSS) and pH in textile wastewater.

In processing data, the technique of mechanical processing data is the scale experimentation laboratory which aims to determine the effectiveness of the thickness of the carbon active against the reduction of waste liquid to the parameters Tied BOD_5, COD, chromium (Cr), suspended solids (TSS) and pH in textile waste. By using the 5 thickness in filtering the then made observations before and after against every treatment filter trial. The research variables consists of the independent variable (the thickness of the activated carbon filter media from 0 cm, 5 cm, 7.5 cm, 10 cm, 12.5 cm and 15 cm) and the dependent variables (BOD_5, COD, Chrom (Cr), suspended solids (TSS) and pH in textile wastewater).

RESULTS AND DISCUSSION

The research carried out includes the manufacture of tools developed or trial and error. Analysis of liquid waste, which was carried out three times each before being flowed into a filtering device and after flowing into an activated carbon filter with 6 variations of filter media, was the result of the test.

Table 1. The results of testing levels of BOD, COD, Cr, TSS, and Ph with various filters

Ketebalan	Parameter															% tingkat
Karbon aktif	COD			BOD			Cr			TSS			Ph			kejenuhan
(cm)	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	
Sebelum diolah	1069,4	985,0	1058,9	372,3	364,1	376,1	0,1536	0,1656	0,1963	150	170	170	6,06	6,09	5,98	
0 (kontrol)	1016,7	890,1	995,6	324,6	333,6	336,7	0,1128	0,1228	0,1523	140	170	140	6,11	6,18	6,37	
5	731,9	731,9	805,6	214,3	180,6	219,1	0,1074	0,1140	0,1360	90	150	100	6,55	6,52	7,02	3,81
7,5	700,2	552,5	647,5	200,5	120,4	191,6	0,1033	0,1093	0,1292	60	130	80	6,95	6,85	7,25	5,58
10	427,2	399,5	414,3	97,68	88,85	90,52	0,0938	0,1018	0,1137	60	70	70	7,06	7,18	7,3	8,63
12,5	300,4	273,5	287,7	87,13	65,6	86,47	0,0849	0,0950	0,1035	50	50	50	7,33	7,55	8,28	11,05
15	156,9	140,0	148,5	66,59	57,82	65,39	0,0836	0,0836	0,0900	40	30	30	7,97	8,49	8,58	13,29
Rata-rata	148,47			63,27			0,0877			33,33			8,35			
Baku Mutu	150			60			1,0			50			6,0 - 9,0			

Information

Sample I, Waste collection 1, the waste is bluish

Sample II, Waste collection 2, reddish coloured waste

Sample III, Waste collection 3, greenish coloured waste

Where the results when viewed from the table testing the levels of COD, BOD_5, Cr, TSS, and pH with filter variations as follows: average COD levels 148.47 mg/L, Quality Standard 150; average levels of BOD_5 63.27 mg/L, Quality Standard 60; average Cr content 0.0877 mg/L, Quality Standard 1.0; average TSS levels 33.33 mg/L, Quality Standard 50; the average pH level was 8.35, Quality Standard 6.0 - 9.0.

COD parameters: the results of measuring COD levels from waste before and after being treated with variations in the thickness of activated carbon.

Table 2: The results of the testing and efficiency drop in the levels of COD in wastewater by activated carbon thickness variation from 0 cm to 15 cm

Thickness	COD parameter		Derating Efficiency (EP)	
activated carbon	Before	After processing	Total (%)	Activated carbon
(cm)	processed (mg / l)	(mg / l)		(%)

Sample I				
0	1069.4	1016.7	4.93	
5	1069.4	731.9	31.56	26.63
7.5	1069.4	700.2	34.52	29.59
10	1069.4	427.0	60.07	55.14
12.5	1069.4	300.4	71.91	66.98
15	1069.4	156.9	85.33	80.39
Sample II				
0	985.0	890.1	9.64	
5	985.0	731.9	25.70	16.06
7.5	985.0	552.5	43.91	34.27
10	985.0	399.5	59.44	49.80
12.5	985.0	273.0	72.29	62.65
15	985.0	140.0	35.78	76.14
Sample III				
0	1058.9	995.6	5.98	
5	1058.9	805.6	23.91	17.93
7.5	1058.9	647.5	38.85	32.88
10	1058.9	414.3	60.88	54.90
12.5	1058.9	287.7	72.83	66.85
15	1058.9	148.5	85.58	79.60

This shows the relationship between the thickness of activated carbon and COD levels, that the thicker the activated carbon, the lower the COD levels. The data calculated using the semi logarithmic approach 1. The efficiency of the calculation results using the semi-logarithmic approach with the equation $Y = ax^{b}$, the equation for sample I, $Y = 0.04085 x^{1.096}$; sample II, $Y = 0.01836 x^{1.402}$; and to sample III, $Y = 0.02014 x^{1,386}$.

Table 3: Results of the calculation of the efficiency of reducing COD levels in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm.

X thickness activated carbon (cm)	Y (Reduction Efficiency) (%)		
	Sample I	Sample II	Sample III
5	2384	1753	1874

7.5	3718	3095	3288
10	5096	4633	4898
12.5	6507	6335	6674
15	7947	8180	8593

The relationship between the thickness of the activated carbon layer and the efficiency of reducing COD levels as a whole indicates that the thicker the activated carbon layer the ability to reduce COD levels is more effective. This situation is due to the contaminants in the liquid waste that are physically adsorbed. the thickness of activated carbon affects the deep surface area . This surface area is the place for the bonds to occur between particles or substances that cause the COD levels to absorb. If the thickness of activated carbon decreases, the surface area also decreases. so the thickness of activated carbon and surface area has a proportional relationship.

The presence of thickness also affects the contact time. Contact time is the residence time of the liquid limb in the activated carbon filter or it can be said to be residence time. this time will determine the duration of the binding of pollutants from the wastewater. in the presence of sufficient thickness, more pollutants will be bound to the adsorbent. Another thing from the existing surface area will be filled optimally. If this contact time is narrow, the sorption runs imperfectly, because the pollutants leave the activated carbon filter too quickly.

Parameters BOD_5: results of the analysis of BOD_5 of the waste before and after treated with activated carbon thickness variation.

Table 4: The results of measurement and calculation of the efficiency of BOD5 levels in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm

Thickness	COD parameter		Derating Efficiency (EP)	
activated carbon	Before	After	Total	Activated carbon
(cm)	processed (mg / l)	processed (mg / l)	(%)	(%)
Sample I				
0	372.3	3426	12.83	
5	372.3	2143	42.45	29.62
7.5	372.3	2005	46.16	33.32
10	372.3	9768.0	73.77	60.93
12.5	372.3	8713	76.6	63.77
15	372.3	6659	82.11	69.28
Sample II				
0	364.1	333.6	8.37	
5	364.1	180.6	50.41	42.03
7.5	364.1	120.4	66.93	58.56
10	364.1	88.85	75.6	67.23

12.5	364.1	65.60	81.98	73.61
15	364.1	57.82	84.12	75.75
Sample III				
0	376.1	336.7	10.47	
5	376.1	219.1	41.75	31.29
7.5	376.1	191.6	49.06	38.6
10	376.1	90.52	75.93	65.46
12.5	376.1	86.47	77.01	66.54
15	376.1	65.39	82.61	72.15

The table shows the relationship between the thickness of activated carbon and BOD levels, that the thicker the activated carbon the BOD content decreases. The data calculated using the semi-logarithmic approach. The efficiency of the calculation results using the semi-logarithmic approach with the equation $Y = ax^{b}$, the equation for sample I, $Y = 0.0694 x^{0.87}$; sample II, $Y = 0.1863 x^{0.539}$; and to sample III, $Y = 0.0813 x^{0.831}$ results can be seen in the table below.

Table 5: Results of the calculation of the efficiency of reducing BOD levels in liquid waste with active thickness variations from 0 cm to 15 cm.

X thickness	Y (Reduction Efficiency) (%)		
activated carbon (cm)	Sample I	Sample II	Sample III
5	28.16	44.35	30.97
7.5	40.07	55.19	43.38
10	51.46	64.44	55.1
12.5	62.49	72.68	66.54
15	73.23	80.18	77.17

From the results of calculations and graphs of the relationship between the thickness of the activated carbon layer and the efficiency of reducing BOD levels, it can be seen that after treatment by filtering liquid waste through a control filter (without activated carbon) up to a thickness of 15 cm as a whole shows that the thicker the activated carbon layer is , hen the ability to reduce pollutants, especially BOD $_5$, is getting bigger, in other words, the greater the efficiency. this ability is due to the binding of pollutants both organic and inorganic to activated carbon. the bond is due to the adsorption and absorption processes. adsorption is the process of collecting dissolved substances in solution, by the surface of the absorbent substance or object and there is a physical chemical bond between the substance and its absorption.

In the experiment, the decrease in BOD_5 levels with activated carbon occurred physically. Sorption is the process of attaching or entering pollutants to activated carbon, not chemically, namely the reaction between solids and absorbed solutes. Sorbsi in this physical bond on weaker when compared with chemically sorbsi. Physical sorption is highly dependent on the attractive forces between the solute and the adsorbent. Therefore,the thicker activated carbon layer, the organic and inorganic pollutants that have not been bound to the upper part will be bound by the activated carbon at the bottom. This is due to the thicker the activated carbon layer, the greater the surface area. This surface area plays a very important role in the sorption process, namely as a place for attachment or entry of pollutants or a place for bonding between pollutants and adsorbents. As a result of this incident the liquid waste from the textile industry that comes out of the active victim screening will have a lower BOD_5 contamination level. This causes the thicker the layer of activated carbon, the efficiency of reducing BOD_5 levels, the greater is the contact time. This contact time is important, because the sufficient contact time, more pollutants are scattered. this contact time has a close relationship with the surface area of the carbon above. although the surface area is large, but if the contact time is small, the surface area cannot bind the pollutants optimally. The room is still empty, because there is not enough time for the bonding. if the thickness of the activated carbon layer is thin, the contact time will be short.

Parameters Chrom (Cr)

From the measurement of Cr content from waste before and after processing with variations in the thickness of activated carbon, it can be seen in table 5.

Table 5: Results of measurement and efficient calculation of Cr content in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm.

Thickness	COD parameter		Derating Efficiency (EP)	
activated carbon	Before	After processing	Total (%)	Activated carbon
(cm)	processed (mg / l)	(mg / l)		(%)
Sample I				
0	0.1536	0.1128	26.56	
5	0.1536	0.1074	30.08	3.52
7.5	0.1536	0.1033	32.73	6.16
10	0.1536	0.0938	38.93	12.37
12.5	0.1536	0.0849	44.7	18.14
15	0.1536	0.0836	45.59	19.03
Sample II				
0	0.1656	0.1228	25.83	
5	0.1656	0.114	31.14	5.31
7.5	0.1656	0.1093	34	8.17
10	0.1656	0.1018	38.53	12.70
12.5	0.1656	0.0950	42.61	16.79
15	0.1656	0.0896	45.89	20.07
Sample III				
0	0.1963	0.1523	22.42	

5	0.1963	0.1360	30.69	8.27
7.5	0.1963	0.1292	34.15	11.74
10	0.1963	0.1137	42.07	19.62
12.5	0.1963	0.1035	47.20	24.83
15	0.1963	0.0900	54.14	31.73

It can be seen from the table that shows the relationship between the thickness of activated carbon and the Cr content, that the thicker the activated carbon, the Cr main decreases. The data calculated using the semi-logarithmic approach. The efficiency of the calculation results with the semi-logarithmic approach with the equation $Y = ax^{b}$, the equation for sample I, $Y = 0.0024\ x^{0.87}$; sample II, $Y = 0.00699\ x^{0.539}$; and to sample III, $Y = 0.01035\ x^{0.831}$ results can be seen in the table below.

Table 7: The results of the calculation of the efficiency of reducing Cr content in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm

X thickness	Y (Reduction Efficiency) (%)		
activated carbon (cm)	Sample I	Sample II	Sample III
5	3.50	5.20	7.85
7.5	6.87	8.62	13.08
10	11.09	12.34	18.79
12.5	16.08	16.31	24.89
15	21.77	20.47	31.31

From the calculated data and the graph of the relationship between the thickness of the activated carbon layer and the efficiency of reducing the Cr content, it can be seen after going through the control filter (without activated carbon) up to 15 cm as a whole that the thicker the activated carbon layer will be the more effective, in other words, the greater the processing efficiency. This is because the pollutants in the liquid waste are physically absorbed and the thickness of the activated carbon affects the Chromium (Cr) content.

Table 8: Suspended Solids (TSS): The results of measuring TSS levels from waste before and after processing with variations in the thickness of activated carbon

Thickness	COD parameter		Derating Efficiency (EP)	
activated carbon	Before	After processing	Total (%)	Activated carbon (%)
(cm)	processed (mg / l)	(mg / l)		
Sample I				
0	150	140	6.67	
5	150	90	40.00	33.33
7.5	150	60	60.00	53.33

10	150	60	60.00	53.33
12.5	150	50	66.67	60.00
15	150	40	73.33	66.70
Sample II				
0	170	150	11.76	
5	170	130	23.53	11.76
7.5	170	70	58.82	47.06
10	170	60	64.71	58.82
12.5	170	50	70.59	52.94
15	170	30	82.35	70.59
Sample III				
0	170	140	17.65	
5	170	100	41.18	23.53
7.5	170	80	52.94	47.06
10	170	70	58.82	41.18
12.5	170	50	70.59	52.94
15	170	30	82.35	64.71

The table at the top shows the relationship between the thickness of the active carbon with levels of TSS, that maikn thick activated carbon TSS levels further down .

The data calculated using the semi-logarithmic approach. The efficiency of the calculation results using the semi-logarithmic approach with the equation $Y = ax^{b}$, the equation for sample I, $Y = 0.14358 x^{0.576}$; sample II, $Y = 0.01554 x^{1.471}$; and for sample III, $Y = 0.07163 x^{0.808}$ the results can be seen in the table below:

Table 9: The results of the calculation of the efficiency of reducing TSS levels in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm.

X thickness	Y (Reduction Efficiency) (%)		
activated carbon (cm)	Sample I	Sample II	Sample III
5	3.50	5.20	7.85
7.5	6.87	8.62	13.08
10	11.09	12.34	18.79
12.5	16.08	16.31	24.89
15	21.77	20.47	31.31

From the calculated data and the graph of the relationship between the thickness of the activated carbon layer and the reduction efficiency of suspended substance levels, it can be seen that after going through the control filter (without activated carbon) up to the thickness of activated carbon is 15 cm. This is because the suspended solids are relatively high which can increase the turbidity in the water. Calculation of the reduction efficiency of suspended substances. The surface area of the filter tool is 1245.57 cm / gr. In this situation there is also sufficient contact time. But the reduction of suspended substances will have a direct effect on other parameters, namely BOD_5 and COD. This is because the pollutants are in the form of suspended or dissolved solids. If the suspended substance can be reduced, then BOD_5 and COD can also be reduced.

The degree of acidity (pH): Results of analysis pH of waste before and after treated with carbon thickness variation is active is shown in the table below this.

Table 10: Results of measurement and calculation of the efficiency of pH levels in liquid waste with variations in the thickness of activated carbon from 0 cm to 15 cm

X thickness	Y (Reduction Efficiency) (%)		
activated carbon (cm)	Sample I	Sample II	Sample III
Initial grade	6,06	6.09	5.98
0	6.11	6.18	6.37
5	6.55	6.52	7.02
7.5	6.95	6.85	7.25
10	7.06	7,18	7.30
12.5	7.33	7.55	8.28
15	7.97	8.49	8.58

Based on the results of the study, it can be analyzed that the thicker the activated carbon layer, the greater the efficiency of reducing levels of COD, BOD_5 , TCC, Cr and pH . As in the discussion of the above parameters, it is caused by a large enough surface area on the activated carbon filter used with a size of 20-30 mesh. Also due to sufficient contact time.

The thickness of the activated carbon affects the surface area. The surface area acts as a sorption process, namely as a place to attach or enter contaminants with adsorbents. With a large surface area, the ability of activated carbon to bind pollutants will be even greater. If the thickness of the activated carbon layer decreases, the surface area will automatically decrease.

Relevant research on the comparison of absorption rates using activated charcoal, floating breccia and peanut shells obtained absorption efficiency of 98% with activated carbon, 70.12% with floating breccia adsorbent and 62.59% with peanut shell adsorbent, respectively. The highest absorption efficiency using activated charcoal adsorbent. From the graph of the average efficiency of decreasing waste content, it is found that the efficiency increases in proportion to the higher the thickness of the activated charcoal. So the thicker the layer of activated charcoal, the longer the contact time, so that more pollutants are absorbed (the decrease in the waste content is higher) (Peni, 2001).

The results obtained by using activated carbon filtering treatment showed that the activated carbon used could reduce the liquid waste content of the textile industry PT SSI Grogol Sukoharjo. Prior to processing, the liquid limbha level was obtained for the parameters COD = 1037.33 (mg/l), BOD5 = 371.167 (mg/l), TSS = 163.33 (mg/l), Cr = 0.171 (mg/l) and pH = 6,04. After processing, the levels of liquid limbha were obtained for the parameters COD = 148.47 , BOD5 = 63.27, TSS = 33.33, Cr = 0.0877 and ph = 8.35. So that there was a decrease in efficiency for COD parameters: 85.69%, BOD5: 82.85%, Cr: 48.71%, TSS: 79.59%.

Based on laboratory analysis, calculation of COD removal efficiency, BOD_5, Cr, and TSS that there is a difference ny a ta between the thickness of the layer of activated carbon. The thicker the activated carbon layer, the greater the reduction efficiency of the parameters examined. Based on five variations in the thickness of the activated carbon layer, and the five parameters examined, namely COD, BOD_5, Cr, TSS and pH , the greatest efficiency was achieved at a thickness of 15 cm activated carbon for a diameter of 9 cm and a filter height of 40 cm.

The results of the analysis of textile industrial wastewater carried out were compared with the quality standard value of textile industrial wastewater based on the Central Java Provincial Regulation No. 10 of 2004 concerning the quality of liquid waste as shown in table 11.

Table 11: Comparison of Test Results / Measurement of Liquid Waste withTextile Industry Liquid Waste Quality Standards

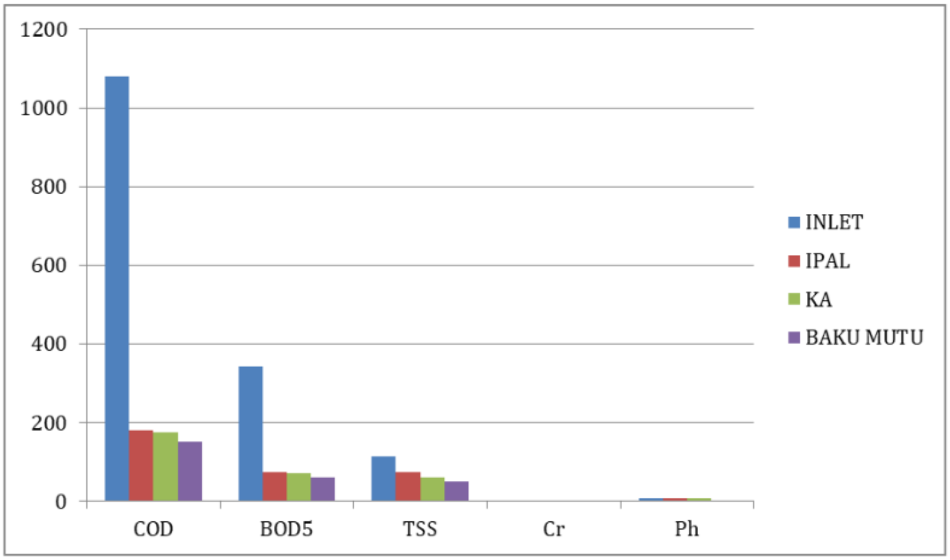
No.	Parameter	Level (mg / l)				Average	% Decrease
		Quality standards	Experimental results				
			I	II	III		
1	COD	150	156.9	140.0	148.5	148.47	85.69
2	BOD5	60	66.59	57.82	65.39	63.27	82.85
3	Cr	1	0.0836	0.0896	0.0900	0.0877	79.59
4	TSS	50	40.0	30.0	30.0	33.33	48.71
5	Ph	6.0-9.0	7.97	8.49	8.58	8.35	

From the table it can be seen that the values for COD, Cr and TSS are below the threshold, for the BOD_5 parameter the value is above the threshold, while the pH is still in the normal range of 6.0 to 9.0 and is alkaline, which is indicated by the higher pH value.

From the research results, effective absorption was obtained from a filter with a diameter of 9 cm and a height of 40 cm with a thickness of 15 cm of activated carbon. The following are the results of testing the textile industry wastewater with a thickness of 15 cm, and the test results for the IPAL Outlet of PT. SSI.

Table 12: Comparison of the results of testing the textile industry liquid waste from the inlet, PT SSI Sukoharjo outlet, the liquid waste quality standard and by using a filtering of 15 cm thick activated carbon.

No.	Parameter	Test result	Test result	Test result	Quality standards
		Inlet	WWTP outlet	with Carbon	(mg / l)
		PT.SSI (mg / l)	PT.SSI (mg / l)	Active (mg / l)	
1	COD	1079.9	181.3	174.2	150
2	BOD5	343.5	74.06	71.66	60
3	Cr	Sgd	Sgd	Sgd	1
4	TSS	115	75	62	50
5	pH	6.29	6.92	7.83	6.0-9.0



The histogram image of the test results between the textile industry wastewater from the inlet, Outlet PT. SSI Sukoharjo, Quality Standards for liquid waste and with using activated carbon filtering.

Where the tables and graphs show that the test results using activated carbon are better than the outlet and inlet results. From the laboratory testing of the UNS MIPA Center, it was obtained that the COD, BOD_5 and TSS parameters exceeded the quality standards based on the Central Java Provincial Regulation No. 10 of 2004, the Cr parameter was not detected while the parameter for the ph parameter was still in the range of quality standards (normal), namely 6.0 to 9.0. From the description above it is proven that using activated carbon can reduce waste parameters such as COD, BOD_5, and TSS as shown in the table.

CONCLUSION AND SUGGESTIONS

Based on the results of the analysis and the calculation of the efficiency of reducing levels, the following conclusions can be drawn:

1) The quality of the outket wastewater of PT Sinar Surya Indah Grogol Sukoharjo and the results of filtering using activated carbon for the BOD_5, COD, TSS parameters are above the threshold, the Cr parameter is not detected and the pH is still in the quality standard range of 6.0-9.0 based on Central Java Provincial Regulation No. 10 of 2004. The results of waste processing with activated carbon are better than those from the IPAL PT. SSI.
2) The thicker the activated carbon used, the more efficient it is to reduce levels of liquid waste. The thickness of activated carbon which is effective for filtration is 15 cm thick. While effective absorption was obtained for COD, BOD_5, and TSS parameters, Cr parameter was less effective for absorption as indicated by the value of $1/n = 3.0451$, which exceeds the maximum limit of absorption values.

To increase the adsorption capacity of activated carbon, it is advisable to carry out pre-treatment of wastewater. This processing is carried out by coagulation and flocculation processes to remove larger substances or particles. This is done to reduce processing costs. Do further research eg activated carbon thickness above 15 cm for a diameter of 9 cm, a height of 40 cm filter and liquid waste volume of 1.5 liters.

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