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Preface

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PREFACE

Mangrove, as one of the potential coastal ecosystems, provides many valuable processes that ensure the availability of goods, and services of provisioning, regulating, and supporting culture. More than a third of the mangrove area has been lost due to the conversion and over-exploitation in the past three decades. The threats to this precious resource, especially those that have not been explored, will impact ecosystem functions and services. Therefore, Universitas Jenderal Soedirman is deeply intense to support the scientific community in providing solutions in managing quality, diversity, and environmental sustainability, including, in this case, mangrove as a unique ecosystem. To formulate the real action, International Conference on Mangrove and Its Related Ecosystems (ICoMIRE-2019) had been organized by the Faculty of Biology, Universitas Jenderal Soedirman, co-hosted by Coordinating Ministry of Maritime Affairs and supported by the Ministry of Research, Technology, and Higher Education and the Ministry of Environment and Forestry of Republic Indonesia.

The ICoMIRE-2019 forum facilitates scientists who are interested in mangrove and its related ecosystems to discuss their findings on biological resources, including biotechnology, for multiple purposes, i.e., to preserve biodiversity while utilizing it for human welfare. It is also a forum to create or strengthen the networks among the scientists, build up partnerships, and exchange ideas with both government and a variety of experienced researchers, practitioners, research institutes, and academia. We accommodate four symposia covering 1) mangrove ecosystem health, 2) mangrove ecosystem management, 3) recent approach to mangrove monitoring, and 4) interrelated mangrove system. The conference program had been preceded by workshops and field trip to the mangrove ecosystem, and also the first congress of establishment Indonesian Mangrove Society.

This conference was attended by speakers and participants from several countries, including Japan, Philippines, Vietnam, Bangladesh, Malaysia, Sudan, and Indonesia. A total of 66 articles have been presented, composed of 56 oral presentations and 10 poster presentations.

We would like to thanks the parties that give great support to the conference. We would like to deliver the highest appreciation to keynote speakers: Jenderal TNI (Purn.) Luhut Binsar Panjaitan, M.P.A. (Coordinating Minister of Maritime Affairs), Dr. Ir. Siti Nurbaya Bakar, M.Sc. (Minister of Environment and Forestry), Dr. Jurgenne H. Primavera (Zoological Society of London – Philippines), Dr. Koji Takayama (Kyoto University, Japan); others invited speakers from Vietnam and Indonesia; and all participants, also steering and organizing committee.

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IOP Conference Series: Earth and Environmental Science

Table of contents

Volume 550

2020

Previous issueNext issue

International Conference of Mangroves and Its Related Ecosystems 2019 21 - 23 August 2019, Purwokerto, Indonesia

Accepted papers received: 23 July 2020
Published online: 16 September 2020

Open all abstracts, in this issue

Preface

Papers

Open abstract, Mangrove Community Structure in Papuan Small Islands, Case Study in Biak Regency View article, Mangrove Community Structure in Papuan Small Islands, Case Study in Biak Regency PDF, Mangrove Community Structure in Papuan Small Islands, Case Study in Biak Regency

012003

THE FOLLOWING ARTICLE ISOPEN ACCESS

Composition and Characterization of Actinomycetes Isolated from Nipah Mangrove Sediment, Gastrointestinal and Fecal Pellets of Nipah Worm (*Namalycastis Rhodhocorde*)

A H Yanti, T R Setyawati and R Kurniatuhadi

Open abstract, Composition and Characterization of Actinomycetes Isolated from Nipah Mangrove Sediment, Gastrointestinal and Fecal Pellets of Nipah Worm (Namalycastis Rhodhocorde) View article, Composition and Characterization of Actinomycetes Isolated from Nipah Mangrove Sediment, Gastrointestinal and Fecal Pellets of Nipah Worm (Namalycastis Rhodhocorde) PDF, Composition and Characterization of Actinomycetes Isolated from Nipah Mangrove Sediment, Gastrointestinal and Fecal Pellets of Nipah Worm (Namalycastis Rhodhocorde)

012004

THE FOLLOWING ARTICLE ISOPEN ACCESS

Study of Mangrove Forest Change towards the Diversity and Carbon Stock of Mangroves in Segara Anakan, Cilacap

Nurmalahayati, E R Ardli, A Widyastuti, E Yani and A S Piranti

Open abstract, Study of Mangrove Forest Change towards the Diversity and Carbon Stock of Mangroves in Segara Anakan, Cilacap View article, Study of Mangrove Forest Change towards the Diversity and Carbon Stock of Mangroves in Segara Anakan, Cilacap PDF, Study of Mangrove Forest Change towards the Diversity and Carbon Stock of Mangroves in Segara Anakan, Cilacap

012005

THE FOLLOWING ARTICLE ISOPEN ACCESS

Kandelia candel (L.) Druce Reproductive Organ Phenology, in Berbak and Sembilang National Park, South Sumatra

H Marisa, Sarno, M R Ridho, D P Indriani and P Wulansari

Open abstract, Kandelia candel (L.) Druce Reproductive Organ Phenology, in Berbak and Sembilang National Park, South Sumatra View article, Kandelia candel (L.) Druce Reproductive Organ Phenology, in Berbak and Sembilang National Park, South Sumatra PDF, Kandelia candel (L.) Druce Reproductive Organ Phenology, in Berbak and Sembilang National Park, South Sumatra

012006

THE FOLLOWING ARTICLE ISOPEN ACCESS

Translocation Factor of Zinc (Zn) in Water and Sediment by Root and Stem of *Rhizophora* sp. at Blanakan Riparian, West Java

A R Purwaningdyah and N D Takarina

Open abstract, Translocation Factor of Zinc (Zn) in Water and Sediment by Root and Stem of Rhizophora sp. at Blanakan Riparian, West Java View article, Translocation Factor of Zinc (Zn) in Water and Sediment by Root and Stem of Rhizophora sp. at Blanakan Riparian, West Java PDF, Translocation Factor of Zinc (Zn) in Water and Sediment by Root and Stem of Rhizophora sp. at Blanakan Riparian, West Java

012007

THE FOLLOWING ARTICLE ISOPEN ACCESS

Leaf Morphological Variation of *Acanthus* in Some Estuarine Areas of Cilacap

W Herawati, P Widodo, Sukarsa and D Palupi

village to the world" PDF, Mangrove governance: Establish a new paradigm of mangrove management "from village to the world"

012013

THE FOLLOWING ARTICLE ISOPEN ACCESS

Estimation of Carbon Stocks in Mangrove Stands at Bagek Kembar Mangrove Ecotourism Sekotong West Lombok

D A Candri, Athifah, B Faristа, A Virgota, I S Rohyani and H Ahyadi

Open abstract, Estimation of Carbon Stocks in Mangrove Stands at Bagek Kembar Mangrove Ecotourism Sekotong West Lombok View article, Estimation of Carbon Stocks in Mangrove Stands at Bagek Kembar Mangrove Ecotourism Sekotong West Lombok PDF, Estimation of Carbon Stocks in Mangrove Stands at Bagek Kembar Mangrove Ecotourism Sekotong West Lombok

012014

THE FOLLOWING ARTICLE ISOPEN ACCESS

Morphological and Physiological Adaptation of *Synedrella nodiflora* (L.) Gaertn. in Various Altitudes

M Dwiati and A H Susanto

Open abstract, Morphological and Physiological Adaptation of Synedrella nodiflora (L.) Gaertn. in Various Altitudes View article, Morphological and Physiological Adaptation of Synedrella nodiflora (L.) Gaertn. in Various Altitudes PDF, Morphological and Physiological Adaptation of Synedrella nodiflora (L.) Gaertn. in Various Altitudes

012015

THE FOLLOWING ARTICLE ISOPEN ACCESS

Macrozoobenthos Diversity as a Bioindicator of Heavy Metal Pollution in Segara Anakan Lagoon, Cilacap District, Indonesia

S Lestari and T A Rahmanto

Open abstract, Macrozoobenthos Diversity as a Bioindicator of Heavy Metal Pollution in Segara Anakan Lagoon, Cilacap District, Indonesia View article, Macrozoobenthos Diversity as a Bioindicator of Heavy Metal Pollution in Segara Anakan Lagoon, Cilacap District, Indonesia PDF, Macrozoobenthos Diversity as a Bioindicator of Heavy Metal Pollution in Segara Anakan Lagoon, Cilacap District, Indonesia

012016

THE FOLLOWING ARTICLE ISOPEN ACCESS

Pathogenicity Profile of Indigenous Bacteria Isolated from Gastrointestinal Tracts and Fecal pellets of Nipah Worm (*Namalycastis rhodochorde*)

T R Setyawati, A H Yanti and R Kurniatuhadi

Open abstract, Pathogenicity Profile of Indigenous Bacteria Isolated from Gastrointestinal Tracts and Fecal pellets of Nipah Worm (Namalycastis rhodochorde) View article, Pathogenicity Profile of Indigenous Bacteria Isolated from Gastrointestinal Tracts and Fecal pellets of Nipah Worm (Namalycastis rhodochorde) PDF, Pathogenicity Profile of Indigenous Bacteria Isolated from Gastrointestinal Tracts and Fecal pellets of Nipah Worm (Namalycastis rhodochorde)

012017

THE FOLLOWING ARTICLE ISOPEN ACCESS

Enzymatic Activities of *Streptomyces* spp. Isolated from Natural Habitat of Nipah Worm in Sungai Kakap District, West Kalimantan

A H Yanti, T R Setyawati and R Kurniatuhadi

Phytoremediation of liquid waste electroplating using *Salvinia* sp.

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Phytoremediation of liquid waste electroplating using *Salvinia* sp.

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Abstract. Liquid waste of chromium electroplating can cause water pollution if not treated. The negative impact of chromium can be minimized with water weeds such as *Salvinia molesta* and *Salvinia natans*. The objective of this research was to compare the effectiveness between *S. molesta* and *S. natans* as a phytoremediator and the best time exposure. The research design was Randomized Completely Block Design. The main plot was the biomass of *S. molesta* and *S.natans* 50 g (B1), 100 g (B2), and 150 g (B3). The subplot was the time of exposure, which consists of 1 day (T1), 6 days (T2), and 12 days (T3). There were 24 treatment combinations, and each treatment was repeated three times. Observed parameters include Cr in water, pH, DO, and TSS. Data were analyzed by Anova and followed by Tukey's test. This research showed that both *S. molesta* and *S. natans* were effective in decreasing Cr in water and TSS in the opposite increase of pH and DO. The most effective treatment was biomass of *Salvinia* 150 g and 12 days of time exposure. Both of *S. molesta* and *S.natans* can be used as phytoremediators to improve water quality, while *S. molesta* is more effective than *S.natans*. Biomass of *S. molesta* 150 g and 12 days were effective treatments to improve the water quality of chromium electroplating.

1. Introduction

The chrome plating industry produces chromium-containing liquid waste with characteristics of high Cr content (> 2ppm), acidic pH (<3), low dissolved oxygen (DO), otherwise high Total Suspended Solid (TSS) levels. If the waste is not treated first, it will cause a decrease in water quality and the life of aquatic organisms [1,2]. Pollution of chrome liquid waste reduction is necessary to try a simple, inexpensive, but effective waste treatment using phytoremediation techniques [3,4]. Phytoremediation is the use of plants to extract, remove, or detoxify pollutants from their environment [5,6]. Some waterweed plants such as Salvinia, Pistia, and water hyacinth can be used as phytoremediators to absorb toxic elements, especially heavy metals [7,8,9]. One of the heavy metals is chromium, which found in chrome plating waste. Salvinia is a type of aquatic plant that floats freely in water and includes water weeds. This plant habitat is rice fields, gutters, and ponds. Salvinia sp as a phytoremediator plant is selected based on the consideration that *Salvinia* sp can grow in waters with low nutrient content. The morphology of *Salvinia molesta* has long, thick roots, thus absorbing more heavy metals [10,11].

Salvinia found in Indonesia are *S. molesta* with hair and *S. natans* without hair [12,13]. This plant leaves unite to form a composition composed of three tight leaves. Two leaves of each bouquet float with short stems and hair on *S. molesta*. Each leaf does not share a flat edge, and all three leaves hang in water and function to absorb water [14]. The broad root of Salvinia contains phytochelatin substances to absorb Cr in liquid chrome plating [10,11]. The process of absorption heavy metal, including Cr through the roots of aquatic plants, is called rhizofiltration. In this case, it is assumed that the area of the rhizosphere is directly proportional to the biomass amount. Thus there is a relationship between an increase in plant biomass and an increase in chromium absorption. Besides the exposure time factor and leaf surface area, the presence of hair or waxy coatings in the aquatic plants used is vital to influenced chrome absorption [10].

The purpose of this study was to determine the ability of *S molesta* and *S. natans* as phytoremediators in absorbing Cr from Cr plating waste. To determine biomass and the best exposure time of Salvinia as a phytoremediator to improve water quality due to the pollution of chrome plating.

2. Methods

2.1. Material

Salvinia molesta and *S. natans* are taken from the rice fields of the Pamijen district of the Baturraden sub-district. Waste was taken from the chrome plating industry in Tegal. The instrument used include analytical scales, BOD incubators, sample bottles, and Atomic Absorption Spectrophotometry (AAS) brands of Perkin Elmer. The research design was Randomized Completely Block Design. The main plot was the biomass of *S. molesta* and *S.natans* 50 g (B1), 100 g (B2), and 150 g (B3). The subplot was the time of exposure 1 days (T1), 6 days (T2), and 12 days (T3). There was 24 treatment combination, and each treatment was repeated three times. Independent variables were biomass and time of exposure. The dependent variable was Cr in water. Other parameters were DO, pH dan TSS.

2.2. Research procedure

Salvinia was taken from the rice fields of Pamijen village, the Baturaden sub-district, then maintained in a greenhouse with a plastic bucket that was given 10 ml of distilled water. The pH is set 6-7 for 14 days. Then Chrome plating diluted 1:10 with aquadest. Salvinia was selected based on the same size and washed thoroughly. Then the biomass was weighed at 50 g, 100 g, and 150 g. Then put into chrome liquid waste that has been diluted with distilled water 1:10. After 14 days, Salvinia plants are taken from electroplating waste then roasted for 12 hours at 80^0C so that the weight is constant. Then it is transferred to the porcelain cup and put into the furnace for 8 hours until the color turns white ash weight was weighed and ready to be analyzed by Atomic Absorption Spectrophotometry. Measurement of Cr levels with AAS at a wavelength of 357.9 nm and strong current 3,5 A° [15]. Measurement of supporting parameters DO with DO meter and TTS with APHA method [16]. Value of pH measured by pH meter. Both primary and supporting parameters were measured at 1 , 6, and 12 days.

3. Results

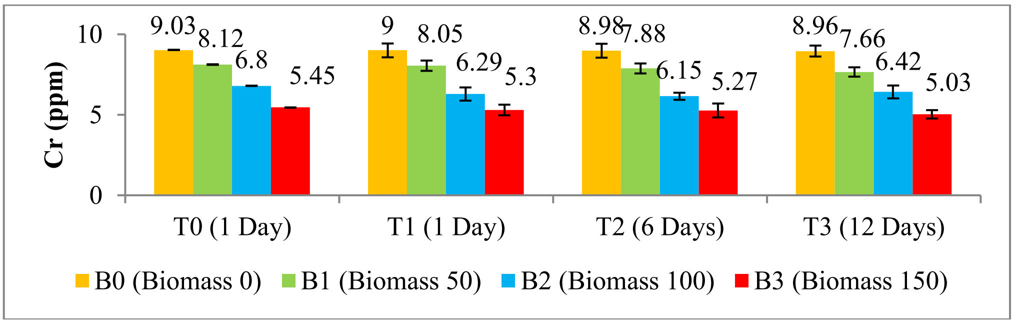

Figure1. Chromium (Cr) Levels in waste after treated with *S. molesta*

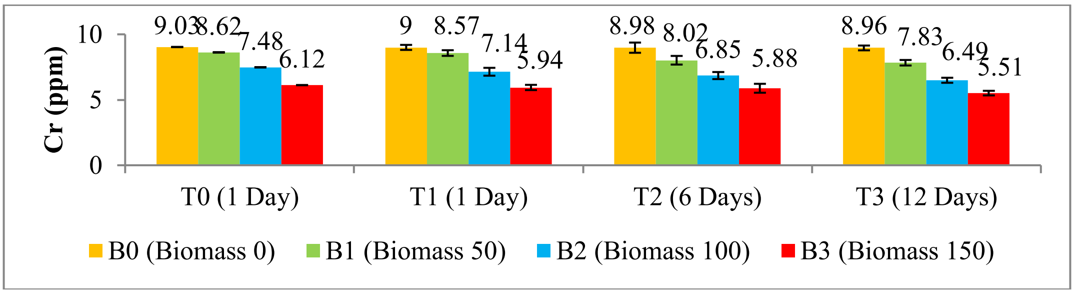

Figure 2. Chromium levels in waste after treated with *S. natans*

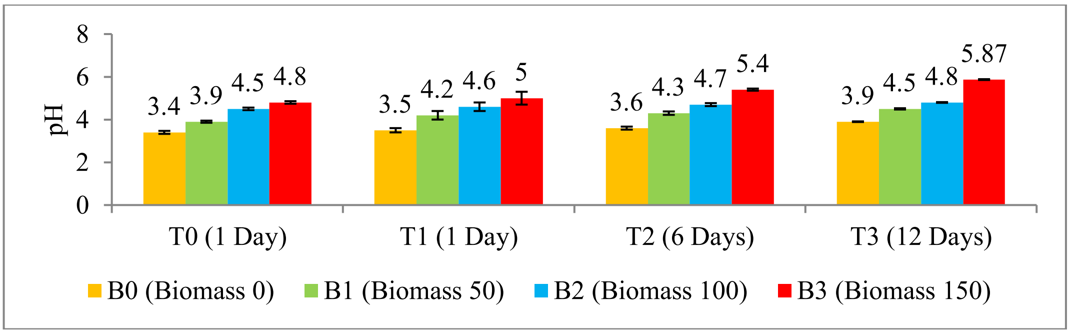

Figure 3. pH Value in waste after treated with *S. molesta*

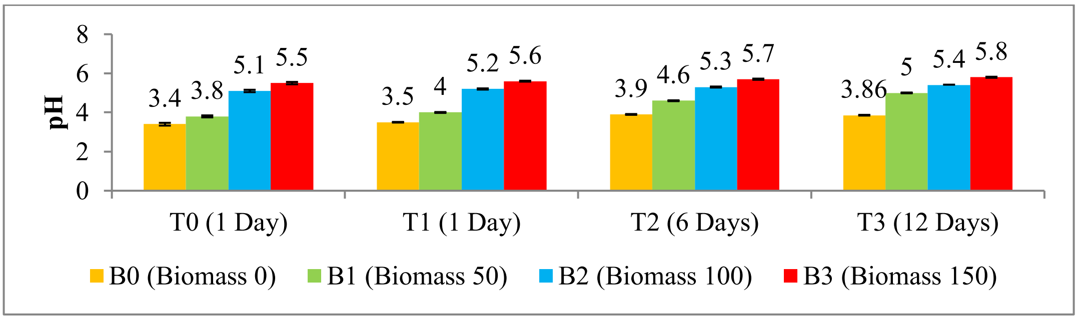

Figure 4. pH Value in waste after treated with *S. natans*

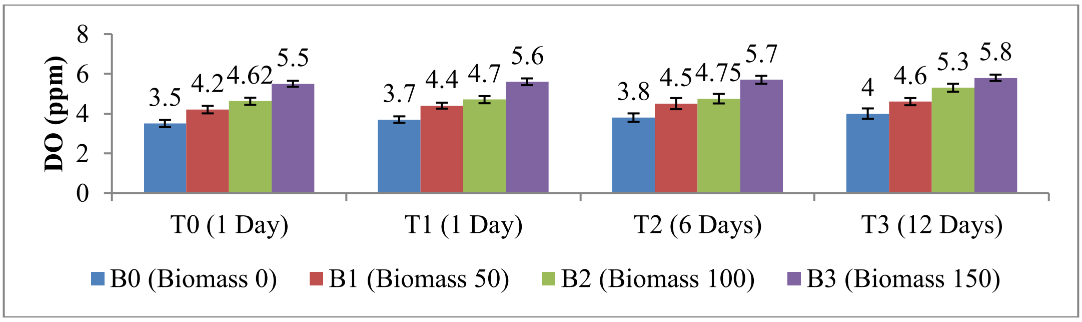

Figure 5. Dissolved Oxygen (DO) Levels after waste treated with *S. molesta*

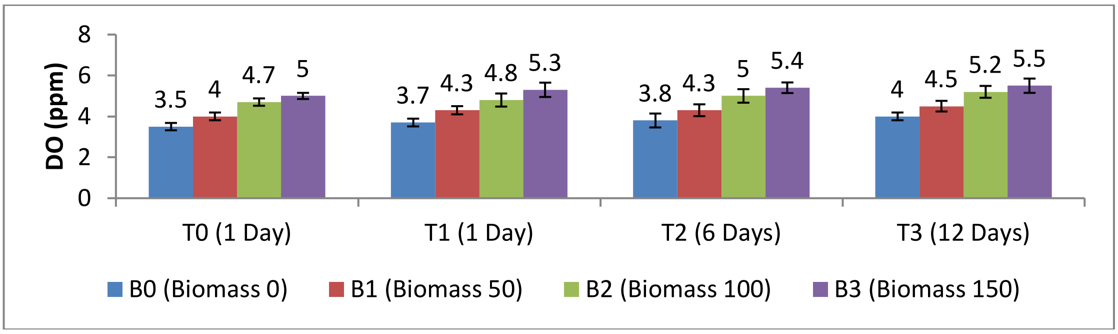

Figure 6. Dissolved Oxygen (DO) Levels after waste treated with *S. natans*

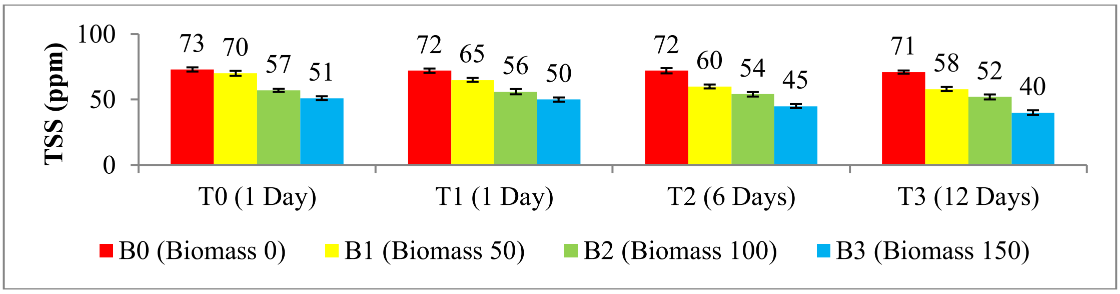

Figure 7. Total Suspended Solids (TSS) Levels after waste treated with *S. molesta*

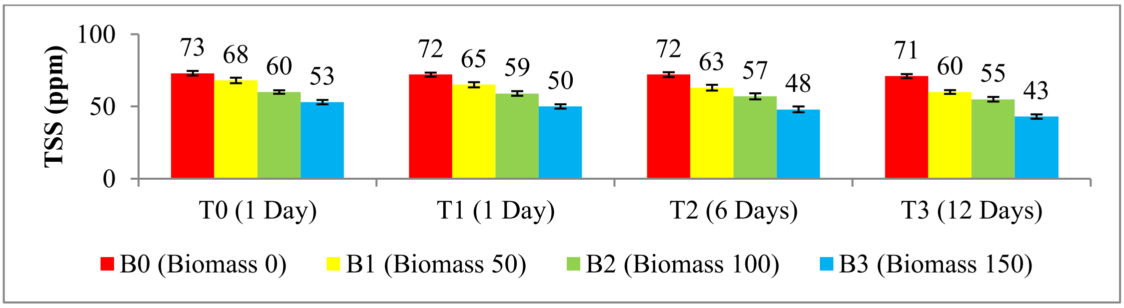

Figure 8. Total Suspended Solids (TSS) Levels after waste treated with *S. natans*

4. Discussion

Based on these data indicated that both *S. molesta* (Figure1) and *S. natans* (Figure 2) could absorb Cr. The absorption of toxic elements, including Cr by plants, can be done in two ways, first through the root system and the leaf surface. Include passive absorption and active absorption involving energy derived from the photosynthesis process in the form of ATP [6,17]. Ion Cr will be absorbed through the process of rhizofiltration by phytochelatins that are in the roots. Phytochelatin is a peptide compound composed of glutamate, cysteine , and glycine will increase when the plant undergoes stress metal. The peptide in phytochelatin binds metal ions, and so on, Cr will be stored in tissue and vacuole [3,5,7]. In the next process, the metal moves across the root membrane to the leaf. The Water's Cr levels were decreased because of the Caspary band on the endodermis. The transport is passed through the symplast to and accumulated in the leaves [13,14,18].

Salvinia molesta can decrease Cr in waste of 44.41%, but *S natans* only for 40.88%. *S. molesta* has a longer root than *S. natans*, which is 17-20 cm, while S. natans is only 14-15 cm so that Cr is absorbed by *S. molesta* more. In addition to root shape, leaf surface area and leaf shape also influence the absorption of Chrome. The surface of *S. natans* leaves narrower than S. molesta, and the surface shape of leaves is smooth with no hair, whereas *S. molesta* leaves the surface is wider than S. natans, and the surface of leaves is hairy [10]. As a result, *S. molesta* can make the transpiration process faster than *S. natans* so that it can absorb more Cr.

The pH value of chrome plating at the fist is acidic at range 3.4- 3.5 [2]. After treated with *S. molesta* and *S. natans*, the pH value is increased. An increase in pH value was started at 50g, 100 g, and 150 g biomass treatment for days 1, 6, and 12. The highest pH value was on the 12 days after treatment with 150 biomass of *S. molesta* and *S. natans*. It is occurred due to much CO2 was utilized by photosynthesis of both *S.molesta* and *S. natans*. That process will shift the balance to the right, and a reduction in H^+ ions will occur so that the liquid waste increases to near neutral pH [3,19]. Tuckey's test results showed the exposure time of 12 days with 150 g of Salvinia spp biomass 150 g was the most effective treatment in increasing pH value. The increasing percentage pH value on day 12 with biomass *S. molesta* treatment at range 52.3% and *S. natans* at range 44.74%.

DO levels increased after waste treated with both *S. molesta* and *S. natans*, as shown in Figure 5 and Figure 6. An increase in DO levels on waste is caused by the addition of oxygen produced by the photosynthesis process of Salvinia spp [11]. Tuckey's test showed the exposure time of 12 days with 150 g of Salvinia biomass was the most effective treatment in increasing DO levels. DO levels increased by *S. molesta* remediation was at range 29% and *S. natans* at range 22%.

At first, Chrome plating waste high TSS levels at range 71-73 ppm. The high TSS levels cause inhibition of the penetration light into the water, interfering with photosynthesis, and causing a decrease in the amount of oxygen [4]. Nevertheless, TSS levels were decreased after treated with both *S. molesta* (Figure 7) and *S. natans* (Figure 8). Salvinia spp is an aquatic plant that very strong in absorbing nutrients, thus can absorb Cr heavy metals in large quantities. The more biomass of Salvinia in the treatment is equal to the lower of the TSS level in chrome plating waste. Salvinia spp can actively absorb pollutants but does not inhibit the penetration of light into water [10,20]. Tuckey's test showed the exposure time of 12 days with 150 g of Salvinia spp biomass was the most effective treatment in reducing TSS levels. The highest percentage reduction in TSS level on day 12 with 150 g biomass of *S. molesta* at range 42.86% and *S. natans* 38.76%.

5. Conclusion

Salvinia molesta and *S. natans* have the ability as phytoremediators of chrome plating waste, which is characterized by a decrease in Cr and TSS levels in the waste accompanied by an increase in DO levels and pH values. *S. molesta* and *S. natans* 150 g biomass and 12 days exposure time are the best treatments in improving the quality of chrome plating wastewater. *Salvinia molesta* has a higher ability as a phytoremediator for chrome plating waste compared to *S. natans*

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