International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 8 Issue 11 ǁ 2020 ǁ PP. 14-18

Adsorptive study of lead (II) by Azolla Microfilla

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Abstract
The paper deals with the biosorption of lead by Azolla Microfilla. 1 ppm lead (II) solution prepared by dissolving lead nitrate has been treated with 10 gm Azolla Microfilla up to different intervals of time. Phyto remediation of lead (II) through roots and different parts of Azolla Microfilla decreases the concentration of lead (II) up to 0.004 ppm. Thus an equilibrium concentration of 0.004 ppm is attained in 72 hours at pH 7 and 26^0C. Removal of lead (II) from aqueous medium by aquatic weeds has emerged as an eco friendly and low cost method.

Date of Submission: 31-10-2020 Date of acceptance: 11-11-2020

I. INTRODUCTION

Heavy metal contamination in ground water has attracted the researchers around the globe because it has adversely affected the health of leaving beings.[1-3] presence of lead in drinking water more than the permissible limit causes anaemia, hepatitis and damage to the kidney. There are a number of toxic heavy metals out of which chromium, mercury, cadmium and lead are prominent.[4] the presence of lead in drinking water may be attributed to the effluents from processing industries e.g. paint, dyes, lead batteries and use of red lead. Due to non biodegradability and bio accumulation, use of lead has become very injurious to living beings as well as plant kingdom[5]. The ground water resource of the Gangetic plain has become contaminated with heavy metal in general and Khagaria and Bhagalpur in particular. Presence of Arsenic in ground water is very common in the Gangetic plain of Bhagalpur district but presence of Cr (VI) and Pb (II) at some places has aggravated the pollution problem of underground water.[6]

Several methods of removal e.g. chemical precipitation, ion exchange, reverse osmosis and use of agricultural solid wastes are the techniques employed for detoxification[7.] Bentonite minerals of Rajmahal hills and Hazaribagh district has also been established as a potential remover of Cr (VI), as and heavy metals through adsorption and ion exchange both[9-13].

Several aromatic medicinal plants e.g. Colchium luteum, cympobogon flexuous have been found to remove Cr (VI), As and Pb (II) from aqueous medium through adsorption [14]. Dried powdered biomass containing unsaturated carboxylic acid, cellulose and amines on surface has been mainly responsible for binding of heavy metals[15].

Despite these opinions researches on removal of Pb (II) by low cost and eco friendly techniques are going on and so removal by the use of aquatic weeds has also emerged as an alternative method. Some of the aquatic plants and herbs worth mentioning are Hydrilla, Potamogeton, Vellisneria, Certophyllum, Utricularia, Spirallis, Lemna, Spirodella, Eicchornea erassipes, Nymphea and Azolla[16] Eicchornea crassipes and Azolla are the common aquatic weed of this area and some farmers grow azolla for nutrient supply to soil. Azolla, an amphibious weed, is a rich source of nitrogen and also cultivated in some region for economic upliftment of the farmers. Studies have proved that aquatic plants remove heavy metals through their root, and leaves as a result of which these plants may serve as an effective phyto remediator. Adsorption is the main mechanism through which removal takes place at certain pH and temperature[17]. Freundlich and Langmuir adsorption isotherms are generally employed to explain the nature of adsorption.

II. EXPERIMENTAL

Azolla Microfilla has been collected from B.A.U Sabour, Bhagalpur. The root of these plants is washed several times with distilled water and again by double distilled water. The plants have now been weighed and put in 100 ml 1 ppm lead (II) solution prepared from lead nitrate solution. A stock solution of 100 ppm is prepared by dissolving 0.05 gram in 100 ml distilled water. Now 5 ml of this solution is mixed with 5 ml water to get 5 ppm lead (II) solution which on further dilution gives 2.5 ppm, 1.25 ppm, 0.625 ppm and 0.3125 ppm lead (II) solution. This can be summarized as

1. 0.05 gm in 100 ml distilled water-100 ppm

2. 5 ml solution a + 5 ml H_2O - 5 ppm
3. 5 ml solution b + 5 ml H_2O - 2.5 ppm
4. 5 ml solution c + 5 ml H_2O - 1.25 ppm
5. 5 ml solution d + 5 ml H_2O - 0.625 ppm
6. 5 ml solution e + 5 ml H_2O - 0.3125 ppm

Dithiazone solution, a chromogenic reagent is prepared by dissolving 0.003 gm in 100 ml isopropanol and SDS micelle by dissolving 10 gm in 50 ml water. 1 ml concentrated HCl is dissolved in 10 ml H_2O. now for UV –Visible measurement each solution contains 5 ml lead(II), 2 ml dithiazone, 32 ml SDS and 2 drop HCl.

250 ml conical flasks are taken which contain 100 ml 1 ppm lead (II) solution. Roots of 10 gm weighed Azolla Microfilla are dipped separately in the conical flasks and left for 12 hours,24 hours,36 hours,48 hours,60 hours and 72 hours. After different time intervals mentioned above the residual concentration of lead (II) is known from U.V double beam spectrophotometer by the method discussed above.

III. RESULT AND DISCUSSION

Azolla Microfilla grows in the pond in a natural way and cultivated by farmers for nutrient supply. It has been revealed during experiment that the concentration of lead (II) decreases from 1 ppm to 0.118 ppm in first 12 hours. The residual concentrations of lead (II) after 24 hours, 36 hours, 48 hours, 60 hours and 72 hours are 0.086 ppm, 0.064 ppm, 0.443 ppm, 0.025 ppm and 0.004 ppm. An equilibrium concentration of 0.004 ppm is achieved after treatment of 10 gm Azolla Microfilla with 100 ml 1 ppm lead(II) solution up to 72 hours at pH 7 and 26^0C (Table 1). The maximum percentage removal is 99.6 Calculated from the formula percentage removal equal to $[(Ci-C_t) X100]/C_i$

C_i stands for initial concentration and C_e for equilibrium concentration

Table 1: Residual concentration of lead (II) ion with Azolla Microfilla

Initial Concentration in ppm	Weight of Azolla Microfilla	Time	Residual Concentration in ppm	% Removal	qt	log qt	log ct	ct/qt
100 ml 1 ppm Pb(II) solution	10 gram	12 hours	0.118 ppm	88.2	8.82	0.9454	-0.9281	0.0133
100 ml 1 ppm Pb(II) solution	10 gram	24 hours	0.086 ppm	91.4	9.14	0.9609	-1.065	0.0009
100 ml 1 ppm Pb(II) solution	10 gram	36 hours	0.064 ppm	93.6	9.36	0.9712	-1.1938	0.0068
100 ml 1 ppm Pb(II) solution	10 gram	48 hours	0.0443 ppm	95.57	9.557	0.9803	-1.3536	0.0046
100 ml 1 ppm Pb(II) solution	10 gram	60 hours	0.025 ppm	97.5	9.75	0.9890	-1.6020	0.0026
100 ml 1 ppm Pb(II) solution	10 gram	72 hours	0.004 ppm	99.6	9.96	0.9983	-2.3979	0.0004
100 ml 1 ppm Pb(II) solution	10 gram	84 hours	0.004 ppm	99.6	9.96	0.9983	-2.3979	0.0004

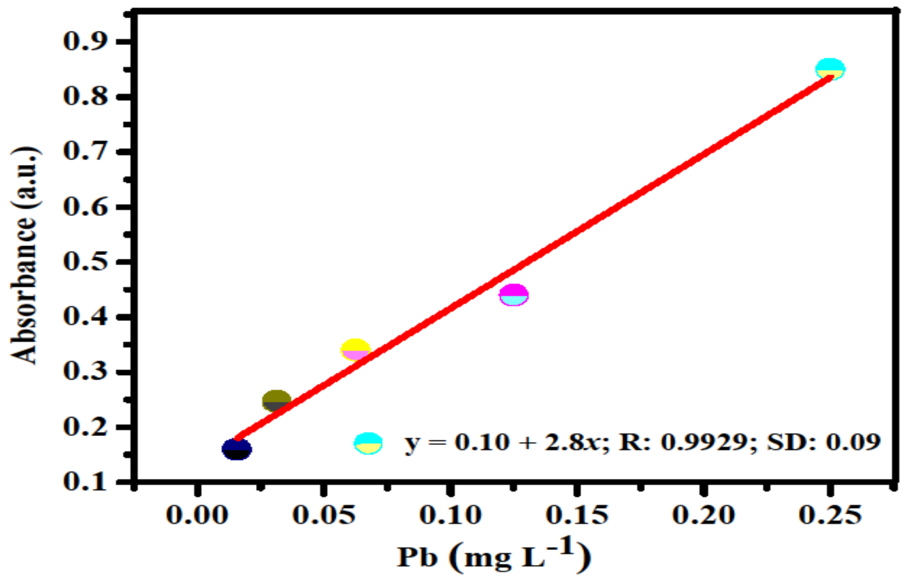

Figure 1: Absorbance of standard Pb (II) solution

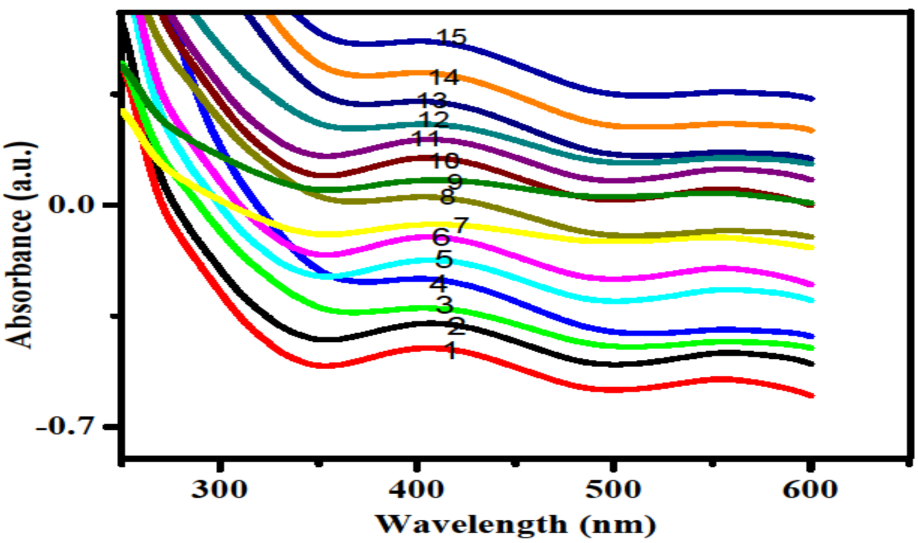

Figure 2: Absorbance of residual Pb (II) solution

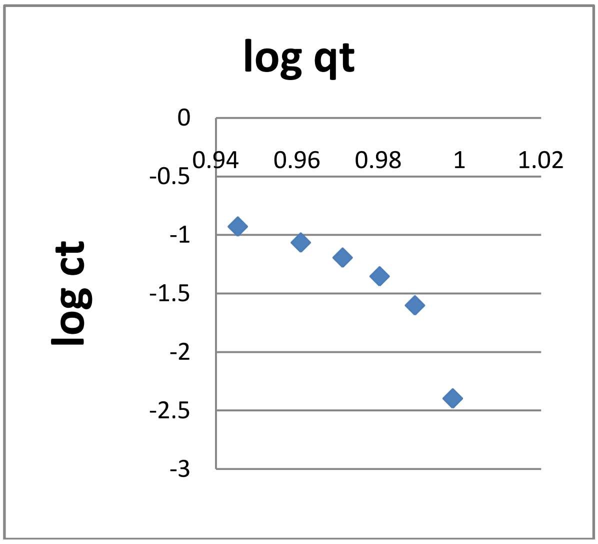

Figure 3: Plot of Log C_t VS Log q_t

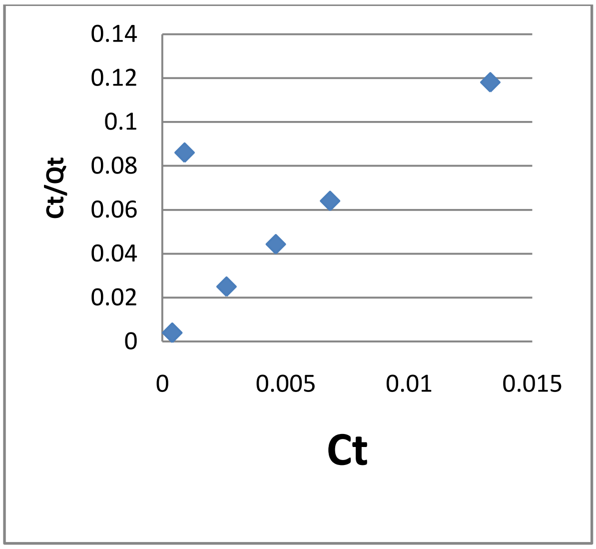

Figure 4: Plot of C_t/Q_t VS Ct

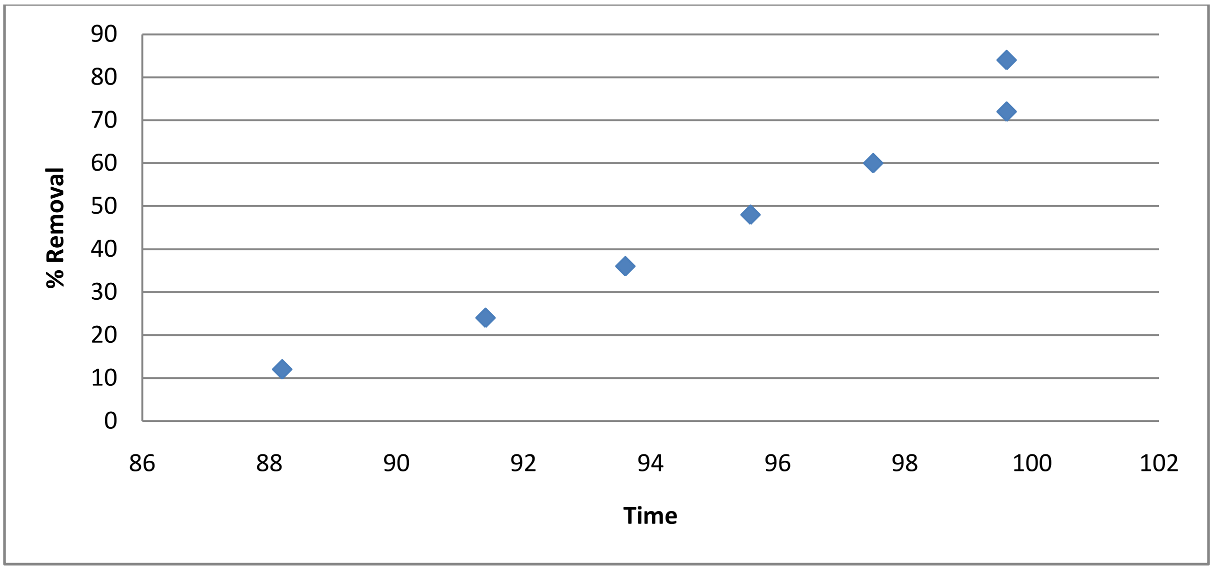

Figure 5: Plot of % Removal Vs Time

A graph of log q_t versus log C_t represents Freundlich isotherm whereas C_t/q_t versus C_t shows Langmuir isotherm. Freundlich isotherm shows multilayer adsorption and Langmuir isotherm shows monolayer adsorption. These graphs have been plotted to see a fit for the experimental data in Freundlich and Langmuir adsorption isotherm. q_t is calculated as $q_t = [C_i\text{-}C_t]XV/m$ where m is the mass of adsorption in gm and V is the volume of solution in liters. Earlier studies from Bentonites have also proved a success for removal by Azolla Microfilla certainly appears to be an alternate opinion.[18-20]

IV. CONCLUSION

Aquatic weeds are useful for detoxification of heavy metals in general and Azolla Microfilla is a potential remover of lead (II) from aqueous medium at pH 7 and 26^0C. Thus phyto remediation by plants appears to be suitable eco friendly and low cost method of removal of lead.

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