Magnetic nanoparticles for hydroxy-PAHs removal from synthetic urine

Bassam F. Alfarhani¹, Riyam R. Al-Mousawi, ALI S. ALZAIIDY, Raghad Shaker Aziz, Fadha Kareem Shingar²

¹Department of chemistry, College of sciences, University of Al-Qadisiyah, Iraq
²College of sciences, University of Al-Qadisiyah, Iraq
bassam.alfarhani@qu.edu.iq

ABSTRACT:

The study summarizes using a new synthesized core/shell type of nanoparticles to remove hydroxy-polycyclic aromatic hydrocarbons (PAHs). The Fe₂O₃ coated with compound ((3-aminopropyl) triethoxy silane ) and tested for removal of hydroxy PAHs from synthetic urine, The synthesized Core/shell nanoparticles were characterized using several techniques such as XRD analysis of The synthesized nanoparticles show amorphous structure. The results obtained showed the high value of the removal ratio that indicates of the tremendous power of the synthesized nanoparticles on removal of PAH.

1. INTRODUCTION:

PAHs is a hydrocarbon composed of molten aromatic ring molecules. These are the rings that share one or more sides and contain electrons, they are molecules made by combining two or more benzene rings, aromatic multi-core hydrocarbons contain only two carbon and hydrogen atoms, as well as hydrocarbons consisting of more than 100 different chemicals that are formed during incomplete combustion For coal, oil, gas, garbage, or other organic materials such as tobacco or charcoal grilled meat, the majority of PAHs do not dissolve easily in water. They attach to solid particles and settle in the depths of lakes and rivers. But microorganisms can break down aromatic hydrocarbons. • There are 16 PAHS compounds that have been identified as a priority in the EPA (Enviromented Protection Agency) as their concentrations must be monitored continuously. Polycyclic compounds present in soil or water after a period ranging between weeks and months. In soils, it is very certain that polycyclic aromatic hydrocarbons (PAHs) are tightly attached to the particles, and some PAHs penetrate the soil and pollute the groundwater. The polycyclic aromatic hydrocarbon content in plants and animals may be much higher than the polycyclic aromatic hydrocarbon content in the soil and water in which these animals and plants live. PAHs are a complex contaminant ¹,²,³,⁴,⁵

The most important problem facing the world directly is pollution of all kinds ⁶,⁷,⁸,⁹,¹⁰,¹¹ according to the World Health Organization that a very high percentage of the world lives in a polluted environment. Air pollution may be watery, Some polycyclic aromatic hydrocarbons are known for their ability to cause cancer and mutations, and thus pose a serious threat to human health. Various physico-chemical methods have been used to remove these compounds from our environment ¹²,¹³,¹⁴,¹⁵
2. Chemicals:
All the materials used were HPLC grade, the chemicals used were, pure and needing no purification, while (1-hydroxy pyrene) were purchased from Sigma- Aldrich as well as all other chemicals from other commercial sources such as Merck.

3. Methods:
3.1. synthetic Urine
Preparation of a medium similar to natural urine by simulating the optimal conditions of the medium by knowing the properties of the urine medium and its content of dissolved substances in it and the operation of a medium similar to a large extent, characteristics of urine: the hydration is naturally formed from water as a basic component, and it also contains nitrogen molecules, including urea , In addition to containing creatinine and other metabolic waste components, the following are the normal proportions of the chemical composition of urine: Water, more than 95% urea, 9.3 grams / liter. Chloride, 1.87 g / l. Sodium, 1.17 g / l. Potassium, 0.75 g / l. Creatinine, 0.67 g / L. Other dissolved ions, organic and inorganic compounds, such as: proteins, hormones and receptors. The acidity of urine ranges between 5.5 to 7.5 and it depends on the diet. Therefore, the medium was prepared based on the previous data, where each of urea with a weight of 0.58 grams, chloride of 0.11 grams, sodium with a weight of 0.075 grams, potassium with a weight of 0.045 grams, ammonium with a weight of 0.11 grams, phosphates and sulfates with a weight of 0.0625 in 60 ml of aqueous medium

3.2. Preparation of stock solution of PAHs
Stock solutions of (1-Hydroxypyrene ) were prepared by dissolving ( 3) mg of standards in (0.5) mL of methanol and comple the volume with distilled water to(10) ml. stock solution was kept in the dark place at.( 4) °C. Prior to use, stock solutions were monitored via Room temperature fluorescence spectroscopy for possible photo-degradation of the PAHs. stock solution has been used for a period of less than (6 months). Working solutions of PAHs were prepared daily by serial dilution of stock solutions.

4. Results and Discussion:
4.1. Fluorescence Spectroscopic Study
4.1.1. Excitation-Emission spectrum
Excitation and emission spectrum are obtained using the commercial spectrometer (Shimadzu RF-5301pc).The excitation source is a( 150-watt xenon lamp),( 220 – 900) nm. The precision reached a uniform color (± 1.5 nm).The wavelength scan was performed at (5500 nm – min). The excitation and emission spectrum was calculated for multi-drug compounds ( 1-Hydroxy Pyrene ). compound is dissolved in a certain amount of synthetic urine.the excitation spectrum was used to determine the excitation and emission wavelength.measurements at room temperature, monitoring the performance of the device using standard materials and determining the radiation intensity at the highest spectrum

4.2. Using of Fe₂O₃ - SiO₂ -R Core/Shell NPs for extraction of PAHs from synthetic urine
The Fe₂O₃-SiO₂-R core/shell was used to study the interference with hydroxy PAHs and obtain the extraction process. Preparation of different concentrations of (1-hydroxy pyrene)( ppb) (20,40,60,80,100) In synthetic urine, 1-hydroxy pyrene( Where the extraction ratios were estimated and monitored by means of fluorescence spectroscopy, and the best concentration was chosen for the highest extraction ratio, where the best extraction concentration reached ((40, 60, 80 ppb), as shown in the figures (2,3,4) where the extraction ratio was (96.30% ± 0.30, 86.00% ± 1.30, 91.55% ± 2.50).
Figure (1) shows the intensity spectrum of emission before and after the extraction process for 1-HydroxyPyrene.

Figure (2) shows the intensity spectrum of emission before and after the extraction process for 1-HydroxyPyrene.
Figure (3) shows the intensity spectrum of emission before and after the extraction process for 1-HydroxyPyrene.

5. Practical applications
5.1. The possibility of reuse of the prepared nanoparticles after the removal process
Nanoparticles through the use of several solvents (methanol, 1-Hexanol, toluene, 2-Propanol). For an idea of extraction more than once, and it was used in the collection process (3 ml) of the 2-propanol compound into the nanocomposite, where it is placed in the shaker device for no more than (20) minutes and no less than that, as the most suitable was chosen after evaluating experiments, then placed in The centrifuge for a period of (20) minutes is also done, after separation, the intensity of the emission of the medium is measured by the fluorine device, and it was found that 2-propanol could disassemble the bond between the envelope and R (Fe₂O₃ - SiO₂ - R) as in Figure (6) so that we can then take advantage of From the nanoparticle in the extraction process more than once.

Figure (4) shows the possibility of reusing the prepared nanoparticles after the removal process.
6. Conclusion:
In this research, an advanced method for synthesis and using of core/shell nanoparticles to remove hydroxy PAHs from the synthetic urine, the results demonstrate the advantage of using (3-aminopropyl) triethoxy silane as a shell of nanoparticles. The extraction ratios were around 90%, which gives an indication of the benefit for the extraction of hydroxy PAHs.

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