RINGKASAN

BIOREMEDIASI MERKURI (Hg) DENGAN TUMBUHAN AIR PADA LIMBAH TAMBANG EMAS RAKYAT DIMEMBE KABUPATEN MINAHASA PROPINSI SULAWESI UTARA

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Kegiatan pertambangan emas rakyat di kecamatan Dimembe kabupaten Minahasa menggunakan merkuri sebagai bahan pengikat emas (amalgam) telah berlangsung sampai saat ini. Penggunaan merkuri mengakibatkan emisi merkuri berpotensi mencemari lingkungan. Berdasarkan hasil uji pendahuluan, limbah buangan pengolahan emas tradisional di kecamatan Dimembe telah mengandung logam berat berupa merkuri (Hg), timbal (Pb). Kandungan logam-logam berat tersebut telah melewati ambang batas baku mutu lingkungan, dan diduga telah terjadi akumulasi logam-logam berat pada sungai, biota air dan tumbuhan.

Penelitian ini dilakukan dengan tujuan untuk mengetahui efektifitas dan kemampuan beberapa jenis tumbuhan air sebagai agen bioremediasi limbah merkuri. Penelitian dilakukan dalam dua tahap. Tahap pertama yakni tahap pendahuluan bertujuan untuk menentukan model instalasi yang digunakan sebagai wadah bioremediasi, menentukan jenis tumbuhan, dan konsentrasi logam berat dan kandungan nutrisi dalam limbah. Pengujian awal ini digunakan sebagai acuan untuk kegiatan penelitian selanjutnya. Tahap kedua yakni tahap bioremediasi bertujuan untuk mengetahui kemampuan tumbuhan air: kangkung air (*Ipomoea aquatica*), teratai (*Nelumbium nelumbo*), eceng gondok (*Eichhornia crassipes*) dalam menyerap merkuri dalam limbah serta untuk mengetahui pengaruh kombinasi jenis tumbuhan dan biomassa terhadap penurunan konsentrasi merkuri dalam air limbah tambang emas. Selain itu juga dilakukan perhitungan pengaruh tumbuhan terhadap IBR. Pelaksanaan bioremediasi dilakukan dengan cara menampung limbah buangan sebelum dilepas ke lingkungan. Setelah pelaksanaan bioremediasi, maka dilakukan verifikasi terhadap kandungan merkuri pada tumbuhan. Penelitian ini merupakan penelitian eksperimen skala lapangan dengan rancangan acak lengkap (RAL).

Hasil penelitian menunjukkan bahwa air limbah tambang emas rakyat di kecamatan Dimembe mengaung Hg 9,03 mg/l,As 0,00 mg/l, Pb < 0,05 mg/l. Selain itu mengandung nutrisi tumbuhan berupa N 545 mg/l, P 25,58 mg/l, dan Kal;ium 11,67 mg/l. Hasil penelitian juga menunjukkan bahwa pada hari ke 15 jenis tumbuhan tidak berpengaruh bermakna ($p > \alpha$ 0,05), namum biomassa tumbuhan berpengaruh bermakna ($p < \alpha$ 0,05) terhadap penurunan kadar Hg pada air limbah. Demikian juga kombinasi jenis dan biomassa tumbuhan tidak berpengaruh bermakna ($p > \alpha$ 0,05). Pada hari ke 30 jenis tumbuhan berpengaruh bermakna ($p < \alpha$ 0,05), tapi biomassa tidak berpengaruh bermakna ($p > \alpha$ 0,05), demikian pula kombinasi jenis tumbuhan dan biomassa tidak berpengaruh bermakna ($p < \alpha$ 0,05). Tumbuhan air yang paling efektif sebagai agen bioremediasi adalah teratai (*N. nelumbo*) dengan biomassa 15 kg mampu menurunkan kadar Hg air limbah hingga 0,022 mg/l dengan IBR 99 % terjadi pada hari ke 15. Hal ini didukung oleh nilai FBK dari masing-masing tumbuhan air menunjukkan bahwa nilai FBK teratai 8,30 lebih tinggi dari nilai FBK kangkung air dan eceng gondok 4,68.

Berdasarkan penelitian ini secara umum tumbuhan air: kangkung air (*I. aquatica*) , teratai(*N. nelumbo*), eceng gondok (*E. crassipes*) dapat digunakan sebagai agen bioremediasi merkuri yang terdapat pada limbah tambang emas tradisional. Kemampuan ini terjadi karena tumbuhan mampu beradaptasi dengan kondisi limbah, dan tersedianya nutrisi tumbuhan yang ada di dalam limbah.

SUMMARY

BIOREMEDIATION OF MERCURY (Hg) USING WATER PLANT FROM TRADITIONAL GOLD MINING WASTEWATER AT THE DISTRICT DIMEMBE, NORTH SULAWESI PROVINCE

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Traditional gold mining at Dimembe district, Minahasa in North Sulawesi always use mercury for catching the gold (amalgam) until now. Utilization of mercury rise possibility of producing emission to the environment. Based on the previous observation, the pollution in the gold mining area in Dimembe district already consist of heavy metals (e.g. mercury, plumbum). The heavy metals founded in the wastewater are over the maximum standard accepted by the environment (0,001 ppm), and the possible assumtion is accumulated in the surface water (river), water organism and plant.

This research is held for some purposes namely to know the effectiveness and capabilities of some water plants as bioremediation agents of mercury. This research has been working in two steps. At first step, the research has been looking forward to the model of installation for bioremediation process, determining the water plant to be used, heavy metals concentration, the nutrient in wastewater. This previous test has to be used for a reference to the next step. At second step (bioremediation), the research goals were to look forward deeply the absorption capabilities of the water plants: kangkung air *(I.aquatica)* teratai (*N.nelumbo*), eceng gondok (*E.crassipes*) to the mercury in the waste water and also to know more the effect of plant combinations and biomass for the reducing of mercury concentration in wastewater. In the other hand the effect of plants to Bioremediation Index (BRI) was calculate. Bioremediation was executed following this step: the wastewater is collected before throwing out from the mining area. Then, plants were planted in wastewater. After 15 days, the wastewater was collected for 300 ml to be measured in order to know the value of mercury reducing in the wastewater. In the 30th days, the wastewater was sampled and analyzed again. After bioremediation process, verification is executed to know the mercury concentration in plants. This research is field experimental study using completely randomized design.

Result of research shows, on one hand that the installation model can be used as a bioremediation installation, which is the water plant can live in the wastewater and can live along the research period of time 35 days. Finally, the wastewater constitutes of Hg (9,04 mg/l) and Pb < 0,05 mg/l. In the 15th days, the differentiate of kind of plants have no effect explicitly ($p > \alpha$ 0,05) at the reduced of Hg, but plant biomass has an effect ($p < \alpha$ 0,05). There is also the effect of interaction between kind of plant and its biomass has no effect ($p > \alpha$ 0,05). In a days of 30th, kind of plants has an effect ($p < \alpha$ 0,05) but plants biomass has no effect ($p > \alpha$ 0,05). The effective af water plant as an agen be of bioremediation is (*N.nelumbo*) with biomass of 15 kg, that able reduce concentration of Hg in waste water until 0,022 mg/l with IBR 99 % appear 15 th days. Its supported by the value of BKF more highest than value of *I.aquatica* BKF (0,06) and *E.crassipes* BKF (4,68).

The conclusion of this research is that water plants such kangkung air *(I.aquatica)*, teratai (*N.nelumbo*), eceng gondok *(E.crassipes)* can be used as an agent of bioremediation of mercury in a wastewater at the traditional gold mining, which is each plants has different capabilities.

ABSTRACT

BIOREMEDIATION OF MERCURY (Hg) USING WATER PLANT FROM TRADITIONAL GOLD MINING WASTEWATER AT THE DISTRICT DIMEMBE, NORTH SULAWESI PROVINCE

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Traditional mining activity which is used mercury can caused pollution to the environment. Such pollution occurred on every step of gold mining process particularly at the process of catching the gold (amalgam) and also at the burning of amalgam. Since the mining activity is being held for long term period, it is possible that mercury is being accumulated at the mining area, which is possible environment quality is decreased.

This research is held to know the effect of plants (amount of plants and biomass) to the decreasing of Hg concentration in wastewater. The research design used Complete Random Design with factorial module which consists of kind and biomass of plants. Plants factor is divided into three levels and plants biomass is divided into three levels with three iterations. Research results performs that the plant can be use for bioremediation, while the plants can be retain life in that even in the polluted water along 35 days. Mining wastewater consists of Heavy metals Hg 9,04 ppm and Pb < 0,05 ppm. In the 15th days, the differentiate of kind of plants have no effect explicitly ($p > \alpha$ 0,05) at the reduced of Hg, but plant biomass has an effect ($p < \alpha$ 0,05). There is also the effect of interaction between kind of plant and its biomass has no effect ($p > \alpha$ 0,05). In a days of 30th, kind of plants has an effect ($p < \alpha$ 0,05) but plants biomass has no effect ($p > \alpha$ 0,05).). The effective af water plant as an agen be of bioremediation is (*N.nelumbo*) with biomass of 15 kg, that able reduce concentration of Hg in waste water until 0,022 mg/l with IBR 99 % appear 15 th days. Its supported by the value of BKF more highest than value of *I.aquatica* BKF (0,06) and *E.crassipes* BKF (4,68).

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Key words: bioremediation, mercury (Hg), traditional gold mining, water plant, *I. Aquatica, N. nelumbo, E. crassipes.*