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FISH'S SCALES APPLIED AS NOVEL ADSORBENT IN THE REMOVAL OF LEAD FROM AQUEOUS SOLUTIONS

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Abstract
Water is under a tremendous pressure caused by the increasing pollution of this valuable source. Many pollutants are present in water both organic and inorganic and one of the most important pollutants is heavy metals. Among these heavy metals lead pb is ubiquitous and is consider toxic even at low concentration, many methods are being used to remove this pollutant and adsorption is consider as one efficient alternative technique to remove heavy metals. This research was carried out to acquire a new, cost-effective, accessible, and biodegradable adsorbent to remove this pollutant from aqueous solutions. The proposed adsorbent in this study was Carb fish scales, four experiment was used to test the ability of this new adsorbent to remove Pb, at first the best contact time was investigated and it was 90 minutes with Removal Efficiency R% 81.65, and it was found the adsorption Pb increase with the increase of both Adsorbent wight and initial Pb concentration, the study found that the best pH value to remove Pb was 9(alkaline) with R% of 91.2. In general, the proposed adsorbent shows a good ability in removing Pb from aqueous solutions.

Keywords: Adsorption, lead, fish scales, water treatment

INTRODUCTION

In present time, the problem of environmental pollution including water pollution is a growing problem that invading the whole globe. And water pollution is one of the main issues since that water is crucial for all disciplines of life. The increase in human population is accompanied with huge amount pollutants that enter the environment (Afroz et al., 2014) Many pollutants can enter the water receivers and polluted it. These pollutants can be diseases causing agent, fertilizers, oil and radioactive wastes, as well as heavy metal (Nathanson, 2022). general water pollution sources are: agricultural, Industrial and household waste. Polluted water must be treated before released to the environment(Haseena et al., 2017).

The foremost urgent problems in water pollution is the presence of heavy metals

in water (Nasir et al., 2021). Some heavy metals such as lead, arsenic and mercury are toxic to humans. When these metals are taken by humans, they have the ability to accumulate in the human body and damage many parts of the body include brain, liver, kidney and bones as well as the immunological problems (Akinnifesi et al., 2020). Lead is present in nature, in air, water and soil and it can cause a variety of health illness in humans' bodies, whereas children are the most susceptible to lead pollution (EPA, 2021) It can be toxic to the neuro-system, effecting brain and blood, interfering with calcium in bones and causing many health issues in children (Lu et al., 2022)

Many methods of treating water pollutants are being used. Among these methods adsorption take a great attention since it has the ability to remove both organic and inorganic pollutants, cost effective, doesn't require large space for operation and the pollutants are adsorbed on the surface of the adsorbent and subsequently reduce the pollutants in the solution (Al-Muttairi et al., 2022).

Fish a major food source around the world and being used extensively, therefore, an enormous amount fish waste is being disposed of including skin, bones and scales (Rouf et al., 2021) and these wastes are used as fertilizer, aquaculture feeding, and parts are just disposed of (Coppola et al.,2021). In this study fish scales are being used as proposed novel, cost effective and eco-friendly adsorbent to get rid of Pb.

Many researches have been carried out to deal with the removal of lead using a variety of adsorbent with different degree of success. Wang et al. (2021) study the ability of blast furnace slag to remove pb ions with removal ability up to 99.9 %. While (Ankrah et al., 2022) investigate the ability of NaP1 to remove Zinc and lead, copper. On the other hand, (Yirga et al., 2022) Used the orange waste peel for the adsorption of Cu and Cd in contaminated water.

Material and Methods

The experimental works carried out throughout this study was according to (Salman et al.,2017) and (Al-Muttairi et al. 2018)

Metal solution preparation

Preparation of the standard solution of lead (1000 ppm) by dissolving PbSo4 in D.W. and then the required concentration was prepared by using the following equation

$N_1V_1 = N_2V_2$

Where N1 the initial concentration, V1 volume of initial concentration needed to prepare the required concentration, N2 the required concentration, V2 the required volume.

Adsorbent Preparation

The adsorbent used in this study was Carp fish scales. The fresh fish scale was collected and then were air dried for a week and then grinded to fluffy flecks of the scales and the cut down to the smallest possible size as shown in Fig.1.

Fig.1: Grinded Carb fish Scales

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Experimental Work

The key aspects that can affect the adsorption process include time of contact, initial metal concentration, adsorbent weight and solution pH value.

The contact time was determined by using a series of contact time (30, 60, 90, 120 and 150 minutes), sample volume was 50ml, with initial Pb concentration of 20 ppm.

The outcome of changing the adsorbent weight was tested through a series of adsorbent weight (0.25, 0.5, 0.75, 1 and 1.25 gm), sample volume was 50 ml, initial Pb concentration was 20 ppm, and retention time was 90minutes.

The effect of initial Pb concentration was determine be testing a series of Pb concentration (10, 20, 30, 40 and 50 ppm), sample volume 50 ml, adsorbent weight was 0.5 gm and contact time was 90 minutes.

The final experiment was to investigate how the solution pH can affects the adsorption process. three pH value were tested, pH=5 (acidic), pH=7 (neutral), pH=9 (alkaline). with sample size of 50ml, initial Pb concentration was 20 ppm, adsorbent weight 0.5gmand the contact time was for 90 minutes.

Measurements

All the samples from the forementioned experiments were then transfer to the centrifuge for 5 minutes at 5000 RPM and the supernatant was taken. The concentration of lead was measured in the centrifuged samples by using flame atomic spectrometer.

Results and Discussion

At first the best contact time was tested and the results are illustrated in Fig.2. the adsorption was fast at the beginning of the experiment up to 90 minutes which give the utmost retention time with removal efficiency R% of 81.65% and after that the adsorption reach an equilibrium. This can be accredited to the presence of large amount of adsorption site at the beginning of the adsorption process and as the site stat to filled up the repulsion increase due to the presence of adsorped metal ions and the difficulty of reaching the left vacant site (Alghamdi et al., 2019). The results are similar to the findings of (Cherono et al., 2021) which study the ability of waste tire rubber for the adsorption of Pb, Cd and Ni which find the adsorption rate was high at the first stages of the adsorption and then it reaches an equilibrium sate.

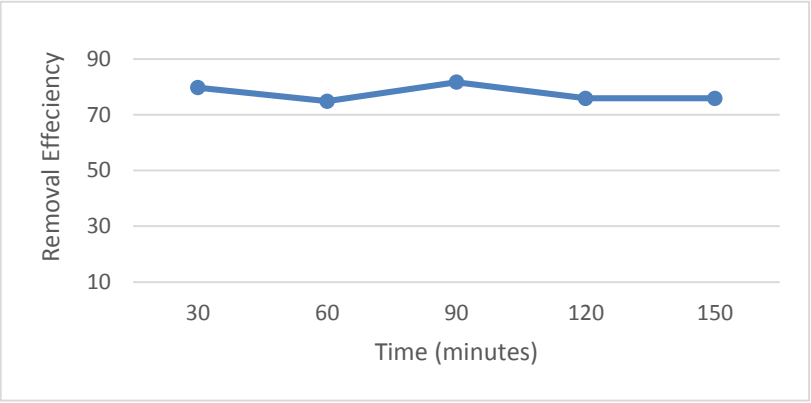

Fig.2: detecting the best contact time for the adsorption of Pb ions

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Changing the adsorbent weight affect the adsorption process of Pb ions. The results depicted in Fig.3 show that the increase in the adsorbent weight from 0.25gm to 1.25 gm cause an elevation in the R% from 55.26% to 86% respectively. This can be easily explained be knowing that the raise in the adsorbent weight cause an elevation in the adsorption sites number available for the adsorbate to attach to them (Gerçel et al., 2007). this is similar to finding of (Musumba et al., 2020) which stated That the adsorption of both lead and copper increased as the amount of bio-char (adsorbent) increase.

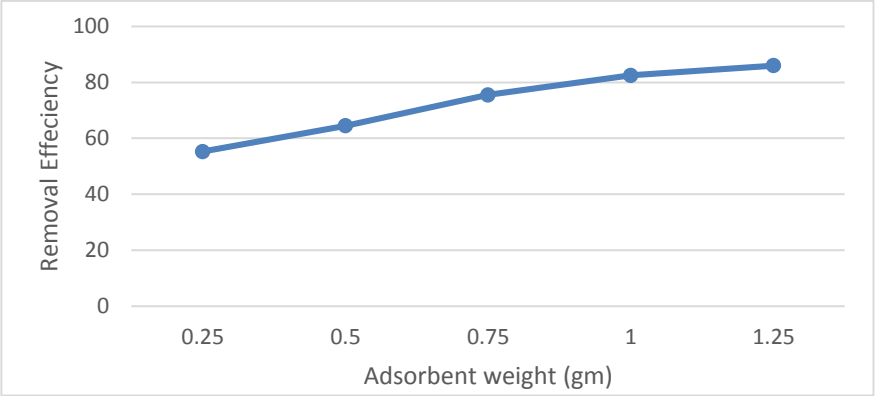

Fig.3: the outcomes of increasing the adsorbent weight on the adsorption process

The effects of primary concentration metal on the adsorption of Pb ions were investigated and the results illustrated in Fig.3. show with the elevation in Pb initial concentration from 10 to 50 ppm an increase in R% from 67.2 to 89.8% respectively was observed. And that could be due to that the increase in the initial metal concentrations increase the driving force of the adsorption and subsequently increase the removal efficiency (Salman et al., 2017). The results agree with findings of (Sidhaarth and Jeyanthi, 2013) which found the adsorption of Pb increased as the initial pb concentration raised from 10 to 100 mg/L.

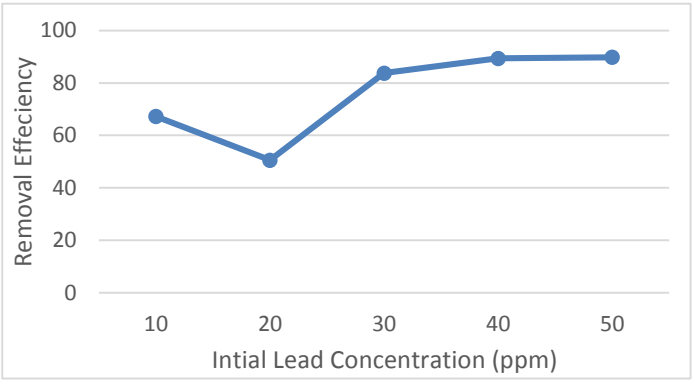

Fig.4: The effect of Pb concentration on the adsorption process

The fourth and final experiment was carried out to find the effect of pH value on the removal of Pb. The results show that the adsorption process increase as the pH value increase and the highest was at pH 9. That can be explained by the fact that at lower pH the H+ is high in the solution and compete with the metal ions for the

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adsorption site which lowers the adsorption process (Sha et al., 2016) and at the higher pH value this competition is decrease as the H+ decrease which increase the adsorption of Pb (Onwordi et al., 2019).

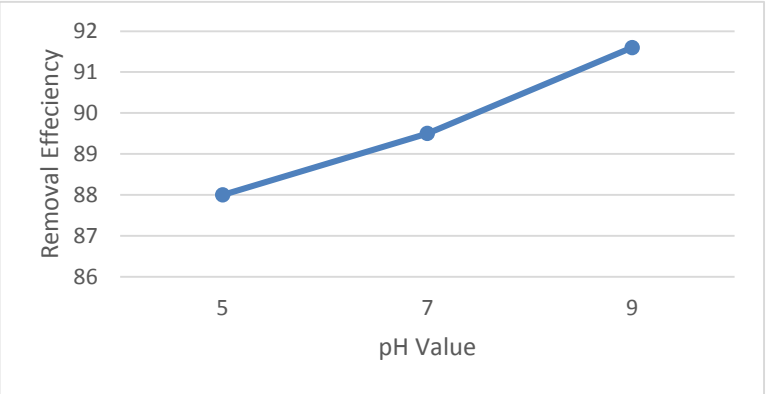

Fig. 5: The effect of the pH value on the adsorption process.

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