

Research Article

Manufacture of Eco-cleaner Based on Eco-enzyme Reinforced Catalyst as Reduction of Metals and Impurities on Roller and Blanked to Improve Offset Quality

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ORCIDEfrizal Siregar: <https://orcid.org/0009-0003-2778-1863>**Abstract.**

Offset printing machines play an important role in the printing process in the printing industry, so many industrial players make various efforts to maintain the quality of offset machine printouts. One of the efforts made is to keep the rollers and blankets on the offset machine clean from metal impurities that come from printing inks. To keep rollers and blankets clean, industry players usually use chemical fluids that can clean rollers and blankets on offset machines. However, the continuous use of chemical fluids can damage the rollers and blankets due to oxidation of these chemicals over time. This affects the printing results, such as the paper getting easily damaged, the blanket becoming sticky, the print being uneven, and the density becoming low. In addition, the cleaning chemicals used can cause environmental damage such as water pollution and soil pollution. This research synthesizes an eco-cleaner from an organic waste fermentation process reinforced with a catalyst that can be used as a substitute for the chemicals used today. This research aims to produce an eco-cleaner product that can reduce metal impurities on rollers and blankets to improve the printing quality of offset machines. The resulting product works effectively to remove metal impurities without damaging the rollers and blankets because the eco-cleaner is non-corrosive. The resulting products can be used by the public and the printing industry. The method used in this research is an experiment with the fermentation synthesis method. Furthermore, the eco-cleaner is tested for characterization for feasibility according to SNI standards. The tests carried out are the organic plating test, physical properties test, test and then analysis of the test results to see the feasibility of the eco-cleaner.

Keywords: eco-cleaner, roller-blanket, printing quality, offset printing

1. INTRODUCTION

In recent years, the printing industry in Indonesia has continued to experience increasing progress. It experienced a decline due to the impact of Covid-19, but slowly the printing industry is starting to recover. Based on data from the official website of the Ministry of Industry, in 2022 the printing industry will experience an increase of around 10% and is likely to continue to increase (ministry of industry, 2022). Therefore, printing industry

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players must be able to take advantage of this momentum by improving the quality of printed output, one of which is by optimizing the work of the printing machines used. Offset printing machines are one of the machines often used by the printing industry because they are capable of printing on a large scale of up to thousands at a cheaper price. However, the use of offset printing machines still experiences several problems which cause poor printing results and can cause damage to the paper [1]. One of the reasons why the offset printing machine's rollers and blankets work less optimally is because these components experience a lot of dirt caused by ink that is still attached to these components. Dirt attached to the rollers and blankets must be cleaned regularly 4 times every month so that the rollers and blankets are clean and can work optimally and run well [2].

The roller and blanket washers currently used are chemical-based liquids that are not friendly to health and the environment, besides that they can damage the rollers and blankets themselves if used for a long period of time due to the oxidation process. If roller and blanket washing chemicals are disposed of improperly, they will pollute the environmental ecosystem. The continuous use of these chemicals is also contrary to the principles of green chemistry that are being promoted by the government. One of the principles is to look for chemical substitutes with organic materials that can be broken down so that prevention is better than prevention. Therefore, the aim of this research is to produce an eco-cleaner product that can reduce metal impurities attached to rollers and blankets that are environmentally friendly and sustainable and do not damage the rollers and blankets themselves [3]. Eco-cleaner is an eco-enzyme based compound which is made by utilizing organic waste which is processed using a fermentation method with the addition of a catalyst to produce protease, lipase and amylase enzymes and is rich in beneficial microorganisms which can be used as a cleaner and dirt remover. At a solution concentration of 15% the solution has been proven to be able to remove and reduce heavy metals such as As, Hg, Pb and Cd [4]. The ink finalization stage in the substrate printing process is one of the determinants of the print quality indicators of an offset machine. This is due to the interaction between the physical and chemical properties of the characteristics of the ink used on the roller and blanket. The main analysis that can be carried out is to identify factors that can influence quality print results for a product produced on an offset printing machine. The following are several things that need to be paid attention to in order to improve the quality of the offset printing machine. The materials that need to be considered are the printing material and ink, dampening solution, and equipment configuration options. To

overcome the problem of assessing mold quality, it is quite complicated and urgent, so it requires information on adaptation and development methods [5].

The aim of this research is offset printing ink emulsion for efficiency in the absorption and curing process on the surface of the ink substrate which is used to improve the quality of offset printing machines. Practically speaking, in the printing process, it is very important to control the level of ink emulsion in the printing process, simple constraints on the quality of the print results are very necessary to consider the constraints that will arise in the offset printing process. Analysis of substrate printing inks needs to be investigated by paying attention to variations in the ink printing process, requiring scientific processes and applying high technology [6]. To overcome problems in the offset printing machine production process, there are many methods that can be used to anticipate problems that will arise. One method that can be used is the FMEA (Failure Mode and Effect Analysis) method. This FMEA method is one of the methods used by applying technical analysis to be able to identify and determine and then provide conclusions that can eliminate potential failures and known problems and potential problems and eliminate failures in the printing process. FMEA can also find out problems caused by rollers and blankets on offset printing machines. From the calculation results, the problems that emerged, these two components contributed to failures in the printing process [7].

Rollers and blankets are important components of an offset printing machine which affect the quality of the print produced by offset printing. The offset printing component which functions to receive ink from the printing plate and transfer it to paper is the main function of the blanket. If the roller and blanket are not maintained it will affect the quality of the offset printing results. Some of the impacts that occur are causing a lot of damage to the paper, it will be difficult to adjust the ink, the blanket will become sticky, the roller and blanket will not be in harmony, the print will become uneven and water balance will become difficult [8]. The microorganisms in eco enzyme are the main ingredients used to make eco-cleaner which helps the decomposition process of ink attached to rollers and blankets which contain heavy metals with environmentally friendly properties. The more microorganisms produced by eco enzymes, the ability of the eco-cleaner to clean metal attached to dirt on the rollers and blankets will be maximized. Based on this, it is very important that an eco-cleaner can clean rollers and blankets [9].

2. METHODOLOGY/ MATERIALS

This research is an experimental research using a combination method of fermentation processes, chemical processes, and the resulting product characterization test process which is presented logically, systematically and controlled under actual conditions. Consists of 4 stages, namely Organic waste Fermentation, Eco-cleaner Synthesis, Eco-cleaner Test, and prototype implementation process in actual conditions [10]. Fermentation Resistant, at this stage the organic waste in the form of orange peel and pineapple peel waste that has been cleaned is cut into small sizes. In this fermentation process, organic waste is added to glucose from palm sugar and put into distilled water which is free from chlorine in a ratio of 1: 3: 10. Put the mixture into a container made of plastic or glass. Eco-Cleaner Synthesis Stage, at this stage the eco-enzymes produced from the organic waste fermentation process are taken at varying levels that have been determined and given a number of Zn/Zeolite catalysts [11]. Eco-Cleaner Test Stage, at this stage the eco-cleaner that has been produced is tested for its characterization for suitability as a combination material for cleaning rollers and blankets on offset printing machines. Prototype Implementation Stage, at this stage the product in the form of a prototype that has been produced will be used on the rollers and blankets of the offset printing machine to see the ability to reduce metals and impurities attached to the offset machine. Then the results will be compared by looking at the print results [4]. The design of this experimental study is displayed in Table 1.

TABLE 1: Research Design.

	Sample Eco-cleaner (A1)	Sample Eco-cleaner (A2)	Sample Eco-cleaner (A3)
synthesis (A1)	1	1	1
Eco-cleaner test A2)	2	2	2
Implementation prototype (A3)	3	3	3

3. RESULTS AND DISCUSSIONS

Before the experiment was carried out on the potential of eco-cleaner in cleaning rollers and blankets on offset printing machines, an analysis of each eco-enzyme concentration in each sample was first carried out with variations in the percentage of eco-enzyme of 10%, 15% and 20%. in each eco-cleaner solution. The results of the analysis can be seen in **Table 1**.

TABLE 2: Results analysis sample Eco-Cleaner.

Sample cleaner	eco-	Concentrate (mg/L)		
		Analysis 1	Analysis 2	Analysis 3
Sample 1	< 0,1	19.84	4.00	
Sample 2	< 0,1	19.86	3.96	
Sample 3	< 0,1	19.88	3.90	

In table 1 it can be seen that from analysis 1 by looking at the fat and oil levels contained in the eco-cleaner samples, it shows almost the same results below 0.1. The lower the fat and oil content, the more optimal it will be for cleaning metal impurities that stick to the rollers and blankets of the offset printing machine. The second analysis shows the absorption capacity of the eco-cleaner against metal impurities on the roller and blanket attached to it. The results of the analysis show that the smallest absorption capacity is the first eco-cleaner sample of 19.84 mg/L, the absorption capacity of the second metal impurities is 19.86 mg/L, while the The highest metal absorption was the third sample, namely 19.88 mg/L. The results of the -3 analysis were by measuring the PH content of the eco-cleaner solution in the three samples which showed the highest PH value in the third sample while the lowest PH value was in the first sample [9].

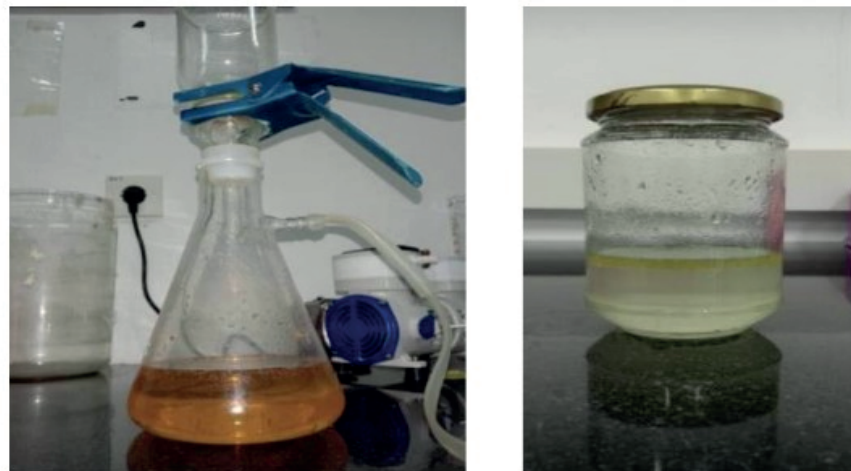


Figure 1: (a) Eco-Enzyme (b) Eco-Cleaner.

Experimental results from the analysis of the samples above on a laboratory scale on samples with variations in the eco-enzyme produced show that samples with a concentration of 10 mg/L have lower acidity compared to other samples with a PH value of 4.00. This causes the sample's ability to reduce metals in offset printing machine ink to be low, namely 19.84 mg/L. in the second sample with an eco-enzyme concentration of 15%, it shows stronger acidic properties when compared to the first sample, namely

with a PH value of 3.96, increasing the PH strength of the second sample can also result in the fiber's resistance to metal also increasing, namely by 19.86 mg/L. while the 3rd sample with the highest Eco-enzyme concentration of 20% showed a PH value of 3.94 with the highest metal reducing power, namely 19.84 mg/L [12].

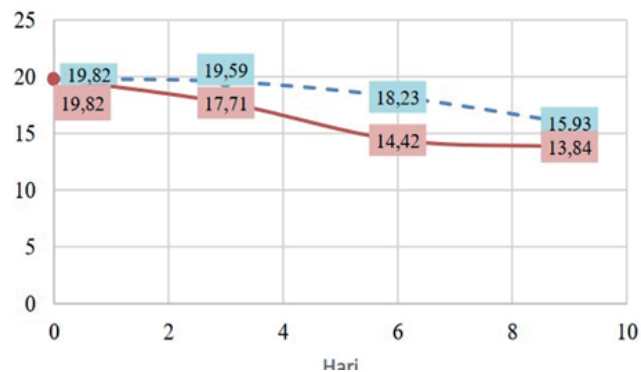


Figure 2: comparison of metal reduction with eco-enzyme and without Eco-enzyme.

This research shows that the bio-catalytic activity of eco-enzyme obtained from fermentation of orange peel and pineapple peel shows optimum conditions in reducing the metal attached to the roller and blanket of the offset printing machine in the 3rd sample with a concentration of 20% eco-enzyme. a metal absorption capacity of 19.84 mg/L. Research on the bio-catalytic activity of eco-enzymes specifically as pectinolytic enzymes was studied to see their ability to reduce metal concentrations in ink on offset printing machines. The higher the level of eco-enzyme in the eco-cleaner, the higher the ability to reduce metals [13].

4. CONCLUSION AND RECOMMENDATION

First, from the research that has been carried out, the manufacture of Eco-enzyme based Eco-cleaner is reinforced with a catalyst as a reducer of metal and dirt attached to rollers and blankets with the highest reduction power of 19.84 mg/L thereby improving the quality of offset printing machines which are environmentally friendly. Second, the feasibility test of an Eco-enzyme based Eco-cleaner reinforced with a catalyst as a reducer of metal and dirt attached to rollers and blankets can improve the quality of offset printing machines which are environmentally friendly. Third, an Eco-enzyme based Eco-cleaner reinforced with environmentally friendly catalysts that can be used as a roller and blanket cleaner on offset machines.

Based on the conclusions above, there are 3 recommendations that can be offered from this research. Firstly, the main ingredient for producing eco-enzyme is fermentation

from orange peel waste and pineapple peel waste because it has good biocatalyst qualities as an eco-cleaner. Second, eco-cleaner can reduce metal impurities in the ink attached to the roller and blanket. Third, eco-cleaner can be used to replace metal cleaning agents from other environmentally friendly chemical compounds.

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