Jurnal E-Komtek
Vol. 7, No. 1 (2023) pp. 13-20
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

Design of a Batik Coloring Waste Treatment Tool Using the Electrocoagulation Method with a Capacity of 50 Liters

Aris Stiyawan[1], Nova Suparmanto[2], Harnandito Paramadharma[3], Asni Tafrikhatin[4], Hendi Purnata[5], Nitis Aruming Firdaus[6]

[1]CV Astoetik Indonesia, Indonesia, 55181
[2]Department of Industrial Engineering, Yogyakarta State University, Indonesia, 55281
[3]Departemenr of Technology Transfer and Incubation, Center for Handicrafts and Batik, Indonesia, 55166
[4]Department of Electronics Engineering, Piksi Ganesha Indonesia Polytechnic, Indonesia, 54311
[5]Department of Mechatronics Engineering, Cilacap State Polytechnic, Indonesia, 53212
[6]Department of Environmetal Engineering, Tirta Wiyata Technical Academy, Indonesia, 56115

asni@politeknik-kebumen.ac.id

https://doi.org/10.37339/e-komtek.v7i1.1243

Published by Politeknik Piksi Ganesha Indonesia

Artikel Info
Submitted:
11-01-2023
Revised:
31-01-2023
Accepted:
07-02-2023
Online first :
00-06-2023

Abstract

Pewarnaan batik masih menggunakan pewarna sintetis, sehingga pembuangan limbah pewarnaan tidak boleh sembarangan. Sebagian besar pengrajin batik mengolah limbah batiknya dengan cara mengendapkan cairan limbah dalam waktu lama. Proses tersebut sangat tidak efektif. Tujuan penelitian ini adalah membuat desain alat pengolahan batik yang murah dan efektif. Metode penelitian menggunakan metode elektrokoagulasi. Metode elektrokoagulasi merupakan pengolahan air secara elektrokimia. Desain alat pengolahan limbah batik ini terdiri dari lima bagian diantaranya: (1) Bak Elektrokoagulasi, (2) Skimmer, (3) Elektroda, (4) Sand Filter, dan (5) Bak Drying Bed Studge. Alat ini bekerja dengan daya 900 watt dengan luaran 20-40 volt DC. Daya tampung limbah cair sebesar 50 liter. Lama pengolahan limbah selama 2 jam. Metode elektrokoagulasi mampu menurunkan nilai BOD5, COD, TSS, dan TDS pada limbah pewarna batik. pH air limbah yang masih tinggi mampu diturunkan kadarnya dengan pemberian tawas.

Keywords: *Batik, Limbah Pewarna, Elektrokoagulasi*

Abstrak

Batik coloring still uses synthetic dyes, so the disposal of coloring waste should not be careless. Most batik craftsmen process their batik waste by settling the waste liquid for a long time. The process is very ineffective. The purpose of this research is to design a batik processing tool that is cheap and effective. The research method uses the electrocoagulation method. The electrocoagulation method is an electrochemical water treatment. The design of this batik waste treatment tool consists of five parts including: (1) Electrocoagulation Tub, (2) Skimmer, (3) Electrode, (4) Sand Filter, and (5) Studge Drying Bed. This tool works with 900 watts of power with an output of 20-40 volts DC. The capacity of liquid waste is 50 liters. Duration of waste treatment for 2 hours. The electrocoagulation method is able to reduce the values of BOD5, COD, TSS, and TDS in batik dye waste. The pH of wastewater which is still high can be reduced by giving alum

Kata-kata kunci: *Batik, Dye Effluent, Electrocoagulation*

1. Introduction

In 2009, UNESCO designated batik as Indonesia's cultural heritage [1]. The impact is that every October 2 is celebrated as Batik Day. In addition, the government is increasingly cultivating clothes with batik motifs to be worn during school and meetings with other countries. Batik has many types. Based on the drawing technique, there are two types, namely written, painted, and stamped batik [2]. The choice of depiction technique is adjusted to the wishes of consumers. Along with the times, batik has been innovated by young artists with creations in the form of souvenirs and other local specialty art products [3]. Based on this data, there are more and more batik craftsmen.

Environmental problems that often occur in batik craftsmen are batik coloring waste [4]. Most batik craftsmen are in household industries, so the waste treatment used is quite simple, namely by settling the coloring waste for several days [2]. Even though the condition of batik coloring waste exceeds the required quality standard threshold, especially for the parameters Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Dissolved Solid (TDS) and Total Suspended Solid (TSS) [5]. Most wastewater treatment plants (WWTP) for batik craftsmen still utilize funds from the APBN / APBD and CSR companies.

Based on these problems, researchers will make a cheap and effective batik coloring waste treatment tool so that wastewater is by the standard quality threshold. This batik dye waste treatment uses the electrocoagulation method. Based on previous research, batik processing using electrocoagulation is still just measuring the effectiveness of the electrocoagulation method in reducing the anode mass and the required voltage [6]. The study conducted by Achmad Chusnun Ni'am states that the distance between the two plates and the type of plate used also affects the breakdown of chemical reactions in batik coloring waste [7]. Novie Putri Setianingrum mentioned that the amount of voltage and the length of the electrocoagulation process also affect COD and TSS reduction [8].

2. Method

This research uses the electrocoagulation method to make a batik coloring waste treatment tool using the electrocoagulation method. Electrocoagulation is an electrochemical water treatment method. At the anode, there is a release of active coagulants in the form of metal ions into the solution. At the same time, at the cathode, an electrolysis reaction occurs at the cathode in the form of hydrogen gas release [9] [10]. The electrocoagulation reaction at the anode and cathode is as follows.

$2H_2O + 2e^- \rightarrow H_2\,(gas) + 2OH^-$

$2H_2O \rightarrow O_2 + 4H^+ + 4e$

$Al \rightarrow Al^{3+} + 4e^-$

This research designs a batik waste treatment tool with a quantity of 50 liters. This research process is presented in **Figure 1**.

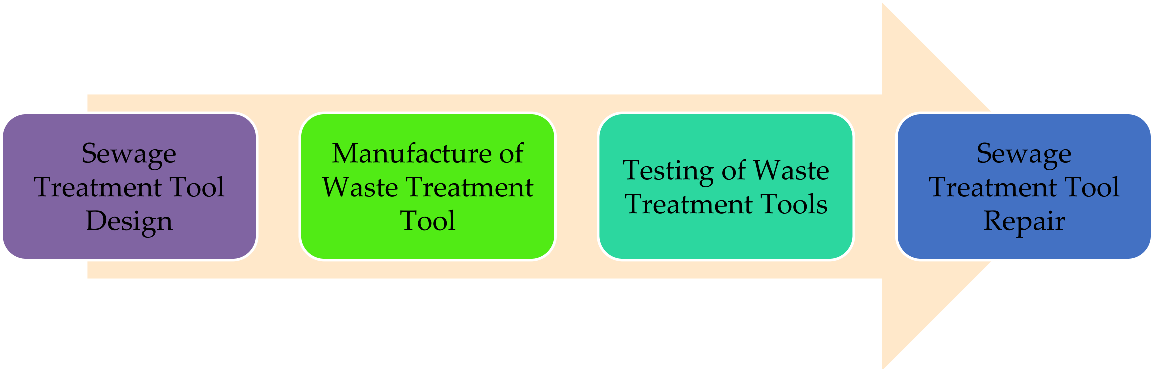

Figure 1. Step of Research

a. Sewage Treatment Tool Design

Design a waste treatment tool using Corel Draw. The tool design is based on the theory found when looking for theoretical studies.

b. Making Waste Treatment Tools

Making waste treatment tools is adjusted to the tool design that has been made.

c. Testing of Waste Treatment Tools

Testing of sewage treatment equipment by sending initial samples of waste before electrocoagulation processing and after electrocoagulation processing to the Yogyakarta Environmental Health and Disease Control Engineering Center for testing BOD5, COD, TSS, TDS, and pH of the wastewater.

d. Improvement of Sewage Treatment Equipment

Repair sewage treatment equipment with good ergonomics and effective values.

3. Results and Discussion

3.1 Sewage Treatment Tool Design

This sewage treatment tool uses electrocoagulation. The electrocoagulation method requires two electrodes (anode and cathode) [9]. These electrodes are made of iron and aluminum. The design of the sewage treatment process is presented in **Figure 2**.

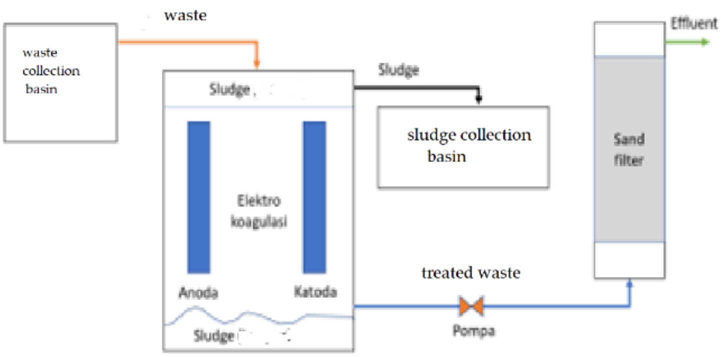

Figure 2. The Flow of Sewage Treatment Process

This sewage treatment process consists of five parts, namely (1) Electrocoagulation Tub, (2) Skimmer, (3) Electrode, (4) Sand Filter, and (5) Studge Drying Bed. The tool design is presented in **Figure 3**.

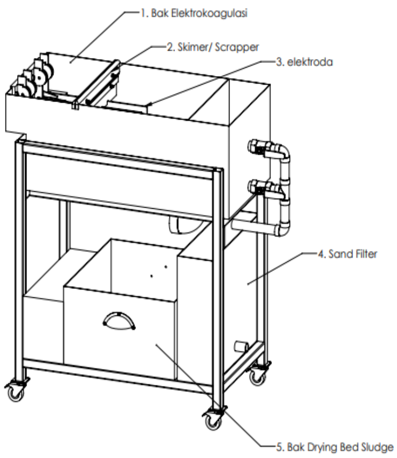

Figure 3. Sewage Treatment Tool Design

Based on Figure 3, this waste treatment tool requires 900 watts of power and DC output power between 20 to 40 volts. The electrocoagulation tub is a container of coloring liquid waste to be processed in 50 liters. Skimmer is a tool for wiping electrodes that have sediment attached. Electrodes use a size of 80 x 10 x 0.5 cm3. A sand Filter is a place for residue from waste that has been decomposed. The studge drying bed serves as a drying tub for sludge that has been decomposed. The design of the sewage treatment tool's top and side views are presented in **Figure 4**.

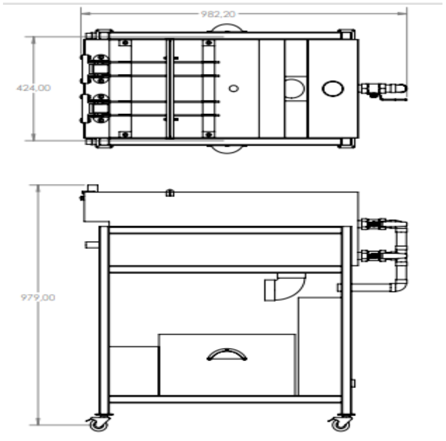

Figure 4. Design of Waste Processing Tools Top and Side Views

Based on Figure 4, the design of this batik processing tool is made using wheels which function to make it easier to move this waste treatment tool.

3.2 Making Waste Processing Tools

This waste treatment tool is the primary raw material is a welded iron plate, so that it can be like **Figure 5**.

Figure 5. Waste Processing Tools

The workings of this waste processing tool are 50 liters of waste liquid poured into a reservoir, then connected to a 220-volt power source with a power of 900 watts and an output power of 20-40 VDC.

3.3 Testing Waste Treatment Tools

There are three types of batik waste samples taken: indigosol, naphthol and a mixture of naphthol and indigosol. All three types are synthetic dye waste. The results of testing indigasol batik waste are presented in **Table 1**.

Table 1. Test Results of Indigasol Waste Content

No.	Parameter	Unit	Unit Maximum Level	Result Test	
				Before	**After**
1	BOD5*	mg/L	60	**900**	30
2	COD*	mg/L	150	**9275**	54
3	TSS	mg/L	50	**890**	25
4	TDS	mg/L	2000	**7840**	520
5	Fenol Total	mg/L	0,5	0,0489	0,0489
6	Krom Total (Cr)*	mg/L	1	<0,0095	<0,0095
7	Ammonia Total (NH	mg/L	8,0	6,7535	6,7535
8	Sulfide (asi S)	mg/L	0,3	<0,0043	<0,0043
9	Temperature*	^{0}C	Temperature ±3	25,2	25,2
10	pH*	-	6,0 – 9,0	7,6	7,6

Based on Table 1, all parameters digasol liquid waste that has been electro coagulated are by the quality standard threshold. The test results of naphthol waste content are presented in **Table 2**.

Table 2. Test Results for Naptol Waste Content

No.	Parameter	Unit	Unit Maximum Level	Result Test	
				Before	**After**
1	BOD5*	mg/L	60	**180**	32,5
2	COD*	mg/L	150	**865**	69,5
3	TSS	mg/L	50	**530**	35
4	TDS	mg/L	2000	**2340**	526
5	Fenol Total	mg/L	0,5	0,2175	0,2758
6	Krom Total (Cr)*	mg/L	1	<0.0095	<0,0095
7	Ammonia Total (NH	mg/L	8,0	6,9124	2,6411
8	Sulfide (as S)	mg/L	0,3	<0,0043	<0,0043
9	Temperature*	^{0}C	Temperature ±3	25,2	26,2
10	pH*	-	6,0 – 9,0	**11,4**	**9,5**

Based on **Table 2**, the test results of Naphtol waste levels are BOD5, COD, TSS, and TDS parameters by the threshold, but the pH parameter is still high. The results of the mixed waste content test are presented in **Table 3**.

Table 3. Test Results of Mixed Waste Content

No.	Parameter	Unit	Unit Maximum Level	Result Test	
				Before	**After**
1	BOD5*	mg/L	60	**213,0**	32
2	COD*	mg/L	150	**765,0**	92,5
3	TSS	mg/L	50	**1240**	23
4	TDS	mg/L	2000	**4270**	577
5	Fenol Total	mg/L	0,5	0,0211	0,7416
6	Krom Total (Cr)*	mg/L	Temperature ±3	26	25
7	Ammonia Total (NH	mg/L	8,0	4,6083	5,1721
8	Sulfide (as S)	mg/L	0,3	<0,0043	<0,0043
9	Temperature*	^{0}C	Suhu udara 3	25,2	26,2
10	pH*	-	6,0 – 9,0	9	**9,8**

Based on **Table 3**, the coagulated mixed waste has a significant decrease in BOD5, COD, TSS, and TDS levels, but the pH value is still high.

Based on **Table 2** and **Table 3**, the pH value in the dye waste liquid is still high, so alum is needed to neutralize it. After mixing with alum water, the wastewater was checked for pH. The result was 8 (neutral). Researchers have tested it before being neutralized with alum by giving the wastewater to catfish. The catfish can survive until now, so the wastewater, if discharged in a pH state of that size, does not harm plants or animals. It should still be given alum so that the pH of the wastewater is neutral and the water color is clear.

4. Conclusion

The design of a batik dyeing waste treatment tool with a quantity of 50 liters is by making (1) an Electrocoagulation Tub, (2) Skimmer, (3) an Electrode, (4) a Sand Filter, and (5) Studge Drying Bed. The electrocoagulation method can reduce the values of BOD5, COD, TSS, and TDS in batik dye waste. The pH of wastewater, which is still high, can be reduced by giving alum.

References

[1] A. Amaris Trixie, "Filosofi Motif Batik Sebagai Identitas Bangsa Indonesia," *Folio*, vol. 1, no. 1, pp. 1–9, 2020.

[2] A. P. Siregar *et al.*, "Upaya Pengembangan Industri Batik di Indonesia," *Din. Kerajinan dan Batik Maj. Ilm.*, vol. 37, no. 1, pp. 79–92, Jun. 2020, doi: 10.22322/dkb.v37i1.5945.

[3] B. Widiyahseno, I. Widaningrum, E. W. Djuwitaningsih, and Sugianti, "PKM Batik: Pengembangan Potensi Batik Ponorogo," *J-Dinamika J. Pengabdi. Masy.*, vol. 5, no. 1, pp. 36–43, Jun. 2020, doi: 10.25047/j-dinamika.v5i1.1428.

[4] B. V. Tangahu and D. A. Ningsih, “Uji Penurunan Kandungan COD, BOD pada Limbah Cair Pewarnaan Batik Menggunakan Scirpus Grossus dan Iris Pseudacorus dengan Sistem Pemaparan Intermittent,” *J. Sains &Teknologi Lingkung.*, vol. 8, no. 2, pp. 121–130, Nov. 2016, doi: 10.20885/jstl.vol8.iss2.art6.

[5] N. Apriyani, “Industri Batik: Kandungan Limbah Cair dan Metode Pengolahannya,” *Media Ilm. Tek. Lingkung.*, vol. 3, no. 1, pp. 21–29, Mar. 2018, doi: 10.33084/mitl.v3i1.640.

[6] A. Hidayanti, U. Ihda Afifa, and D. Julianngaruh Tegangan Elektrokoagulasi dan Konsentrasi Awal Pewarna terhadap Persentase Penyisihan Remazol Red RB,” *Rekayasa Bahan Alam danTeknologi Berkelanjutan*, vol. 5, no. 2, pp. 1–9, 2021.

[7] A. C. Ni’am, J. Caroline, and M. Haris Afandi, “Variasi Jumlah Elektroda dan Besar Tegangan dalam Menurunkan Kandungan COD dan TSS Limbah Cair Tekstil dengan Metode Elektrokoagulasi,” *Al-Ard*, vol. 3, no. 1, pp. 21–26, 2017.

[8] N. P. Setianingrum, A. Prasetya, and D. Sarto, “Pengurangan Zat Warna Remazol Red Rb Menggunakan Metode Elektrokoagulasi secara Batch,” *J. Rekayasa Proses*, vol. 11, no. 2, pp. 78–85, 2017.

[9] Sandi, D. Nurdandi, F. Afriani, and Y. Tiandho, “Pengaruh Jarak antar Plat dalam Penjernihan Limbah Batik Cual dengan Metode Elektrokoagulasi,” in *Prosiding Seminar Nasional Penelitian & Pengabdian Pada Masyarakat*, 2019, pp. 1–14.

[10] S. Bahri *et al.*, “Prototype Alat Olah Limbah Sistem Semi Batch Untuk Pengolahan Limbah Cair Laboratorium Kimia,” *J. Pengendali. Pencemaran Lingkung.*, vol. 2, no. 1, pp. 22–27, 2020.