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Investigating Theoretical Topics with Experimental Application on Education

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Abstract

In our daily life, the gradual increase in industrialization becomes a threat to plants and humans as a number of heavy metals in wastes increases. A number of heavy metals in the wastes has a significant effect on living creatures and depending on the intensity of the metals, it causes short and long term problems. The soil emits the toxic chemicals through the wastewater and then leaks it to the underground water sources. Therefore, pollutes the environment, and puts human's health at risk. If the amount of heavy metal is above a certain level, it creates short term and long term threats for living creatures.

In this research, the leaves of the Oak, Ash, Chestnut, Judas and Sycamore trees were tested for the removal of heavy metals ions, Pb(II), Hg(II), from wastewater. For this research project, we had two aims. First one was the combined theoretical science topics with practical scientific experimentation and application. The second one was the how heavy metals can be a negative effect on the environment and what can be done on this subject? When we started to build our project we knew how to make calculations about the concepts of molarity, moles, and absorption. However, these were just our knowledge from our chemistry course and these knowledge weren't enough to make the process about our project. So, we had to put our laboratory experiences and theoretical bases. For example, in the chemistry classes teachers teach what is the spectrophotometer but, students can't understand exactly the function of this device because they don't have any experience and make experiments help them to understand this knowledge more easily and more logical. Or can make the calculation of dilution but many students can't make this process in the laboratory because they just know the formula; with these kind of projects students can take the chance to work in the lab and can able to develop their science knowledge by their hands.

Keywords: fall foliage, heavy metals , waste water, laboratory experiences, theoretical bases.

1. Introduction

As industrialization increases, the wastes containing heavy metals threatens humans and plants more and more every day. As the toxic chemicals in wastewaters mix with soil, it pollutes underground waters and as a result, underground waters become dangerous and useless for humans. The most common heavy metals found in underground wastewaters today are lead Pb(II), and Mercury Hg(II) . Therefore, in order to use the underground waters, the water must be deionized and the heavy metals must be cleaned. Previously, other projects have used different methods in order to clean heavy metals such as (ion exchange, chemical precipitation, filtration, and electrochemical, Perlite, zeolite, etc) (3). Sadly, these techniques are costly and haven't given sufficient conclusions; therefore, these techniques aren't being used. As a result, natural materials are seen as an alternative way of cleaning heavy metals from wastewater.

In this research the leaves of the Oak, Ash, Chestnut, Judas and Sycamore trees were tested for the removal of heavy metals ions, Pb(II), Hg(II) , from wastewater. Different from other research, in this project, the spilled autumn leaves of several trees were used. Lead and Mercury are very dangerous for human health. Even low levels of lead in the blood of children can result in behavior and learning problems, lower IQ and hyperactivity, slowed growth, hearing Problems and Anemia .Lead is also harmful to other adults. Adults exposed to lead can suffer from cardiovascular effects, increased blood pressure

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and incidence of hypertension, decreased kidney function, and in reproductive problems.[3] Moreover, effects of mercury can be seen as loss of peripheral vision, "pins and needles" feelings, usually in the hands, feet, and around the mouth, lack of coordination of movements impairment of speech, hearing, walking, muscle weakness[4] Because of all of the symptoms and dangers, natural materials are hoped to clean the Lead and Mercury metals from water to make it available again for everyone.

2. Method

Research about the topic has begun in August 2016. During the research, our school's library, the library of Boğaziçi University and the internet were used. The studies were done by 2, 11th grade, students. The experiments were done in our school's art and chemistry departments and laboratories. In this project, the spilled autumn leaves of several trees (Oak, Ash, Chestnut, Judas and Sycamore)were used. These leaves were burned in the oven to active the carbons in it's system. The activated carbons were then mixed with Pb(II) and Hg(II) solutions and filtered. The absorbance levels of these new solutions were measured by the Spectrophotometer. To diminish the error margin the measurements were done twice and the average was taken.

3. Purpose

This project's aim is cleaning heavy metals of Hg(II) and Pb(II) from water with Oak, Ash, Plane and judas.

4. Steps Of The Experiment

1. A sample leaf from 5 different trees in the school garden was taken. These are Oak, Ash, Chestnut, Judas and Sycamore
2. The leaves were washed with tap water, rinsed and allowed to stand for 40 minutes.
3. The dried leaves were dried for 8 hours in a 80C oven.
4. The leaves were blended and sifted.
5. The sifted leaves were washed in solutions of 100 ml 1M KOH and 1 M HCl
6. The sieved leaves were held in a 80C Thermcore oven for 24 hours. This heat caused them to burn, so this part of the study was repeated.
7. New leaf samples were acquired. The same procedures were repeated at 60C and the carbon was activated.
8. A 500ml solution of $Hg(NO3)2$ was used to make three different concentrations of the following solutions: 0.01 M, 0.005 M and 0.0025M

Preparing sample solutions:
M=Molar concentration
V=Volume of solution
V1=The amount taken from a 0.1M solution
M1=Stock solution concentration
M2=Concentration after dilution
V2=Newly prepared volume(mL)

9. During the spectrophotometers measurements,the wavelength is adjusted with intervals of 200nm-1100nm.
10. The absorbance of solutions is measured by using UV spectrophotometer.
11. The results were written on a 4.5 chart.

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[1] https://www.epa.gov/lead/learn-about-lead#effects
[2] https://www.epa.gov/mercury/health-effects-exposures-mercury

12. The absorbance graphs for the discovered absorbance values were drawn using the Excel application.
13. 5 30 mL samples were taken from 0.005 M Hg(NO3)2 solutions.

- 0.32 grams of active carbon from plane leaves into the 1st solution
- 0.32 grams of active carbon from chestnut leaves into the 2nd solution
- 0.32 grams of active carbon from ash leaves into the 3rd solution
- 0.32 grams of active carbon from maple leaves into the 4th solution
- 0.32 grams of active carbon from jade leaves into the 5th solution

14. The same procedures were applied to 0.005M Pb(NO3)2 solutions.
15. 10 samples with active carbon were prepared.
16. The solutions were ran through filtering paper.
17. The absorbance values of the filtrates were measured.
18. Concentration values were measured according to the absorbance values derived from the absorbance graphs drawn in excel.
19. The values were shown in graphs 6, 7 and 8. The values were compared.

5. Conclusion and discussion

The solutions were prepared in 4 different molarities ,0.1 M ,0.01 M, 0.0025 M, 0.005M, and the absorbance levels of Pb(II) and Hg(II) metals were measured. The measured absorbances and molarities were used to draw calibration graphics. (Graph 2.3) The concentration values were read from the graph. As a result, in the solutions Chestnut was observed to be the best deionizer for both Mercury and Lead. However, for Mercury, Sycamore was observed to be the least efficient deionizer and for Lead, Ash was observed to be the least efficient deionizer.

6. Suggestions

The leaves that were used cleaned the heavy metals, Pb(II) and Hg(II) in the water, efficiently. This project can be repeated by using different leaves or trying to clean different heavy metals. During the research, the medium's temperature or pH level and the mixing time of the leaves with the heavy metals can be changed.

7. References

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[4] Co(II), cr(III) and Ni(II) metal ions in aqueous environments mucor pusillus (lindt., 1886) terms enriched in Al2O3 and flame AAS determination by immobilized activated biyokompozit investigation of a thesis prepared by Murat Çetinkaya Kimya Anabilim Dalı Yüksek Lisans Tezi Ocak 2015 Nevşehir