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Research Article

The Ability of Aquatic Weed Water Hyacinth and Water Lettuce To Reduce Heavy Metal Manganese (Mn), Zinc (Zn) and Iron (Fe)

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Abstract: Water quality is very important for human life. On the other hand, human activity can make the quality of river water getting worse especially on heavy metal content. The heavy metals which commonly contain in water are Zinc, Manganese and Iron. Then, to reduce the concentration of heavy metal, people can use quatic plants namely water hyacinth and water lettuce. Based on the result, the heavy metal contain already reduce into <0.05 for Fe, <0.03 for Mn and <0.005 for Zn in Day 4 with water hyacinth; moreover the amount of Fe, Mn and Zn already decreased to <0.05 for Fe, <0.03 for Mn and <0.005 for Zn in Day 4. Both of the aquatic plants showed similar performance of Fe, Mn and Zn. It can be proven from the result of T test. Therefore, there is no significant different between water hyacinth and water lettuce on heavy metal concentration in water.

Keywords: water hyacinth, water lettuce, t test, heavy metal

Introduction

Water quality in river is influenced by many factors, such as industry, domestic waste water and environment. Therefore, water quality is related with aquatic environment around the river. Human activities give contribution for water pollution, such as the waste throwing into river that can make the water quality getting worse.

According to the research of Yulianto et al. (2006) at 12 district/city north coast of Central Java, showed in general to water has been polluted almost all types of heavy metals (such as Mn, Fe, Hg, Cd, Cu, Cr, Pb, Ni, Zn, except As).

In the context of Semarang area, there is large river called Kaligarang. Kaligarang River is the largest river in the city of Semarang, the flow along the Ungaran, bridges Kradenan Semarang, Suharto monument, Jl. Panjangan, the estuary of Sampangan Market, the estuary of BK Market and Kimia Farma, before factory in Semarang Makmur, before PDAM Semarang, Semarang Petompon, Pleret Lemah Gempal Semarang.

In terms of heavy metal in river, Manganese is also one of heavy metal in Kaligarang River. Based on the pretest of researcher, Kaligarang river has 0.073 mg/l Manganese contain. This amount is not tolerated because manganese is a mineral that naturally occurs in rocks and soil and is a normal constituent of the human diet.

Kaligarang river also contain Iron (Fe) with 0.063 mg/l; while WHO (2008) stated that at levels above 0.3 mg/L. Moreover, Kaligarang River also contains Zinc (Zn). Water containing zinc levels above 5.0 mg/L tends to be opalescent, develop a greasy film when boiled, and have an undesirable astringent taste. Therefore, the aesthetic objective is set at a maximum of 5.0 mg/L; meanwhile based on pretest result from the researcher the contain of Zinc in Kaligarang river is 0.052 mg/l.

Based on the condition in Kaligarang River, the researcher will use Macrophytes as aquatic plants. The researcher will use two kinds of water Marcophytes, namely: water hyacinth and water letuce. Both of Macrophytes plants have ability in heavy metal absorption.

Literature Review

1 Water Hyacinth

The water hyacinth (*Eichhornia crassipes* (Mart.) Solms) is a prolific free floating aquatic weed found in tropical and subtropical areas of the world and recognized to be very useful in domestic wastewater treatment (Dinges, 1976; Wolverton and McDonald, 1979).

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Phytoremediation used for removing heavymetals and other pollutants is a newly developed environmental protection technique. Extensive studies on freshwater resources decontamination revealed that some freshwater plants, among which is the water hyacinth growing prolific in wastewater, can efficiently accumulate heavy metals (Soltan and Rashed, 2003).

Water hyacinth's capacity to absorb nutrients makes it a potential biological alternative to secondary and tertiary treatment for wastewater. Cossu *et al.*, 2001). Water hyacinth has long been used commercially for cleaning wastewater. The luxuriant plant's tremendous capacity for absorbing nutrients and other pollutants from wastewater has long been overlooked by many wastewater engineers. Water hyacinth is also known for its ability to grow in severe polluted waters (So *et al.*, 2003).

Liao and Chang (2004) found that the absorption capacity for water hyacinth, as 26.17 kg/ha for Zn. Valipour et al. (2010) stated that if heavy metals exceed the saturation limit of 2764 mg/kg for Zn in shoots and roots, respectively, it can lead to morphological deformity. It is the best species as Cd accumulators. Mishra et al. (2008) used hyacinth for coal mining effluent for the removal of heavy metals and observed 70.5 ± 4.4, 69.1 ± 3.9, 76.9 ± 1.4, 66.4 ± 3.45, 65.3 ± 2.4 and 55.4 ± 2.9 percent Fe, Cr, Cu, Cd, Zn and Ni, respectively was removed.

2 Water Lettuce

Water Lettuce (*Pistia Stratiotes L.*)Is a floating perennial commonly called water lettuce belonging to the family Araceae. It floats on the surface of the water, and its roots hanging submerged beneath floating leaves. Dipu et al. (2011) found that alkaline pH was changed into neutral using lettuce. Similar results were also reported by Mahmood et al. (2005). The reduction in pH is due to absorption of nutrients and other salts by plants or by simultaneous release of H+ ions with the uptake of metal ions. Awuah et al. (2004) used lettuce in their study of bench-scale continuous-flow wastewater treatment system with feed of sewage.

3. Water Quality Standard

Water quality parameters that are used for human needs water should not be contaminated or meet the requirements of the physical, chemical, and biological. According to Razif (2001) water should meet physics and chemical requirement as follow:

a. Physics Water Requirements

Water quality must meet the physical requirements as follows:

1. Clear or turbid: Turbid water caused by the presence of granules of clay colloids.
2. Colorless: Water for domestic purposes should be clear.
3. Fresh: In physics, the water can be felt by the tongue. The water tasted sour, sweet, bitter or salty water is not a good show.
4. Odorless: Good water has no characteristic smell when kiss from far and from near.
5. Normal Temperature: The water temperature should be cool or heat, especially in order to avoid dilution of existing chemicals on the channel/pipe, which may endanger the health and inhibit the growth of micro-organisms.

b. Chemical requirements

Substances or minerals that are beneficial and do not contain toxic substances.

1) **pH (degree of acidity**): Important in the process of water purification because of the acidity of the water is generally caused Oxide gas that is soluble in water, especially carbon dioxide. Concerning the influence of the health aspects of the standard deviation of drinking water quality in terms of a smaller pH 6.5 and greater than 9.2 but can cause some toxic chemical compounds that turn out to be very detrimental to health.

2) **Hardness**: There are two kinds of hardness temporary hardness and permanent hardness. Temporary hardness due to the presence of Calcium and Magnesium bicarbonate is removed by heating the water to boiling or adding lime in the water. Permanent hardness caused by sulfate and carbonate, chloride and Magnesium and Calcium Nitrate of Iron and Aluminum as well.

3) **Iron**: Water containing much ionizes yellow and cause metallic taste of iron in the water, and corrodes the material made of metal. Maximum limits contained in water are 1.0mg/l. Iron is a dietary requirement for humans, just as it is for many other organisms. Men require approximately 7 mg iron on a daily basis, whereas women require

11 mg. WHO (2008) stated that at levels above 0.3 mg/L, iron stains laundry and plumbing fixtures and causes an undesirable taste. The precipitation of excessive iron causes a reddish brown color in the water. It may also promote the growth of iron bacteria, leaving a slimy coating in piping. The presence of iron bacteria can also cause a 'rotten egg' odor in the water and sheen on the surface of the water.

4) **Aluminum**: Maximum limits contained in water according to the Minister of Health Regulation No.82/2001 which is 0.2 mg/l. Water containing a lot of aluminum causes a bad taste when consumed.

5) **Organic** Matter: Solution of organic substances that are complex may include nutrient food sand other sources of energy for the flora and fauna that live in waters.

6) **Sulfate**: Excessive content of sulfatein the water can lead to hard water scale on the tool boil water (pot/kettle) in addition to resulting in odor and corrosion of pipes.

7) **Nitrate and Nitrite**: Water pollution from nitrates and nitrites come from the soil and plants.

8) **Chloride**: In appropriate concentrations, is not harmful to humans. Chloride in small amounts needed for disinfecting but if excessive and interact with the Na+ions may cause a salty taste and corrosion in water pipes.

9) **Zink**: Zink maximum limit contained in water is 15 mg/l. Standard deviations of the bitter taste of this quality, sepet, and nausea. In small amounts, Zinc is an essential element for metabolism, because Zinc deficiency can cause a drag on the growth of children. According to WHO (2008), water containing zinc levels above 5.0 mg/L tends to be opalescent, develop a greasy film when boiled, and have an undesirable astringent taste. Therefore, the aesthetic objective is set at a maximum of 5.0 mg/L.

10) **n**: Manganese is one of the most abundant metals in Earth's crust, usually occurring with iron. An epidemiological study in Japan described adverse effects in humans consuming manganese dissolved in drinking-water, probably at a concentration close to 28 mg/l (Kawamura et al., 1941).

Research Method

In the context of this research, it was started from problem about heavy metal in river. Now days, there are many rives that has been polluted by heavy metal, then the heavy metal concentration in water was very dangerous for human. Therefore, people need to find the way to reduce the heavy metal concentration in water. Based on the problem of research, the researcher found problem formulation.

After that, the researcher would collect data from control group, experiment group as primary data, and then the researcher also collected data from previous research to compare this research with previous research. After the researcher conducted the experimental research, the researcher compared the mean by t test to compare the ability of heavy metal absorption for water hyacinth and water lettuce. Then the researcher compared this research with previous research and analyzed it.

The researcher used two kinds of aquatic plants, namely water hyacinth and water lettuce. Water hyacinth and water lettuce for this research were collected from Ambarawa because those plants are very common in that area. The number of initial water hyacinth and water lettuce used in each treatment were 1.8 kg dry weight leak. Water hyacinth and water lettuce were used had a number of leaves between 6-10 specification sheets, the number of stems between 9-15 stems, leaves 10-15 cm long, 8-10 cm wide leaves and plant height of 40-50 cm.

Then the researcher used water from PDAM water to replace Kaligarang River as a water for treatment. The researcher chose water from PDAM and added heavy metal into the water because the researcher wanted to make the same characteristic for the sample of research. In terms of experimental research, the sample should have the same characteristic to identify the result of research after treatment. Therefore, in this research, the researcher used waters from PDAM and added heavy metal with the same concentration to all of the ponds both experimental ponds and control pond. Then, the researcher would know the comparison between experimental ponds and control pond after treatment with water hyacinth and water lettuce.

Moreover, the size and shape of ponds that were used to conduct this research are consisting of 47 cm for diameter, 42 cm height and 38 cm width.

In terms of the use experiment data, the researcher used tap water and adds heavy metal in it. According to (Scheneider & Mahamadi, 2011) the maximum ability of heavy metal absorb for water hyacinth and water lettuce are 20 mg/l, therefore the researcher added 5 mg/l of Zinc (Zn) in water. The researcher used 5 mg/l of Zinc (Zn) because this amount was higher than the concentration of Zn in Kaligarang River, namely only 0.052 mg/l. If the researcher only used 5 mg/l, it means that the result could be used as estimation for the real application for Kaligarang River.

Moreover, according to Kawamura et al., (2000) the concentration close to 28 mg/l of Manganese (Mn) is very dangerous for health especially muscle tone, tremor and mental disturbances. In the context of this research, the researcher used 10 mg/l. This amount was higher than the real condition in Kaligarang River, namely 0.073 mg/l. Therefore, the result of this research could be used as recommendation for problem solving about heavy metal content in Kaligarang River.

Then, according to (WHO, 2008) the Iron (Fe) maximum limits in water is only 1.0 mg/l, therefore the researcher will use 5 mg/l to test the water hyacinth and water lettuce absorption. This amount of Fe for research was also higher than the real condition in Kaligarang River, namely 0.063 mg/l. It means that the experiment with higher amount of Fe could be used as anticipation for the higher number of Fe in the future condition.

Then, the researcher added heavy metal to experiment ponds with the following compositions:

Table 3.1 Preparation of Heavy Metal in Water

No	Material	Unit	Fe	Mn	Zn
1	Water Hyacinth Pond 1 (WH 1)	Mg/l	15,00	10,00	5,00
2	Water Hyacinth Pond 2 (WH 2)	Mg/l	15,00	10,00	5,00
3	Water Hyacinth Pond 3 (WH 3)	Mg/l	15,00	10,00	5,00
4	Water Lettuce 1 (WL 1)	Mg/l	15,00	10,00	5,00
5	Water Lettuce 2 (WL 2)	Mg/l	15,00	10,00	5,00
6	Water Lettuce 3 (WL 3)	Mg/l	15,00	10,00	5,00
7	Control Pond (CP)	Mg/l	15,00	10,00	5,00

Source: Data Collection 2014

The researcher used artificial pond to make experiment. The ponds consist of 7 (seven) place, namely 3 (three) ponds for water hyacinth (WH1, WH2, and WH3), 3 (three) ponds for water lettuce (WL1, WL2 and WL3) and 1 (one) pond for control pond (CP) without water hyacinth and water lettuce.

4. Result and Discussion

4.1 pH and Temperature

In the context of pH and Temperature of research, the researcher always measured pH and Temperature to make observation about the condition of pH and Temperature during research. Based on the result of pH level, the researcher also observed the average of pH level of Water Hyacinth Ponds compared to control pond pH. In the first day, the pH level of Water Hyacinth Ponds was 6.87 while control pond was 6.90. In the second day, the average pH level on Water Hyacinth ponds was still same, namely 6.87, while in Control pond was increase into 7.18. Then, in the third day the pH average on Water Hyacinth was decrease to 6.77, while control pond increased again into 7.20.

In the forth day and the fifth, the condition were still same, Water Hyacinth faced decreasing of pH while control pond faced increasing of pH. Moreover, in sixth and seventh day of research, the Water Hyacinth showed increasing of average of pH into 6.69 and 6.73 while Control Pond showed increasing into 7.80 and 8.Water Hyacinth is presented in Figure 4.1

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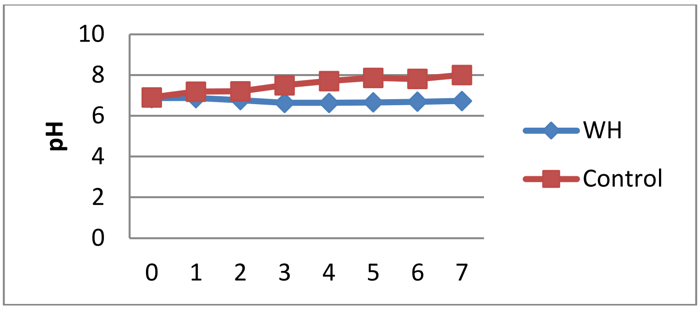

Figure 4.1 pH for Water Hyacinth

Moreover, this research also observed the temperature of Water Hyacinth and Control Pond. The description of Temperature is presented in Figure 4.2.

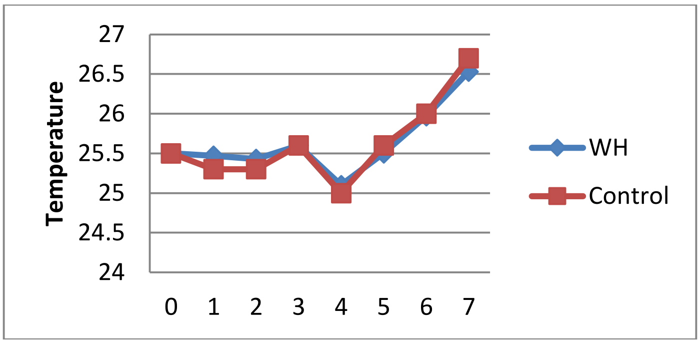

Figure 4.2 Temperatures for Water Haycinth

In terms of temperature for water hyacinth, the changed between days were not increased or decreased dramatically. It is because of the weather in the area of research was stable. Based on Figure 4.1 and Figure 4.2, it can be seen that pH of water lettuce showed similar result as water hyacinth. The value of pH were decreased then increased again from the fifth day of experiment. In terms of temperature, the value were varied during experiment but did not show significant different between days. When it compared to control group, the pH of control group was higher than experiment group. This condition due to the existence of heavy metal in experiment group so it influenced the pH value in experiment group.

The figure of pH and temperature of water lettuce will be described as follow:

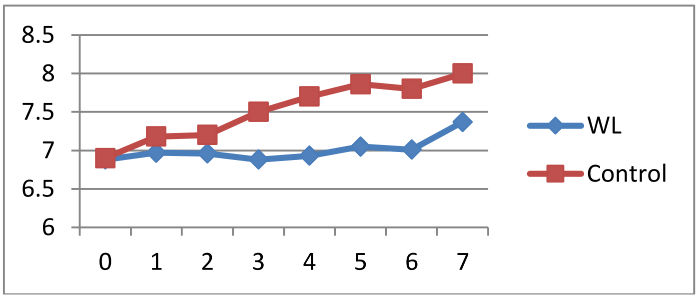

Figure 4.3 pH of Water Lettuce

Figure 4.3 showed that Water Lettuce has the average of pH around 7, and then in the last of research day, the average was increase dramatically into 7.4. The average of pH level for Water Lettuce was lower than control pond pH level. In terms of Control Pond pH level, the score of pH was increased for every day until the last of day of research

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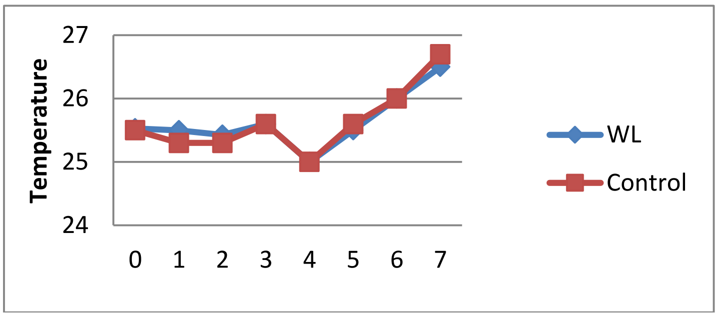

Figure 4.4 Temperature of Water Lettuce

In terms of temperature, the different between days did not changed significantly and almost same direction between for Water Lettuce. Then, the result of temperature also similar with Control Pond. Based on the pattern of pH for water hyacinth and water lettuce, the value of pH were decreased and increased between days although did not changed significantly. The pH is an index of concentration of hydrogen ions (H +) that characterizes the balance of acids and bases. High or low pH is affected by fluctuations in $O2$ and $CO2$ content. The degree of acidity (pH) is very important as water quality parameters as pH control the type and speed the rate of reaction of some materials in the water. In addition, aquatic organisms can survive in a certain pH range. A PH fluctuation is determined by the alkalinity of the water.

PH levels contained in water sources can vary in accordance with their respective places. Source of river water has pH levels average around 7.0 to 7.5. A PH level in river water solution is base. This can be caused by flowing water will produce oxygen through small ripples coming from the rock. Water circulation continues to help dissolving the acidity with the binding of hydrogen ions so that the acidity of the water is reduced. Human activities related to waste disposal detergent can make alkaline content increases. The role of the community is expected to support balance pH levels in the water.

4.2 Heavy Metal Concentration

In the context of heavy metal concentration, the researcher conducted observation for everyday for heavy metal concentration. The result of research is as follow:

1) Iron (Fe)

The concentration of Fe will be described in the following:

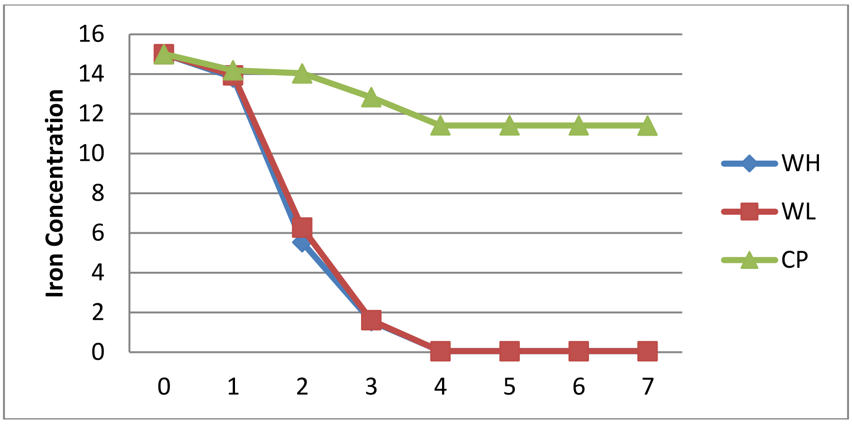

Figure 4.5 Iron (Fe) Concentration in Water

Based on the Figure 4.5, it can be seen that the concentration of Fe were decreased drastically more than 50% in second day both for water hyacinth and water lettuce. Then, in the third day, the concentration of Fe also decreased again. Moreover, the Fe in water were absorbed again until <0,05 in the forth day both for water hyacinth and water lettuce. It can be seen that the water hyacinth and water lettuce can showed good performance for heavy metal absorption. Water hyacinth and water lettuce work effectively since the plants were put to the water. When it compared to control group, the performance of water hyacinth and water lettuce showed good performance because the value of Iron (Fe) in control group still high. This research was inline with the result of Erakhrumen and Agbontalor (2007) that Fe contain was decreased into 3.177 ppm (65.45%) Speed of absorption of contaminants from the waste water by the water hyacinth is influenced by several factors, including the composition and concentration of substances contained in waste water, the density of water hyacinth, and time remain in the waste water hyacinth. Water Hyacinth can absorb quickly if the water has concentration of dissolved O2 levels between 3.5 to 4.8 ppm.

1) Manganese (Mn)

In terms of Manganese (Mn) contain in water, the result of manganese concentration during experiment are as follow.

Based on the result of research in Figure 4.6, it can be seen that water hyacinth and water lettuce had good performance on heavy metal absorption. In the first day of experiment, the contain of manganese has already decreased around 10%, then in the second day of research the manganese already decreased again around 70%, moreover in the third day the concentration of manganese decreased again around 10%.

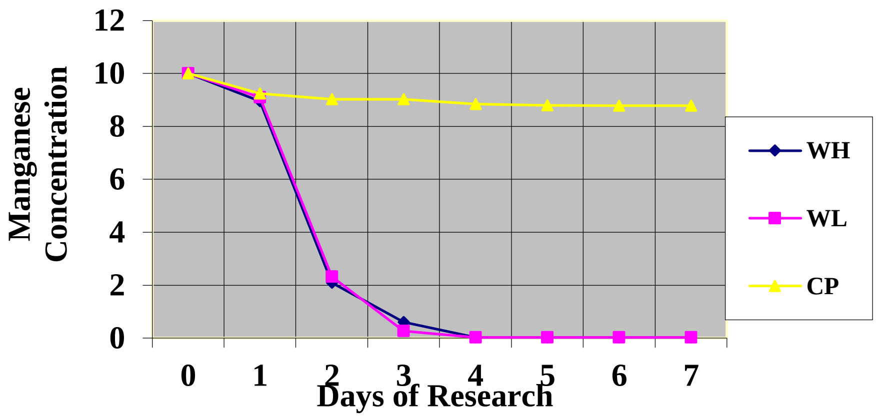

Figure 4.6 Manganese (Mn) Concentrations in Water

Based on figure 4.6, it can be seen that water hyacinth and water lettuce has good performance on absorption compared to control group. The concentration of control group remain stable because there was no treatment for manganese absorption; while the value of manganese in experiment group Water Hyacinth and Water Lettuce showed decreased.

This research was inline with the research result of Parashar et al (2003) that bioaccumulated value of Mn in the macrophyte in the range 224.33 to 956.5 mg kg-1 (Parashar et. al. 2003). The higher concentration of metal in the macrophyte signifies the bio-magnification that lead to filtration of metallic ions from water (Parashar et. al. 2003). The results of study indicate that the heavy metals are extracted from the polluted water by the weed substantially.

1) Zinc (Zn)

In terms of Zinc (Zn) contain in water, the result of research will be described as follow:

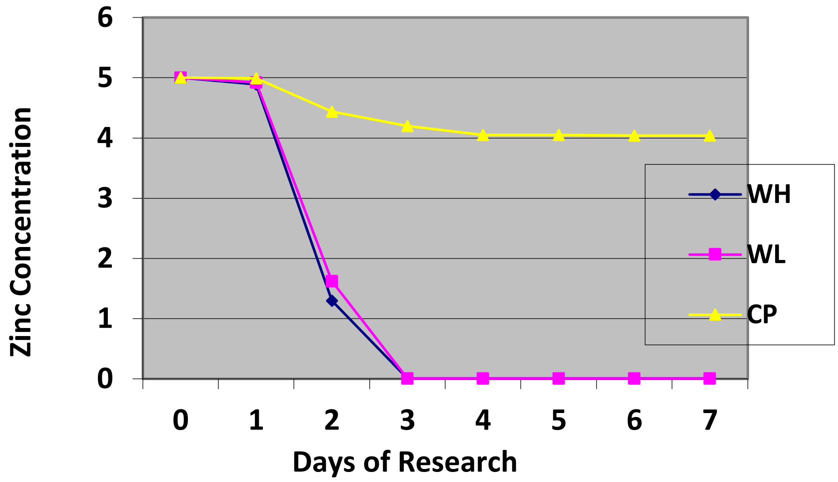

Figure 4.7 Zinc (Zn) Concentration in Water

Based on Figure 4.7 it can be seen that the performance of water hyacinth and water lettuce were good because it can showed the significant differnet with the control group in terms of Zinc (Zn) absorption. The ability on absorption between water hyacinth and water lettuce showed the similar. Both of the plants could absorp Zinc (Zn) in the first day of research, although the absorption of Zinc still showed little absorption. Then, both plants absorbed Zinc (Zn) again until 90% in the second day of experiment. It means that water hyacinth and water lettuce showed their performance faster on Zinc absorption.

This research was in line with Lu et al (2004) that the concentrations of dissolved Zn in the solutions at 5, 10, 20 and 40 mg/L were 0.82, 2.42, 5.06 and 6.29 mg/L, respectively on day 12.

Water hyacinth effectively removes appreciable quantity of heavy metals (Mn, and Zn) from freshwater especially at low concentrations. Soltan and Rashed (2003) reported that remaining Zn concentration in water was inversely related with time and depended on the initial Zn concentration. In the present study, Zn was efficiently depleted from the solution with the greatest decrease observed during the first four days. The sharp decrease in Zn concentration remaining in the residual solutions is indicative of the fast attainment of a saturation state. As soon as the saturation state was reached, it seemed a little difficult for plants to further absorb Zn. Still the concentration decreased with the passage of time.

In the context of this research, the researcher used T test to analyze the different between pre test and post test. Before that calculation, the homogenity of the sample did not need test to make sure whether the sample was homogen or not because the researcher already manipulated the content of heavy metal in the same amount:

a. Fe = 15 mg/l both for experiment group and control group;

b. Mn = 10 mg/l both for experiment group and control group;
c. Zn = 5 mg/l both for experiment group and control group.

4.3 T Test

This research used T-Test as a way to make comparison between pre test and post test. The comparison of the mean of T test was usefull in making a decision about the treament that had been given by the researcher. The researcher did the T test for the pre test and post test's result of those two groups.

1. T Test of Fe Day 2

Based on the T test calculation on the previous page, it could be seen that the T obtained was 1.887. Moreover, the T critical for this test was 2.015. The T criticial was from df(n-1) →df (6-1) → df (5) →2.015 with 5% significance. We could infer that there was no significant different between water hyacinth and water lettuce in terms of Fe absorption in Day 2 of research. Then, it could be concluded that T obtained fall in Ho area.

2. T Test of Mn Day 1

Based on the result of the T test calculation, the T obtained was 1.43. Moreover, the T critical for this test was 2.015 which came from df(n-1) → df (6-1)→df (5)→2.015 with 5% significance. It could be seen that there was no significant different between the result water hyacinth and water lettuce for absorbing Mn in water because the T obtained fell in Ho area.

3. T Test of Mn day 2

Based on the T test result above, the value of T obtained was 1.86 Moreover, the T critical for this test was 2.015 which came from df(n-1) → df (6-1)→ df (5)→ 2.015 with 5% significance. It could be seen that there was no significant different between the result of water hyacinth and water lettuce for Mn abortion due to the T obtained fell in the Ho area.

4. T Test of Zn Day 1

Based on the result of the T test calculation, the T obtained was 1.5 Moreover, the T critical for this test was 2.015. The T critical came from df(n-1) → df(6-1) → df(5) → 2,015 with 5% significance. It could be seen that T obtained fell in Ho area. Based on the result, it could be concluded that there was no significant different between water hyacinth and water lettuce in terms of absorbing Zn in water.

5. T Test of Zn Day 2

Based on the T test calculation on the previous page, it could be seen that the T obtained was 1.4. Moreover, the T critical for this test was 2.015. The T critical was from df(n-1) →df (6-1) → df (5) →2.015 with 5% significance. We could infer that there was no significant different between water hyacinth and water lettuce in terms of Zn absorption in Day 2 of research. Then, it could be concluded that T obtained fall in Ho area.

Based on T Test result of Fe, Mn and Zn in Day 1 and Day 2, it could be concluded that the result of T Test Fell in Ho area, it menas that there were no different between water hyacinth and water lettuce in Fe, Mn and Zn absorption in water. This condition happened because water hyacinth and water lettuce showed the similar or almost same performance on absorbing Fe, Mn and Zn. Then, the researcher could not calculate the T test for Day 3 until Day 7 because the results of absorbtion were same between water hyacinth and water lettuce. It could be seen on Figure 4.6, 4.7 and 4.8 that the line for water hyacinth and water lettuce showed similar performance.

Based on the research result, it could be seen that water hyacinth and water lettuce worked good absorption on heavy metal. The researcher will described the progress of heavy metal absorption as follow:

- **pH level**

In terms of pH level, the pH level were stable and normal during the experiment, namely between 6.6 and 7.7; while the standard of normal pH level are 6.5 and 8.5. The normal condition of pH level although the researcher added heavy metal into ponds due to the existance of water hyacinth and water lettuce.

As mentioned by Dipu et al (2009), water hyacinth can convert alkaline pH into neutral. The reduction in pH is due to absorption of nutrients or by simultaneous release of H+ ions with the uptake of metal ions. This statement was proven until the seven days observation, the number of pH level for water hyacinth ponds (WH 1, WH 2 and WH 3) showed 6.66, 6.70 and 6.83; while in the control pond, the number of pH was higher namely 8.

Moreover, in terms of water lettuce, Dipu et al. (2011) found that alkaline pH was changed into neutral using lettuce. Similar results were also reported by Mahmood et al. (2005). The reduction in pH is due to absorption of nutrients and other salts by plants or by simultaneous release of H+ ions with the uptake of metal ions. Those statement were supported the same result with this research, namely the lower number of pH level of water lettuce ponds than control pond.

- **Heavy Metal**

In terms of this research, the heavy metal namely Fe, Mn and Zn were decreased in line with the time used for absorption. The absorption of heavy metal was very effective, in the first day, the absorption were still low, but on the second days, the absorption showed good work.

In the context of this research, the result about heavy metal concentration due to Water Hyacinth and Water Lettuce absorption can be implemented in the real life, especially relates with the water pollution. As mentioned in the previous pages, Semarang has a very big river named Kali Garang. The water quality in Kaligarang is very bad because of heavy metal existence. Moreover, the concentration of heavy metal also depends on the place of area where the sample of water was taken. The highest concentrations of heavy metal are spreaded in the location near factories.

In the context of Kaligarang River, government should organize waste management through regulation. Then, it also needs the commitment of government, officers, and community to keep the environment well. Relates with the function of water hyacinth and water lettuce, the government can put the plants in the location of river which has high concentration of heavy metal. Then, to manage the amoung of Water Hyacinth in water and to avoid the blockage in the river, the government can make collaboration with community in using water hyacinth for handy craft material. This effort can be used to increase community income.

Based on the research result, it can be concluded as follow:

1. Water hyacinth gave good influence on heavy metal in water. It could be seen that the Fe, Mn and Zn decreased dramatically on Day 2 of absorption. Then, the heavy metal contain already <0.05 for Fe, <0.03 for Mn and <0.005 for Zn in Day 4.
2. Water lettuce gave good influence on heavy metal absorbtion. The amount of Fe, Mn and Zn already decreased to <0.05 for Fe, <0.03 for Mn and <0.005 for Zn in Day 4.
3. Water hyacinth and water lettuce showed similar performance on Fe, Mn and Zn absorbtion in water. It could be seen from T test, that T obtained for all of the test fell in Ho area, it means that there was no significant different between water hyacinth and water lettuce on Fe, Mn and Zn absorbtion.
4. Water hyacinth gave faster result on Fe, Mn and Zn absorbtion in water than water lettuce. It could be seen from the first day of experiment, that water hyacinth result of absorbtion were higher than water lettuce.

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