# B−17 THE STUDY OF LEAD (Pb) PHYTOREMEDIATOR CANDIDATE FOR REMEDIATION LAPINDO MUD AT SIDOARJO, EAST JAVA PROVINCE, INDONESIA

Sukoso[1,2*], Marsoedi[2], Yeny RISYANI[2], Tarzan PURNOMO[3] and Takanobu INOUE[4]

[1]Graduate Program of Environmental and Development, Brawijaya University.
(Jl. MT. Haryono, 169. Malang, Jawa Timur, Indonesia)
[2]Fishery and Marine Science Faculty of Brawijaya University
[3]Biology Department. Surabaya State University
(Kampus Ketintang, Surabaya, Indonesia).
[4]Department of Architecture and Civil Engineering, Toyohashi University of Technology
(1-1 Hibarigaoka Tenpaku-cho, Toyohashi, Aichi 441-8580, Japan)
* E-mail: *mrsukoso@yahoo.com*

## 1. INTRODUCTION

Lapindo mud is a hot mud that gushed from the well gas exploration of PT Lapindo Brantas, in Porong, Sidoarjo. This incident is an environmental tragedy which caused economic looses, ecological and enormous social problem. This mud spurt since 2006 and has submerged 11 villages in the area of 3 districts namely Porong, Tanggulangin, Jabon and inundated 11,000 hectares of farmland, and aquaculture area 7,772 hectares in the east coast of Sidoarjo.

Lapindo mud containing heavy metal such as Cu, Pb, Zn, Mn, Fe, Cd, As, Sb, Au, Hg, Tl, and Se[1)]. If these metals are present in nature, these will be potentially enter to the food chain system in aquatic environment[2)]. In aquatic environments, lead will be deposited in the sediment.

Lead can cause disease, because it is toxic to living things. Through the food and water contaminated by lead, lead can enter and distributed to body tissue and a portion of lead will be accumulated in the body. In addition, lead compounds will also precipitates biological phosphate or catalyze the decomposition of bioloycal phosphate[3)]. Therefore, in order minimization of lead in water, the use of phytoremediatiation must be done.

Phytoremediation is a method of restoring polluted environmental conditions using plants that can degrade and absorb the pollutants. By using the phytoremediation, the concentration and toxicity of pollutants can be reduced.

## 2. RESEARCH METHODOLOGY

Experiments carried out for 2 weeks with two factors namely biomass *T. latifolia* and detention time (day) by 3 replications.The first factor is biomass *T. latifolia*, namely: 0 g (control), 300 g, 600 g, and 900 g, and detention time (day) which is 7 days and 14 days. *T latifolia* was taken from the area in the village of Lapindo puddle mud at Pajarakan, Porong, Sidoarjo, which has been maitained for 14 months. Lead level in water, sediment and the root of *T. latifolia* were analyzed at the beginning and the end of experiment (days 0, 7, 14 and 21), using Atomic Absorption Spectrophotometer (AAS).

Data obtained from the research include: lead level in water, sediment and root of *T. lativolia*. Physical-Chemical water parameters (salinity, temperature, pH) were analyzed descriptively and qualitatively compared with the standard quality from Ministry of Agriculture, Fisheries Research and Development, 1987; East Java Governoor Decree No. 45, 2002; and Ministry of Environment Decree No.5, 2004.

## 3. RESULT AND DISCUSSION

### (1) resistant plant in area contaminate by Lapindo mud.

Six species of plants in situ grew well in water at around Lapindo mud, consisting of 2 species of wetland plants (*Typha latifolia* L., and *Cyperus* sp.,) and 4 species of aquatic plants ( *Eichhomia crssipes* (Mart) Solms, *Ipomoea aquatica, Lemna major*, and *Lemna minor*) (Table 1). These plant showed a high level of resistance against the growing environment contaminated Lapindo mud containing heavy metals. Therefore, these plants can be identified as candidate of phytoremediator.

**Table 1** Distribution of resistant plant contaminated by Lapindo mud.

| No | Species | Station | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. | *Typha latifolia* | +++ | +++ | ++ | +++ | ++ | ++ |
| 2. | *Cyperus sp.* | ++ | +++ | ++ | + | - | - |
| 3. | *Eichhornia crassipes* | - | - | - | + | ++ | +++ |
| 4. | *Ipomoea aquatica* | +++ | ++ | ++ | + | +++ | +++ |
| 5. | *Lemna mayor* | + | - | ++ | + | ++ | ++ |
| 6. | *Lemna minor* | ++ | - | - | + | ++ | +++ |

Location: Station: 1 (Desa Mindi), 2 (Desa Pejarakan), 3 (Desa Reno Kenongo), 4 (Desa Kedung Bendo), 5 (Desa Ketapang Keres), dan 6 (Desa Jatirejo Barat & Siring Barat).
- = none, + = small, ++ = medium, +++ = over.

Of the nine plants that can grow in an environment polluted by Lapindo mud, showed that *T. latifolia* is dominant plant growing well in all station, therefore it can be expected to have potetial as phytoremediator. Based on the above data, this research focused on *T. latifolia.*

### (2) phytoremediator effectiveness and efficiency of *T. Latifolia*.

*T. latifolia* is a species wetland plants that are found to survive and live predominantly in several areas around the territorial of Lapindo mud. Result showed that the root, stems, and leaves can accumulate lead content in water and sediment of Lapindo mud.

Analysis of *T. latifolia* organ growing in an area polluted by Lapindo shows the distribution of lead content in plant organs as shown in table 2.

**Table 2** Lead level in plan organ of *T.latifolia*

| No | Plant Organ | Lead Concentration (ppm) | | | Standard Quality *) |
|---|---|---|---|---|---|
| | | Station 1 | Station 2 | Station 3 | |
| 1 | Root | 1,677 | 1,924 | 1,800 | 0,03 |
| 2 | Stem | 1,006 | 1,014 | 1,010 | 0,03 |
| 3 | Leaf | 1,249 | 1,302 | 1,276 | 0,03 |
| 4 | Water and sediment | 0,937 | | | 0,005 |

*) Indonesia government Regulation.No.82/2001

*T. latifolia* roots is a very big part in accumulation of lead, followed by leaf and stem as shown in Table 2. According Suhendrayatna[4], the greatest absorption of heavy metals in aquatic plants found in the roots and have capability as hyperacumulator. Absorption and accumulation of heavy metals by plants are devided into three mutually continuous process, i.e heavy metal absorption by roots, translocation from roots to other plant parts, and localization on the part of certain cells to keep do not inhibit the metabolism of plant [5].

Besides the roots, biomass is critical to the effectiveness of lead absorption. Table 3 showed that 600 gr biomasss can absorb lead higher than 300 g and 900 g. These results indicate that the 600 gr biomass is the best density of *T. latifolia* to grow, so has the optimal space for the roots to absorb lead.

**Table 3** Lead concentration (ppm) in the *T.latifolia* cultivated after 21th days of planting treatment

| Lead Conct.(ppm) | | | | | Bio-Accumulation Capacity | |
|---|---|---|---|---|---|---|
| Sediment (Pra-cultivation) | *T. Lativolia* (Post-cultivation) | | | | | |
| | Bio mass (g) | Bio-Accumulation (Replication) | | | | |
| | | 1 | 2 | 3 | Average | (%) |
| 0.271 | 300 | 1.267 | 1.265 | 1.263 | 1.265 | 583 |
| | 600 | 1.324 | 1.323 | 1.324 | 1.324 | 610 |
| | 900 | 1.294 | 1.298 | 1.296 | 1.296 | 597 |

The ability of *T. latifolia* absorb the lead shown by the improvment in water quality. Physico-chemical factors of Lapindo mud water such as salinity, pH, DO and $CO_2$ have decreased, while

DO increased, although not meet the quality standards yet as shown in Table 4.

**Table 4** Physico-chemical parameters of Lapindo mud water in the *T. latifolia* post cultivation

| No | Parameter | Pra Cultivation | Post Cultivation | | | | Standard quality* |
|---|---|---|---|---|---|---|---|
| | | | 0 | 300 | 600 | 900 | |
| 1 | Sal(°/oo) | 20 | 17 | 3 | 5 | 0,5 | 0,00 |
| 2 | Tem (°C) | 30,33 | 30,1 | 28,2 | 28,4 | 28,1 | |
| 3 | pH | 7,43 | 7,4 | 7,2 | 7,1 | 7,1 | 6-9 |
| 4 | DO (ppm) | 1,31 | 1,28 | 2,54 | 2,87 | 2,97 | 5,00 |
| 5 | $CO_2$ (ppm) | 24,7 | 24,4 | 20,1 | 20,4 | 21,2 | 0,75 |

*)Indonesia Government Regulation No.82, 2001.

Heavy metals can be absorbed in plants when present in the solution around the roots. After entry into root cells, transported through phloem tissue and xylem to the plant body. This event is largely a passive process, although there are some who are involved in cell metabolism. The factors that influenceals heavy met bio-absorbtion by aquatic plants are water, pH, temperature and light intensity.

The entry mechanism of heavy metals started at the root area as a part of plant that actively absorbing nutrients for growth. After the metal were brought into the root cells, then transported through a network of metal transporters and metal bound by phytochelatine. Phytochelatine is a peptide that rich in amino acid cystein containing a sulfur to the general structure $(\gamma\text{-Glu-Cys})_n$ Gly. Lead metal ions are bound by the S-atom of cysteines present in the phytochelatin, then be stored in the network. Several heavy metal ions such as $Pb^{2+}$, $Cd^{2+}$, $Cu^{2+}$ dan $Zn^{2+}$ were able to induce the synthesis phytochelatine in plants, if plants fail to synthesize phytochelatine then stunted growth or death[6] .

Phytochelatine be synthesized from the transfer of γ-Glu-Cys at the catalytic transpeptidase tripeptida glutatinate (phytochelatine sythase). The concentration of heavy metals in the cytosol may control the activity of transpeptidase enzyme. If there is no heavy metal ions, the enzyme will not be active. The enzyme becomes active by heavy metals Pb, Cd, Cu, Hg and other metal ions. In the cytoplasma, there is a reduction of heavy metal ions, thus decreasing the activity of free ezyme[7].

Bio-accumulation of *T. latifolia* in sediment of Lapindo mud on 600 g biomass and 21th days cultivate time reached 610%. While the root of *T.latifolia* found have capability as hyperacumulator compared with leaf and stem. Thus, *T. latifolia* is highly efficient as lead phytoremediator in waters Lapindo mud with 600 gram of biomass.

## REFERENCES


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