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Chromium Removal Using Filter Pellets Made of Polyacrylamide, GAC, Iron Oxide, Zinc Oxide, and Kaolin

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ABSTRACT

This study aims to produce novel filter pellets utilizing polyacrylamide (PAM), activated carbon (GAC), iron oxide (Fe_2O_3), zinc oxide (ZnO), and kaolin. The goal is to assess the efficacy of these pellets in treating chromium and nickel in water.. The XRF technique were applied for validation method included filters with known quantities of adsorbed Chromium. XRF accurately measured Cr(VI) concentrations in the fixed filter pellets..

Keywords: Filter, carbon, Iron oxide ,Zinc oxide.

1 Introduction

Industrial activities globally impact water quality. Despite UN recognition of the right to clean water, many still lack access. The World Water Council predicts worsening conditions, with 3.9 billion people facing limited water by 2030. Protecting fresh water is now a major global concern due to industrial water discharges containing harmful metallic substances. Hexavalent chromium (Cr(VI)), a group 1 carcinogen, poses cancer risks through complex mechanisms, causing cellular damage and DNA-adducts. Advancements in organic-inorganic hybrid materials show promise in solving water quality and scarcity issues caused by environmental factors[1] Materials combining clay minerals with amino-functionalized molecules exhibit excellent adsorption properties for removing toxic substances from wastewater .Eco-friendly materials like iron, zinc, and silica are effective in water decontamination, targeting heavy metals and organic pollutants[2]. Notably, iron oxide nanoparticles are used in polymeric membranes for their efficiency in removing contaminants like arsenic and copper, while zinc oxide nanorods and nanoparticles are explored for enhancing photocatalysis and membrane performance in wastewater treatment. Mesoporous silica nanoparticles and kaolinite exhibit high potential in heavy metal removal; African palm fruit activated carbon demonstrates efficacy. Granular activated carbons from waste offer sustainable water treatment, requiring further optimization. Polyacrylamide, effective in heavy metal removal, undergoes extensive study and modification for enhanced adsorption. Mixed material filters, analyzed aim at chromium removal for sustainable water filtration.

2 Experimental

Filter pellets was manufactured based on different weight ratios of PAM, Activated carbon, Iron oxide, Zinc oxide, and Kaolin. The mixture was then heated at 70°C for 120 minutes and molded into pellets using a pellet press.

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2.1 Technical Characterisation

The XRF analysis allows us to determine the absorbed concentrations of Cr(VI) on the filters pellets and therefore it is possible to calculate the retention rate according to the following eq

$$\mathrm{Re}t(\%) = \frac{C_{ads}}{C_{Feed}} \times 100 \quad \textbf{(1)}$$

where, Ret(%): Retention rate of filters pellets; C_{Ads} : Concentration of heavy metal adsorbed by filters pellets(ppm) ; C_{Feed} : Concentration of heavy metal in feed solution,(ppm)

3 Results and Discussion

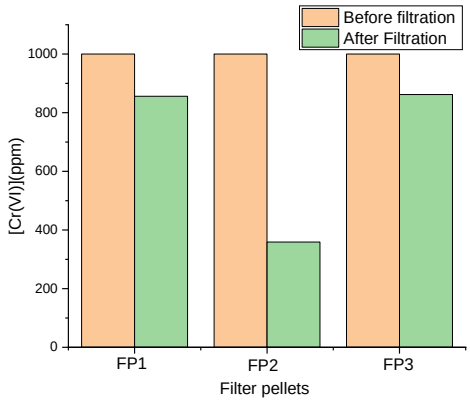

Figure1: Efficiency of Filter Pellets in Removing of Cr(VI)

4 Conclusions

The development of new filter pellets incorporating PAM, GAC, ZnO, and kaolin has effectively removed Cr(VI) from water. Pellets with iron oxide or kaolin additives outperformed those with ZnO in rejecting these contaminants. This efficacy was confirmed through XRF analyses indicating these pellets' potential in enhancing water treatment systems.

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