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Effective Method for the Removal of Lead through Electro-Coagulation Process in Waste Water

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ABSTRACT:
The abundance of lead in the earth's crust invariably increased the industrial growth and its availability, the usage of lead for the production of various user end products which inturn increased the water pollution. The removal of lead at the effluent level is important as it causes genetic disorders to the offspring, neurological and orthopedic disorders. Even corroded lead pipes can make a way through the drinking water. Marine life too gets affected when subjected to untreated water containing lead. Electrocoagulation aggregates the charged lead particles in the water and thus settled lead can be separated. Effective electrocoagulation in industries as tertiary treatment and Domestic water filters installed with heavy metal removal equipment would surely make big difference for potable water provision. On electro coagulating a sample of water for a period of time reduced the concentration of lead by 97.7% in synthetic made lead solution

***KEYWORDS**: Lead, Lead Effects, Electrocoagulation, Galena, Aluminum, Stainless steel*

INTRODUCTION:

Lead is a heavy metal and compounds of it have +2 oxidation state. Self-bonding of lead also exists which can form ring, polyhedral and chain structures[1]. It is obtained in the form of ore of Galena. It is available in abundance in earth's crust[2].

Due to its abundance in the earth, novel technologies have evolved for the best possible separation of lead from its ore. Mass production of lead led to the production various user end products like Paints, pipes, toys, car batteries, Ammunition, lead glazed ceramics etc.,[3][4] These are the direct and indirect ways of lead transmission into human body. The direct ways are pipes, toys, lead glazed ceramics etc., The indirect ways are industrial production process which discharges untreated heavy material water without treating it.

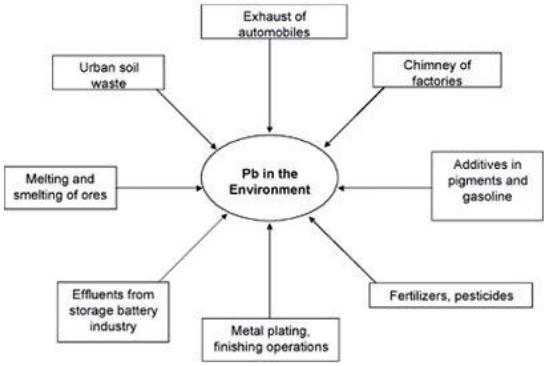

Figure 1: Sources of Lead in the environment [9]

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On consumption of lead filled water in a long run can cease the mental development in infants[5], Renal failure in adults, miscarriage while pregnancy, orthopedic issues and nervous system issues[6][7].

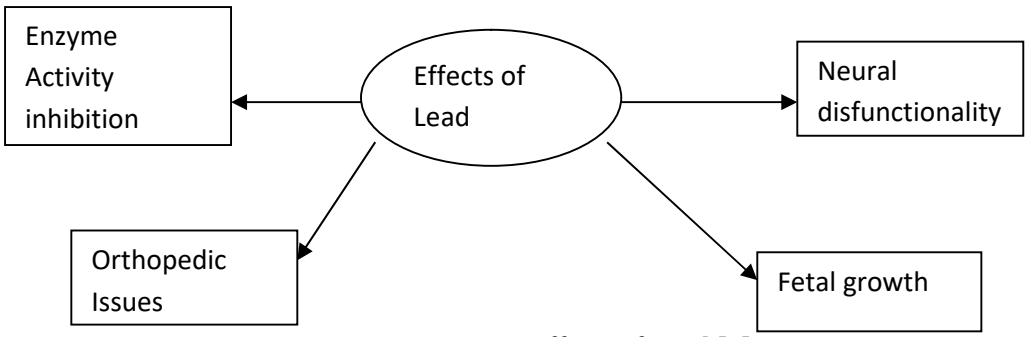

Figure 2: Effects of Lead [9]

Lead being the heavy metal poses issues when used for domestic activities and might harm flora and fauna. Lead gets absorbed through the leaves and stem roots when they are being cultivated near the exploration sites[8]. This gets unknowingly transmitted into humans and animals and humans by consumption

There are many ways by which the lead can be removed from the waste water. It can be removed by Banana[10], Pomegranate peels[11], Mango peel[12] etc biologically but that is ineffective when compared to decades of development on chemical precipitation[13].

In the present article our work has been presented over electro coagulation and this process is quite simple and effective even for the lead generated from the battery industry[14]. Despite the dissolution of electrode materials into the waste water, it will reach the stands of WHO(<0.05-0.2mg/L) in water. A study on combinations Iron and aluminum electrodes is performed to reduce the concentration of lead

MATERIALS AND METHODS:

1. EXPERIMENTAL APPARATUS AND PROCEDURE:

The setup consisted of beaker made up of borosilicate glass, and a magnetic stirrer was provided for uniform concentration of lead in stock solution (150 rpm). Aluminium plate with dimensions of 8cm×0.01cm×10cm were used as electrodes. In order avoid short-circuit, spacer were provided between anode and cathode plates. The gap between anode and cathode was maintained at 3cm to avoid resistance. A single output Adjustable DC power supply was used as the power supplier. The schematic representation as shown in figure8.

Figure 3: Experimental representation of Electro-Coagulation

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Before the experiment was started the passive layer of aluminium electrodes was removed, then it is kept in a 0.1M of HNO_3 for 10 min and it is rinsed with deionised water and acetone.

The beaker containing lead solution is stirred under magnetic stirrer until uniform concentration is reached. The electrodes connected to DCvariable power supply were immersed in the beaker containing lead solution. For every 15 subsequent minutes, lead solution of 10ml is taken and lead concentration is analyzed.

2. ANALYSIS TECHNIQUES:

The water sample formerly subjected to electro-coagulation method is treated analyzed by titrimetric method

Pipetting 10ml sample of each concentration of lead solution in a clean separate 250ml conical flask. Adding 10ml of buffer solution for each separate conical flask containing different concentration of lead solution. These results in precipitation, for removing precipitation two spatula of tartaric acid are added. Then it becomes violet after adding pinch of EBT-indicator then each conical flask is titrated against 0.1M EDTA solution until violet color changes to clear blue as represented in figure

Figure 4: Titrimetric Analysis technique

RESULTS AND DISCUSSIONS:

To reduce the effect of resistance, electrode are spaced at 0.03m using solutions containing . A sample of 1ppm, 5ppm, 10ppm, 20pmm, 30ppm, 50ppm, 75ppm and 100ppm is prepared by adding 1mg, 5mg, 10mg, 20mg, 30mg, 50mg, 75mg, and 100mg respectively. The current density of 3.9065A/m^2 is maintained.

1. An extensive study is performed on Aluminum and Aluminum electrodes maintained at 2.5 A and 5 volts. The current density across the electrodes is 3.9065A/m^2

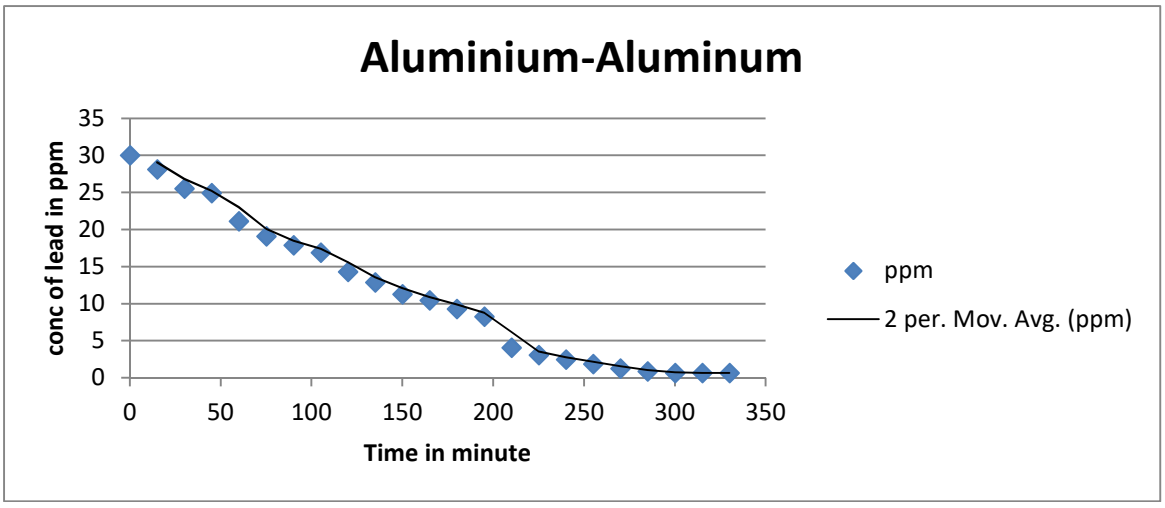

Figure5: Concentration trend with time with Aluminum-Aluminum electrodes

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As we can observe the graphical trends in figure 3, we can see lead concentration reached to 0.6545ppm

2. Study performed Iron-Iron electrodes maintained at 5 Volts and 2.5 Amps. Current density measured over the electrodes is 3.9065A/m^2.

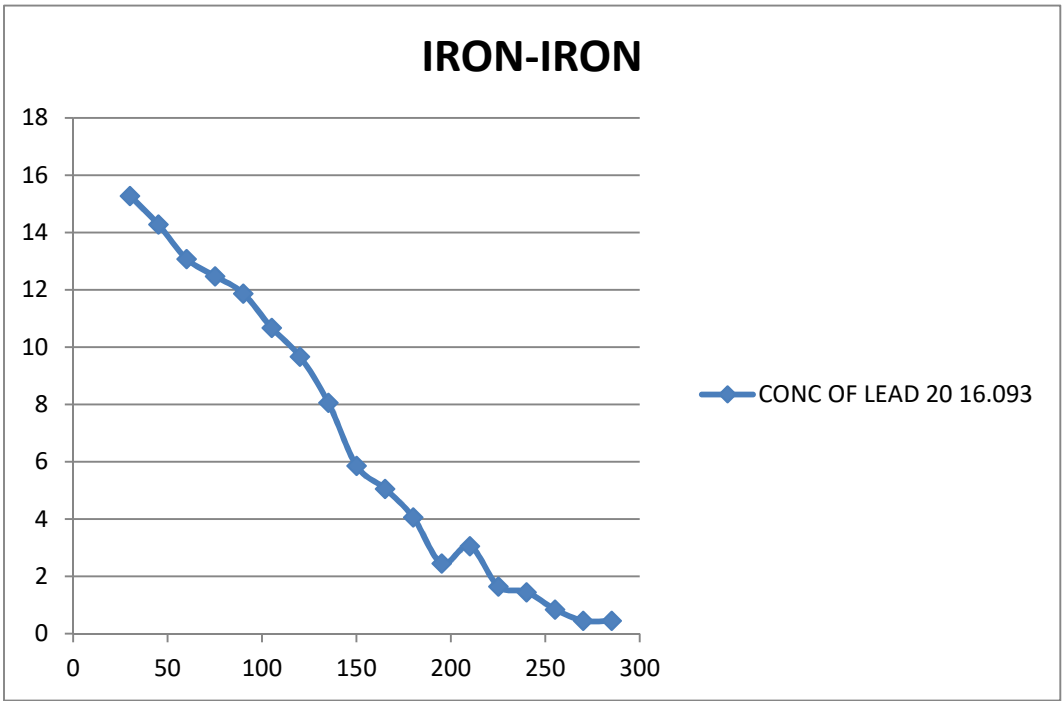

Figure 6: Concentration trend with time with Iron-Iron electrodes

As it is observed from the representation in figure 4, the concentration reduced to 0.454ppm

3. Study performed on Iron Aluminum combination with 2.5A and 5V with 3.905A/m^2 current density across the electrodes

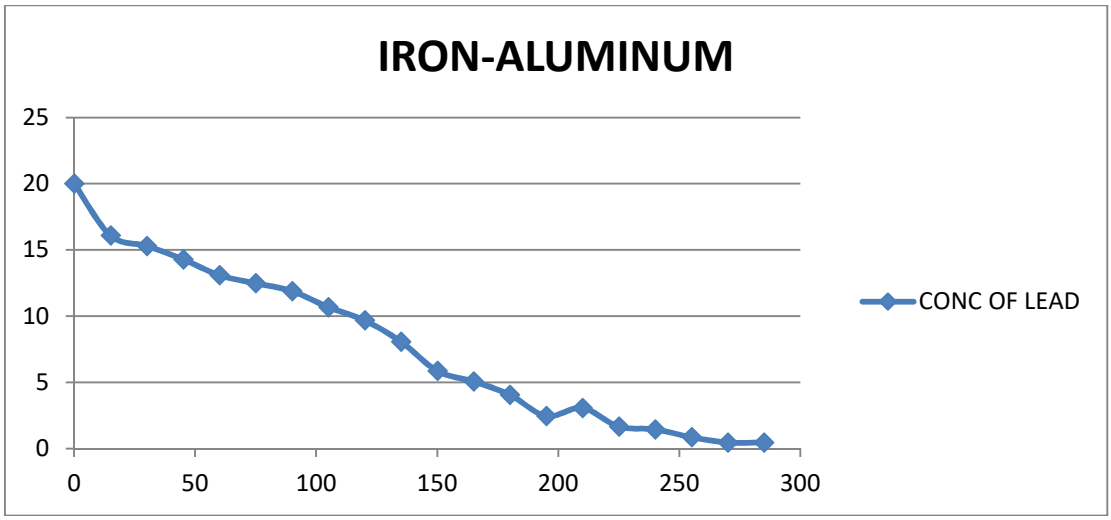

Figure7: Concentration trend with time with Iron-Aluminum electrodes

As it is observed from the representation of the data above, 99.3% can only maximum achieved optimally by the presented conditions.

4. Trends of removal of lead at various Voltages of 3V and 5V are measured and studied. The data is represented as fig 6.

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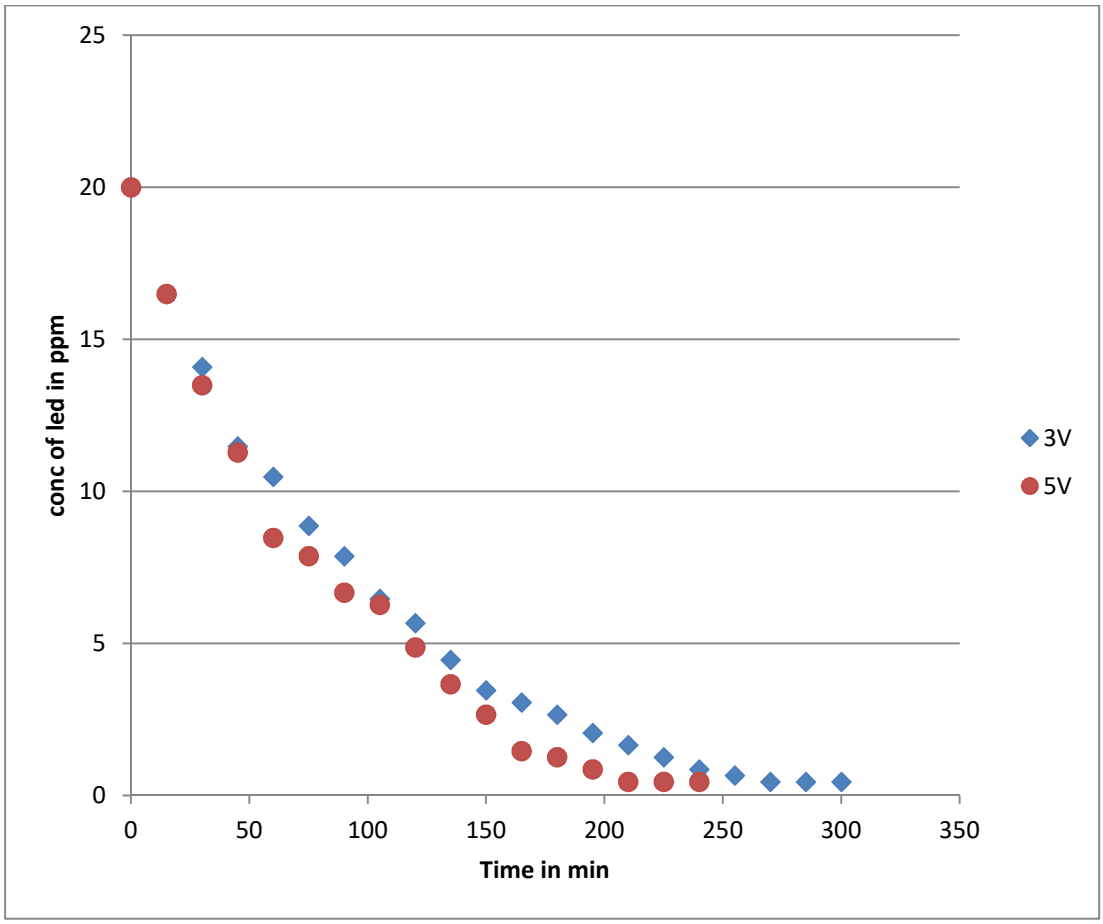

Figure 8: Concentration of Lead at various time intervals for 3V and 5V

At low voltage of 3V compared to 5V time required for the removal of Lead increase as the potential difference is low.

CONCLUSIONS:

The study performed on various combinations of Aluminum and Iron proved that presence of aluminum at 5V potential difference and 3cm inter-electrode distance has the maximum concentration reduction of lead around 99.73% from the synthetically made lead water.

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