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Bioremediation of Heavy Metal Chrome with *Saccharomyces cerevisiae* in Industrial Metal Plating Liquid Waste

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***Abstract*—the metal plating industry realistically and continually produce liquid waste in a number of relatively small but highly toxic. This waste disposal will poison the surrounding environment as well as biotic/abiotic component, if the waste directly disposed of into the environment without being processed first. The purpose of this research is to process liquid waste from the metal-plating industry containing Chrome heavy metals using bioremidiation with spesific microbes. Research was conducted by bioremidiation using Saccharomyces cerevisiae microbes with concentration variation of $10^{2.5}$ and 10^5 and curing time for 48 hours. The results showed that the initial levels of Chromium metal plating liquid waste before processing was 1.35 ppm. Metal plating liquid waste processing in Saccharomyces cerevisiae microbes with bioremidiation can lower the levels of Chrome to 0.297 ppm with a percentage decrease level of 78.03%. The bioremidiation process with concentration of 10^5 Saccharomyces cerevisiae can decrease Chrome levels significantly.**

Keywords—bioremidiation, chrome heavy metal, metal plating liquid waste, Saccharomyces cerevisiae

I. INTRODUCTION

Disposal of metal plating liquid waste industry will poison the surrounding biotic and abiotic environment if the waste is directly discharged into the environment without being processed first. There is an alternative method of industrial waste treatment that is considered more secure and also beneficial for the environment that is biological waste processing.

Cr (VI) contained in the wastewater of the tannery industry can be reduced by *Pseudomonas aeruginosa* to Cr (III) which is non-toxic [1]. *Yarrowia lipolytica* yeast is able to live well in medium containing Cadmium ion (Cd) up to 200 ppm [2]. In a 10-hour incubation period in a cadmium-containing waste, *Yarrowia lipolytica* yeast may absorb 50 percent of Cadmium. *Pseudoctavianiomonas aeruginosa* can reduce the level of Copper metal (Cu) contained in the wastewater of metal coating industry of 81.3% [3]. The research on handling heavy metals in liquid wastes produced by industry by utilizing bacterial microbes and fungi as well as combination of *Pseudomonas aeruginosa* and *Bacillus subtilis* [4]. The results showed that bacterial microbe use can reduce the levels of Nickel (Ni) and Chromium (Cr) in industrial wastewater.

Therefore, this research was conducted to reduce the heavy metal level of Chromium (Cr) contained in industrial metal plating liquid waste by bioremidiation using variation of microbial concentration of *Saccharomyces cerevisiae* with curing time for 48 hours.

II. MATERIALS AND METHOD

A. Apparatus

Apparatus used in this research such as: Atomic absorption spectrophotometer (AAS), quvet, pH meter, bottles, 50 mL flask, 1 mL volume pipette, suction, centrifuge, filter paper, test tube, and dropper pipette.

B. Chemicals and reagents

Chemicals and reagents used in this research such as: industrial metal plating liquid waste, *Saccharomyces cerevisiae*, H_2SO_4 0.2N, concentrated HNO_3, $Ca(OH)_2$, $K_2Cr_2O_7$, 1,5-Diphenyl carbazide, Aquades, Paper label, Filter paper, Acetone.

C. Metal palting liquid waste treatment with bioremediation

Bioremidiation is carried out to treat liquid wastewater metals with *Saccharomyces cerevisiae* with varying concentrations. Bioremediation consist of three phases, such as:

1) Saccharomyces cerevisiae suspension preparation: Saccharomyces cerevisiae are cultured on an appropriate medium. Taken 2-3 ose then included in 100 ml of medium, then incubated at 37 ° C for 24 hours.

2) Administration of Saccharomyces cerevisiae on metal coating waste samples: Samples from the electrocoagulation process of 1 liter in a 1.5 liter water bottle were treated with the addition of Saccharomyces cerevisiae with concentrations of 102.5 cells/ml and 105 cells/ml, then incubated for 2 x 24 hours, pH 7.4; temperature 37^{o}C and then set the weight of the metal [5].

3) Testing the liquid metal plating wastewater samples prior to processing with Saccharomyces cerevisiae: The test sample was taken 100 ml, HNO_3 concentrate was added 5 ml and heated to until the solution was almost dry, then 50 ml of aquabidestilata was added and put into 100 ml flask through Whatman filter paper and 100 ml of 0.2 N H_2SO_4

solution. The test solution was then transferred into cuvet and then read its absorbance using an Atomic Absorption Spectrophotometer (AAS) / UV-Vis Spectrophotometer (SNI 06-6989.17-2004).

III. RESULTS

The result of the research are presented in table and figure below.

A. Chromium level of heavy metal wastewater prior to processing by remidiation with Saccharomyces cerevisiae

TABLE I. CHROMIUM LEVEL OF HEAVY METAL WASTEWATER PRIOR TO PROCESSING BY BIOREMIDIATION WITH SACCHAROMYCES CEREVISIAE

Experiment number	Microbes concentrations *Saccharomyces cerevisiae*	Chrome levels (ppm)
1	0	1,35
2	0	1,35
3	0	1,35

B. Chromium level of heavy metal wastewater after treatment by bioremidiation using variation of Saccharomyces cerevisiae concentration and curing time 48 hours

TABLE II. CHROMIUM LEVEL OF HEAVY METAL WASTEWATER AFTER TREATMENT BY BIOREMIDIATION USING VARIATION OF SACCHAROMYCES CEREVISIAE CONCENTRATION AND CURING TIME 48 HOURS

No	Microbes concentrations *Saccharomyces cerevisiae*	Chromium levels (ppm)	Chromium levels (ppm) after bioremediation	Decreased chromium levels (ppm)
1	0	1,35	1,30	0,05
		1,35	1,31	0,04
		1,35	1,31	0,04
2	$10^{2,5}$	1,35	0,68	0.67
		1,35	0,67	0,68
		1,35	0,67	0,68
3	10^{5}	1,35	0,30	1,05
		1,35	0,29	1,06
		1,35	0,30	1,05

C. Percentage of chromium decrease after bioremidiation processing using variation of Saccharomyces cerevisiae concentration to initial concentration (1.35 ppm) and 48 hours of curing time

TABLE III. PERCENTAGE OF CHROMIUM DECREASE AFTER BIOREMIDIATION PROCESSING USING VARIATION SACCHAROMYCES CEREVISIAE CONCENTRATION (1.35 PPM) AND 48 HOURS OF CURING TIME

No	Consentration of *Saccharomyces cerevisiae*	Percent decrease (%)	Mean percentage decrease (%)
1	0	3,70.	
		2,96	3,21
		2,96	
2	$10^{2,5}$	49,63	
		50,37	50,12
		50,37	
3	10^{5}	77,78	
		78,52	78,03
		77,78	

D. Chromium decrease percentage after bioremediation processing using variation of Saccharomyces cerevisiae concentration on initial concentration (1.35 ppm) and 48 hours of curing time

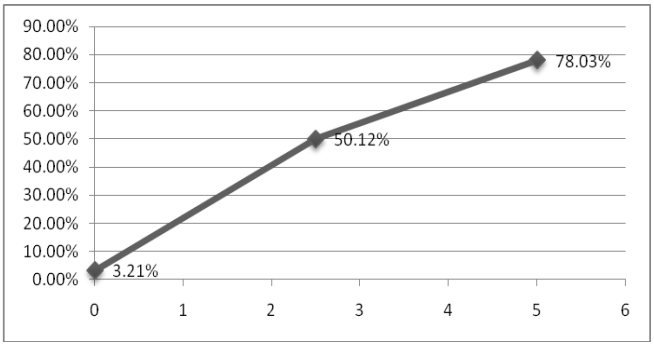

Fig. 1. Chromium decrease percentage after bioremediation processing using variation of *Saccharomyces cerevisiae* concentration on initial concentration and curing time 48 hours

IV. DISCUSSION

The result showed that preliminary levels of Chromium before the addition of *Saccharomyces cerevisiae* is shown in Table 1 (1.35 ppm). Table 2 illustrates the decrease in chromium level after processing with *Saccharomyces cerevisiae* concentration variations of $10^{2.5}$ and 10^{5}, the results showed the addition of *Saccharomyces cerevisiae* with concentrations of 10^{5} lower levels of Chromium was higher than that of *Saccharomyces cerevisiae* with concentration of $10^{2.5}$.The decrease of chromium content from the beginning of 1.35 ppm decreased to an average chromium level of 0.297 ppm. Table 3 shows a decrease in chromium content by 78.03%.

The use of *Saccharomyces cerevisiae* to reduce chromium level is a form of bioremidiation that is the use of microbes for the handling of hazardous waste or soil to convert chemical compounds into harmless chemical compounds [7]. Most of the mechanism of heavy metal cleaning by microorganisms is the ion exchange process, so with this concept chromium level in hazardous waste can be lowered.

V. CONCLUSIONS

A. Conclusions

1) Initial chromium level of metal plating wastewater before processing is 1.35 ppm

2) Bioremidiation of metal plating wastewater treatment with Saccharomyces cerevisiae microbe can decrease Chromium heavy metal level to 0.297 ppm with decreasing percentage of 78.03%. The bioremidiation process with *Saccharomyces cerevisiae* with concentration of 10^{5} can significantly decrease chromium level.

B. Recommendations

1) Please follow up with the combined process of electrocoagulation and bioremidiation to treat the actual waste containing heavy metals.

2) Require the design and manufacture of Wastewater Treatment Plant (WTP) with a simple model that can reduce / remove heavy metals in the liquid lime produced by industries containing heavy metals.

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D. Chromium decrease percentage after bioremidiation

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