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The influence of Water Hyacinth to Decrease the Heavy Metals Mercury (Hg) Concentration for Irrigation

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***Abstract*— Research was conducted in July – September 2012, mercury analysis performed in Environmental Engineering of Engineering Faculty, Andalas University. Levels of mercury that are permitted by Government Regulation Republic Indonesia No. 82 of 2001, fourth grade for water quality is 0.005 mg/l. There mercury content of 0.020169 mg/l in irrigated areas Batang Hari. The research aims to find out ability level water hyacinth (Eichornia crassipes Sloms) to decrease content mercury and to find water depth suitable for phytoremediation. This research uses experimental methods in laboratory. Initial content of heavy metals mercury (Hg) that has been used is 0.02 mg/l in depth water 40 cm and 50 cm. Result in decreased concentrations of heavy metals mercury compared with quality standard heavy metal mercury for fourth grade water quality. The result showed that water hyacinth was able to restore the water quality of heavy metal contaminated Hg for irrigation. Decrease in the concentration of heavy metals mercury of 20 days at depth 40 cm reaching 94.3 % and depth of 50 cm reaching 85.7 %. Mercury concentration reaches a threshold quality standard for irrigation water depth of 40 cm during the 12 days and depth of 50 cm during 16 days.**

***Keywords*—Water hyacinth; Mercury (Hg); Depth; Water quality; phytoremediation**

I. INTRODUCTION

Water is an important natural resource in the earth. Humans, animals and plants needed for metabolism. Beside that human used it for transportation, farm, irrigation and etc. The water used for irrigation have a standard quality, it is meant the water not be impact for growth of plants. Plants make use of water for transportation substance, assimilations and evaporation (Hardjodinomo in Seprama 2010).

Water supply become a big problem and need a special notice. Today, difficult find the suitable water with a standard quality. It causes cesspool from growth inhabitation and development industry. Discard of cesspool to water resource not be equal with handling of cesspool, it's make a pollution. The result, water supply contain of heavy metals and transition metals. They are can be a toxic for environment.

Heavy metals become a toxic in the river are lead (Pb), copper (Cu), arsenic (As), cadmium (Cd), chromium (Cr) and mercury (Hg). Where, In the low concentration they are can be toxic for animals, plants and human.

Mercury require for existence biological, but if over it can be dangerous for environmental. Since development of industry, mercury become pollution substance, it made from mining process. Such as, used in gold miner with amalgamation method (Lestarisa, 2010).

Seprama (2010) found level of mercury in water irrigation Batang Hari achieve 0.0201690 mg/l. Meanwhile, be base on levels of mercury that are permitted by Government Regulation Republic Indonesia No. 82 of 2001 fourth grade for water quality is 0.005 mg/l. it's meant water irrigation in Batang Hari area not fill standard fourth grade for water quality.

Level of mercury up 0.005 mg/l destroy human skin tissue, for plants it become destroy tissue system and cause death by mercury dissolve in to the plants and a half can absorbed in to the soil, and then go into metabolism system and accumulated in plants tissue it can be subtract chlorophyll, destroy roof, leaf and pull down yield (Carey P. Yeager in Seprama 2010).

Pollution problem in Batang Hari irrigated area so apprehensive, it can be influential to yield on this area. That's why need an environmental pollution control cause by mercury, either one method is used phytoremediation.

Salt in Rosiana at all (2007) Phytoremediation is making use of plants, microorganisms to minimalism and detoxification pollutants. Plants has an ability absorbed

metals and minerals or as fitoakumulator and fitochelator. Using this technology give advantages, operation cost is cheep then other method.

This research used water hyacinth (Eichhornia crassipes Sloms) to decrease concentration of mercury. Water hyacinth hipercumulator, that able to absorb many pollutants and able to accumulated in their tissue on much capacity.

II. METHODOLOGY

A. Tolls and Material

The tolls are; bucket, bottle 140 ml, MVU (Mercury Vaporation Unit). The material are; water, Hg $(NO_3)_2$ 1000 mg/l and water hyacinth. Tolls and material support in this research.

B. Research Method

1) Research program: This research used experiment method in laboratory. Independent variable is depths of water that is 40 cm and 50 cm. Dependent variable are initial content of mercury 0.02 mg/l, water hyacinth and during time research monitoring sample every five days.

2) *Research Implementation:* Selected the water hyacinth based on long root 20 cm, total leaf five piece and weight 90 – 150 gr. And amount in one treatment use four shrub water hyacinth or 60% cover the surface. Then check content mercury in water that used for research in laboratory. If water had mercury, so put mercury in to the water until 0.02 mg/l (400 % from fourth grade quality standard). Put water in to bucket appropriate depth that definite 40 cm and 50 cm. and then put mercury until 0.02 mg/l. Every depth uses third replication. In this research use 2x3 treatments. Sign that use for depth of 40 cm is "A", 50 cm is "B" and sign for first replication is "I", second "II", third "III".

3) *Monitoring sample:* Monitoring sample every five hours, aims to find trend of decrease concentration mercury (Hg). Before take the sample, stir water until homogeny, take the sample 140 ml, and then put water in to bucket till border.

4) Sample Result: To show decrease content of heavy metals, analyze water sample in laboratory used MVU (Mercury Vaporation Unit). The result compare with grade standard water quality for agriculture.

C. Analyzed Method

Ability level water hyacinth to decrease concentration mercury (%) next called index Phytoremediation (IFR) use formulas:

$$IFR = \frac{(initial\ concentration - last\ concentration)}{initial\ concentration} \times 100\ \%$$

Trend of decrease concentration mercury to period use simple regression analyze;

$$y = a + bx$$

With; y = mercury concentration (mg/l)
a = Constanta
b = coefficient period
x = period

Ratio decrease concentration depth 40 cm and 50 cm use analyze ratio of mean. Preparation data use program SPSS 17.0.

D. Output

Ability level water hyacinth (*Eichornia crassipes Sloms*) to decrease content mercury and compare with Levels of mercury that are permitted by Government Regulation Republic Indonesia No. 82 of 2001, fourth grade for water quality is 0.005 mg/l. Then achievement fourth grade for water quality by water hyacinth in depth 40 cm and 50 cm.

III. STUDY AND RESULT

Monitoring and taking data in this research use interval 0 hours, 5 days, 10 days, 15 days and 20 days, aims to find trend of decrease concentration mercury by water hyacinth. Average decrease concentration by water hyacinth (Table 1).

TABLE I
AVERAGE DECREASE CONCENTRATION BY WATER HYACINTH

Depth	Standard (mg/l)	Initial concen-tration (mg/l)	Decrease concentration by water hyacinth (mg/l)			
			5 Days	10 Days	15 Days	20 Days
40 cm	0,005	0,02	0,01082	0,00627	0,0037	0,00114
50 cm	0,005	0,02	0,01524	0,00945	0,00563	0,00286

Table 1 showed initial concentration both of depth 40 cm and 50 cm is 0.02 mg/l. Found decrease concentration every crease periods, in 40 cm at 5 days concentration become 0.01082 mg/l, 10 days 0.00627 mg/l, 15 days 0.0037 mg/l and 20 days 0.00114 mg/l. In 50 cm has been decrease concentration every crease periods is at 5days concentration become 0.01524 mg/l, 10 days 0.00945 mg/l, 15 days 0.00563 mg/l and 20 daysr 0.00286 mg/l.

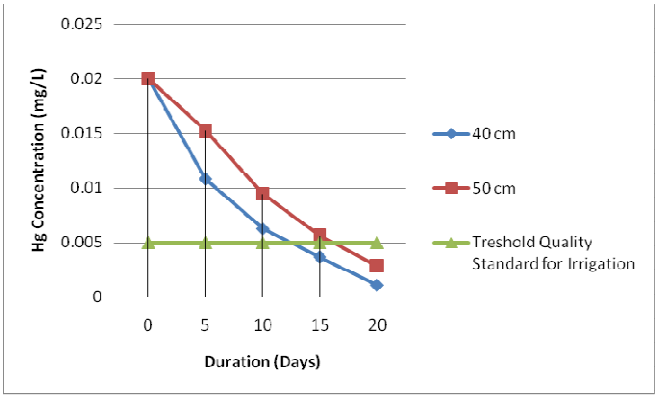

Fig.1. Decrease Concentration Hg by Water Hyacinth

Figure 1 showed depth 40 cm quickly decrease content of heavy metals than 50 cm. Compared with grade standard level mercury for agriculture in 40 cm have reached at 12 days and in 50 cm have reached at 16 days. Show water hyacinth able to remove heavy metals mercury (Hg) from water.

Priyanto & Prayitno (2006) that floating plants, included water hyacinth, used for manufacturing cesspool. Cause this plants accumulated organic and inorganic from cesspool.

Phytoremediation depend to pollutant will be controlled, as organic or inorganic. four subsets of phytoremediation are termed phytoextraction, phytostabilization, rhizofiltration, and phytovolatilization (Henry, 2000).

Enable mekanisme has happened when water hyacinth accumulated heavy metals are phytoextraction and rhizofiltration. This mekanisme happen when extract large concentrations of heavy metals into their roots, translocation the heavy metal into the surface biomass rate of xylem loading, produce a large quantity of plant biomass. In addition, remediative plants must have mechanisms to detoxify and/or tolerate high metal concentrations accumulated in their shoots (Erakhrumen & Agbontalor, 2007).

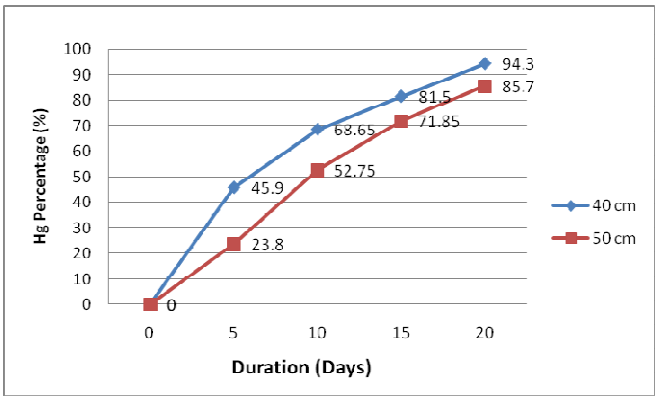

Fig 2. ability level water hyacinth to decrease concentration mercury

Index phytoremediation mercury by water hyacinth in depth 40 cm reach 94,3 % and 50 cm reach 85,7 %. Where this value significant and give indicated that water hyacinth can be phytoremediation agent for heavy metals mercury (Hg).

Index phytoremediation mercury by water hyacinth in depth 40 cm higher than 50 cm, it cause in treatment used same concentration but different volume make content of mercury in 50 cm more than 40 cm.

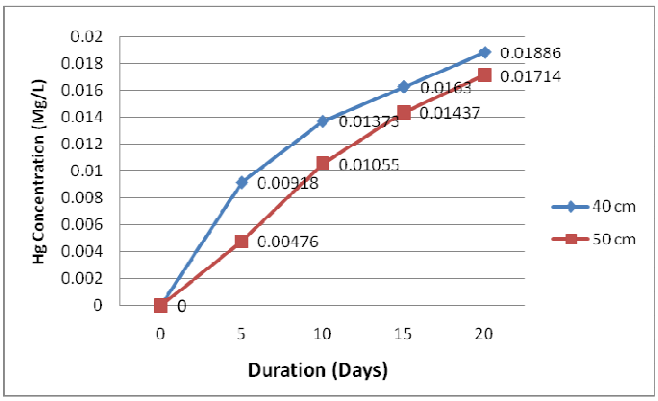

Fig.3. Absorption Hg by water hyacinth

On 20 days showed in Figure 3 absorption mercury in depth 40 cm reach 0.01886 mg/l. And at the same periods in depth 50 cm absorption reach 0.01714 mg/l. Content of mercury that have absorbed not significant. At 5 days absorption in depth 40 cm higher than 50 cm is 0.00918 mg/l, and then in next period's absorption down at 10 days is 0.01372 mg/l. In depth 50 cm absorption only 0.00476 mg/l and up at 10 days 0.01055 mg/l.

Analyze from mean of ratio depth 40 cm and 50 cm showed absorption mercury by water hyacinth with different depth not significant. Result mean of ratio absorption in 40 cm is 0.0116 mg/l and 50 cm is 0.0093 mg/l. Significant value 0.98 or 98 % more than 5 %, that mean in statistic method absorption mercury (Hg) by water hyacinth in depth 40 cm and 50 cm not significant.

IV. Conclusions

Base on data result and analyze, have many conclusion they are; Water hyacinth able removes heavy metals mercury (Hg) from water up; From standard level for four grade water quality; Index phytoremediation mercury by water hyacinth at 20 days in depth 40 cm reach 94,3 % and 50 cm reach 85,7 %; Water hyacinth able to manufacturing water that has 400% mercury higher from level that has permitted as long 12 days in depth 40 cm and 16 days in depth 50 cm; Different of depth 40 cm and 50 cm in consideration method has a distinction. While use statistic method theirs has distinction, but not significant.

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References

[1] Azhar, A. (2011). Teknik Pemulihan Pencemaran Logam Berat Timbal (Pb) dan Tembaga (Cu) dengan Tanaman Enceng Gondok (Eichhornia crassipes Solms) untuk Aktivitas Pertanian [skripsi]. Padang: Teknologi Pertanian Universitas Andalas.

[2] Bambang Kesewo, S. (2001, Desember 14). PP Republik Indonesia No 82 Tahun 2001 tentang Pengolahan Kualitas Air dan Pengendalian Pencemaran Air. Jakarta, Indonesia.

[3] Erakhrumen & Agbontalor, A. 2007. Phytoremediation: An Environmentally Sound Technology for Pollution Prevention, Control and Remediation in Developing Countries, Educational Research and Review , (Online), Vol. 2 (7), (diakses, 23 September 2012).

[4] Feri Asdoma Yunes, S. (2011). Pemulihan Kualitas Air Tercemar Logam Berat Seng (Zn) dan Kadnium (Cd) dengan Enceng Gondok (Eichornia crassipis solms) untuk Irigasi. Padang: Fakultas Teknologi Pertanian Universitas Andalas.

[5] Henry, J.R. 2000. An Overview of the phytoremediation of Lead and mercury.(Online),(http://clu-in.org) USEPA. Washington, D.C. (diakses, 23 September 2012)

[6] Lestarisa, T. (2010). Faktor-Faktor yang Berhubungan dengan Keracunan Merkuri (Hg) pada Penambangan Emas Tanpa Ijin (PETI) Di Kecamatan Kurun Kabupaten Gunung Mas Kalimantan Tengah [tesis]. Semarang: Universitas Diponogoro.

[7] Priyanto Budhi dan Joko Prayitno. Fitoremediasi Sebagai Sebuah Teknologi Pemulihan Pencemaran, Khususnya Logam Berat. www.tripod.com. [12 Maret 2012]

[8] Seprama, N. (2010). Analisa Kualitas Air Daerah Irigasi Batang Hari di Kabupaten Dharmasraya. Padang: Fakultas Teknologi Pertanian Universitas Andalas.