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Data Article

Enhanced electro kinetic- pseudo-Fenton degradation of pyrene-contaminated soil using Fe_3O_4 magnetic nanoparticles: A data set

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A R T I C L E I N F O

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A B S T R A C T

The aim of the data were to increase the treatment efficiency of pyrene from soil using Nano catalysts magnetite iron oxide (Fe_3O_4) and combined with electro kinetic. Soil provided with 100 mg/kg concentration and removal of pyrene done with EK-Fenton process. Nano catalyst was synthesized via a facile co-precipitation method and characterized by FTIR, XRD, SEM, EDX, VSM techniques. The effects of some operational parameters include catalyst dosage, pH, hydrogen peroxide concentration and the voltage were studied on the removal efficiency of pyrene. Results indicated the removal efficiency was obtained 87% under optimal conditions (pH = 3, Nano catalyst dosage = 1 g/l, H_2O_2 = 10 mM and voltage 30 V). Electrokinetic Fenton process can be as efficient and effective method for the removal of pyrene from contaminated soil using Nano Catalyst Fe_3O_4 introduced in optimal conditions.

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Specifications table

Subject area	**Environmental engineering**
More specific subject area	Environmental Chemistry
Type of data	Tables, image, graph, figures, text file
How data were acquired	Pyrene was extracted from the soil texture into acetone solvent. Residual of pyrene was determined using a gas chromatography (GC) equipped with a flame ionization detector and a column C18 with dimensions (5 lm, 250 mm long × 4.6 mm ID). The characteristics of catalyst were conducted by FTIR, XRD, SEM, EDX, VSM techniques.
Data format	Raw, analyzed
Experimental factors	All samples were kept in polyethylene bottles in a dark place at room temperature.
Experimental features	The all above mentioned parameters were analyzed according to the standard method for water and wastewater treatment handbook
Data source location	North of Iran
Data accessibility	Data are included in this article
Related research article	N/A

Value of the data

- Pyrene with low biodegradability and high persistency in environment, which is considered as a priority pollutant by US EPA because of its carcinogenic and mutagenic effects therefore applying the proper technology is the need to remove Pyrene and decreasing of its concern.
- Electrokinetics process is a clean and effective technology for removal of pyrene in the contaminated soil.
- Modified Fenton with Fe_3O_4 nanoparticle is more effective than standard Fenton (iron salt) due to increasing of Fenton process capability to break down the toxic and hazardous substances (pyrene).
- According to the data include in this data article and the considerable benefits obtained from the use of Electrokinetics, including polycyclic aromatic hydrocarbon-contaminated sites.

1. Data

Table 1 indicated properties of pyrene. Table 2 showed the characteristics of sandy clay soil. As shown clay is the most compound of soil texture. Fig. 1 illustrated X-ray diffraction (XRD) of Fe_3O_4, (a) Fourier transform infrared spectroscopy (FT-IR) of Fe_3O_4, (b) EDX image of Fe_3O_4(c), SEM image of Fe_3O_4 and (e) VSM of Fe_3O_4 (d). Fig. 2 depicted the effect of pH on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4=0.5 g/l, H_2O_2=10 mM, voltage = 30 V). Fig. 3 showed the effect

Table 1
Properties of pyrene.

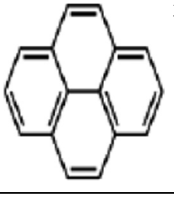
Name	Chemical formula	Structure	Molar mass (g/mol)	Density (g/ml)	Melting point (°C)	Boiling point (°C)	Solubility (mg/l)
Pyrene	C16H10		202.25	1.271	145–148	404	0.135

Table 2
Characteristics of sandy clay soil.

Characteristics	Soil	Value
Texture	Sandy loam	–
Clay	50	%
Sand	44	%
Silt	6	%
pH	8	–
Electrical conductivity	5×10^{-7}	Ms/m
Soil moisture	4.8	%
Organic matter	0.3	%
Organic carbon	0.17	%
Iron	6.3	ppm

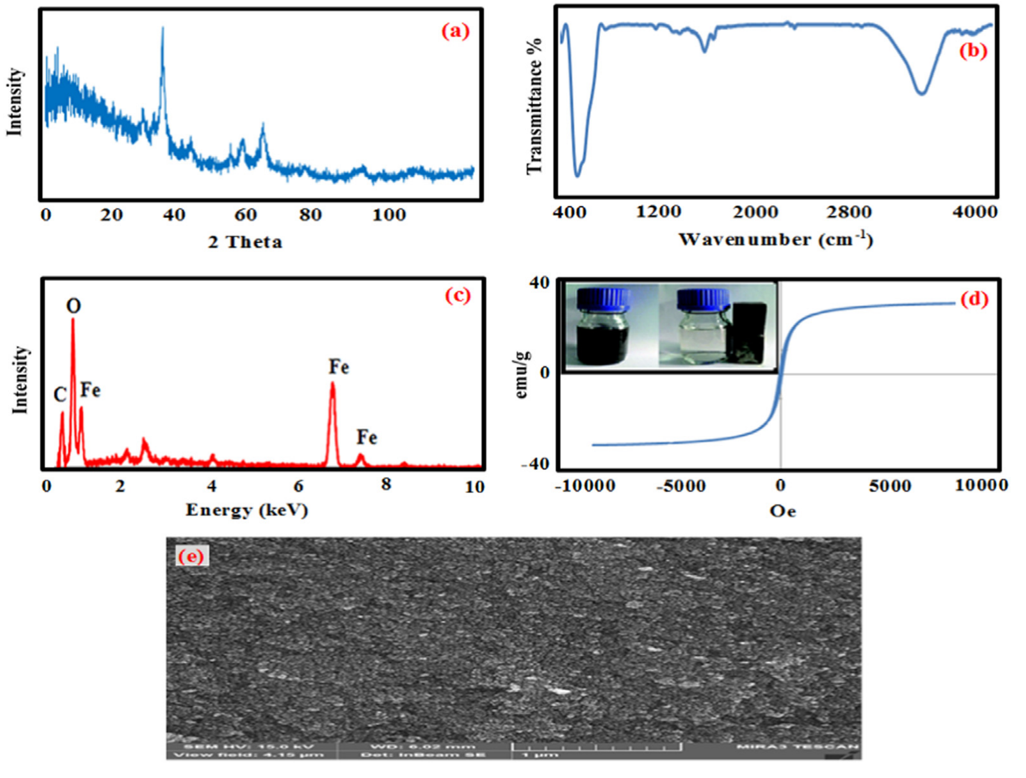


Fig. 1. X-ray diffraction (XRD) of Fe_3O_4, (a) Fourier transform infrared spectroscopy (FT-IR) of Fe_3O_4, (b) EDX image of Fe_3O_4(c), SEM image of Fe_3O_4 and (e) VSM of Fe_3O_4 (d).

of H_2O_2 concentration on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4=0.25 g/l, voltage = 30 V). Fig. 4 indicated the effect of Fe_3O_4 nanocatalytic concentration on the removal of pyrene in soil by electrokinetic-Fenton process (H_2O_2=10 mM, voltage = 30 V). Fig. 5 depicted the effect of current voltage on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4=1 g/l, H_2O_2=10 mM). Fig. 6 showed the effect of contact time on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4=0.5 g/l, H_2O_2=10 mM, voltage = 30 V).

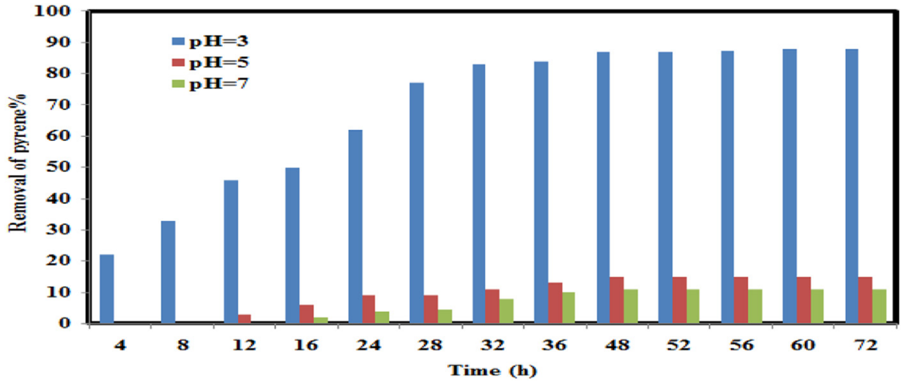


Fig. 2. Effect of pH on the removal of pyrene in soil by electro kinetic-Fenton process (Fe_3O_4=0.5 g/l, H_2O_2=10 mM, voltage = 30 V).

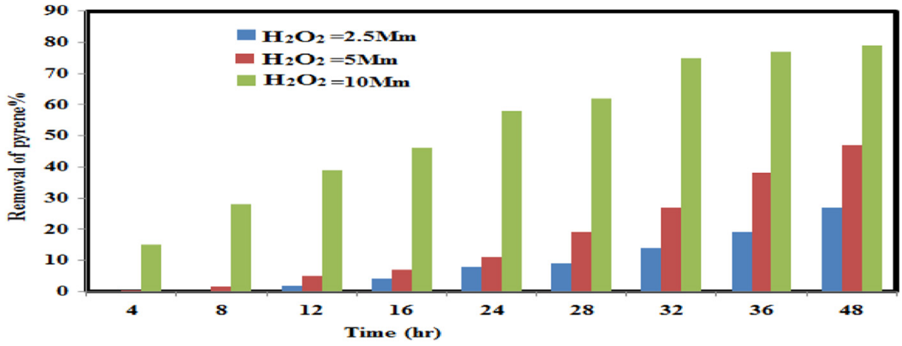


Fig. 3. Effect of H_2O_2 concentration on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4=0.25 g/l, voltage = 30 V).

2. Materials and methods

2.1. Materials

Pyrene was purchased from Merck. The properties of pyrene were shown in Table 1. The acetone [(C3H6O, Assay 99.8%, MW: 58.08 g/mol, Density: 0.791 g/cm^3] as a solvent purchased from Merck company.

2.2. Characteristics of soil

20–30 cm below ground surface of soil were collected from the north of Iran. Sample were dried in the ambient sieved (No. 10 mesh) [1]. Sandy clay soil with various characteristics listed in Table 2. Contaminated soil was prepared and mixed by a pyrene stock solution of 100 mg/l at 200 rpm for 3 h [2].

2.3. EK-Fenton reactor

The set-up of EK-Fenton was conducted as follow: Four components electrode are made of aluminum with the distance of 1 cm. The slurry of soil column with 1/10 ratio was made in Pyrex glass (2000cc). A power supply was connected to the electrodes to provide direct current for EK-Fenton treatment in flow (0–3) A and voltage (0–60) V. The clamp of the adaptor connected from one side to the positive (+) and negative (−) pole device power supply and the other side connected to the

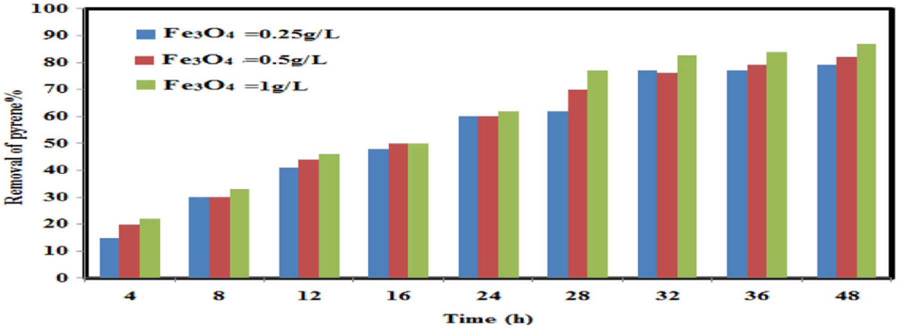


Fig. 4. Effect of Fe_3O_4 Nano catalytic concentration on the removal of pyrene in soil by electro kinetic-Fenton process (H_2O_2 = 10 mM, voltage = 30 V).

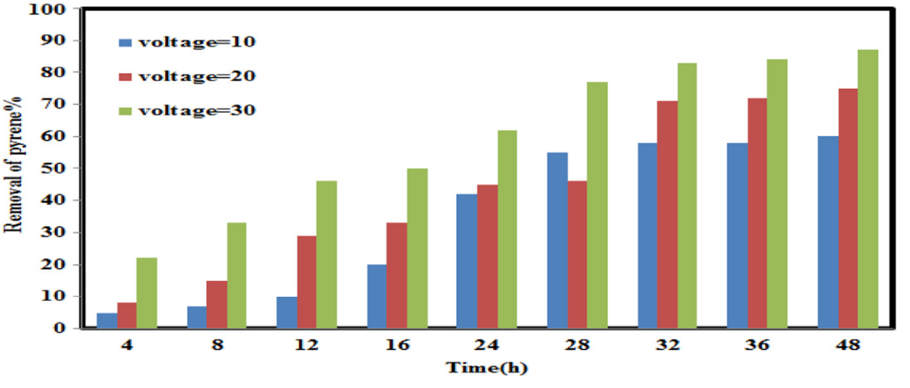


Fig. 5. Effect of current voltage on the removal of pyrene in soil by electrokinetic-Fenton process (Fe_3O_4 = 1 g/l, H_2O_2 = 10 mM).

electrodes. So electrodes connected to the positive pole will role of anode and electrodes attached to the negative pole will role of cathode [3–7].

2.4. Synthesis of Fe_3O_4 magnetic nanoparticles

The Fe_3O_4 were prepared using the co-precipitation method. The certain amount of $FeCl_3.6H_2O$ and $FeCl_2.4H_2O$ were dissolved in 200 ml deionizer water. NH_4OH 25% (25 ml) was added drop-wise to the precursor solution to obtain an alkaline medium (pH = 8) that led to producing a black and gelatinous precipitate of Fe_3O_4 nanoparticles under nitrogen gas. Sample was heated at 80 °C for 2 h with continuous stirring. The desired Fe_3O_4 nanoparticles were collected by a permanent magnet and then washed with deionized water and ethanol for five times. Then it was dried at 80 °C in vacuum for 5 h [8–13].

2.5. Characteristics of Fe_3O_4 magnetic nanoparticles

Fourier transform infrared spectroscopy (FTIR) Model WQF-510 was applied for determine the functional groups of nanoparticle, the chemical characteristics and surface morphology of was determined using X-ray diffraction (XRD) model Shimadzu XRD-6000. Scanning electron microscope (SEM) model Philips XL30 was used to study the surface properties of nanoparticle. The elemental analysis of nanoparticle was determined with Energy Dispersive X-Ray Spectroscopy (EDS) model

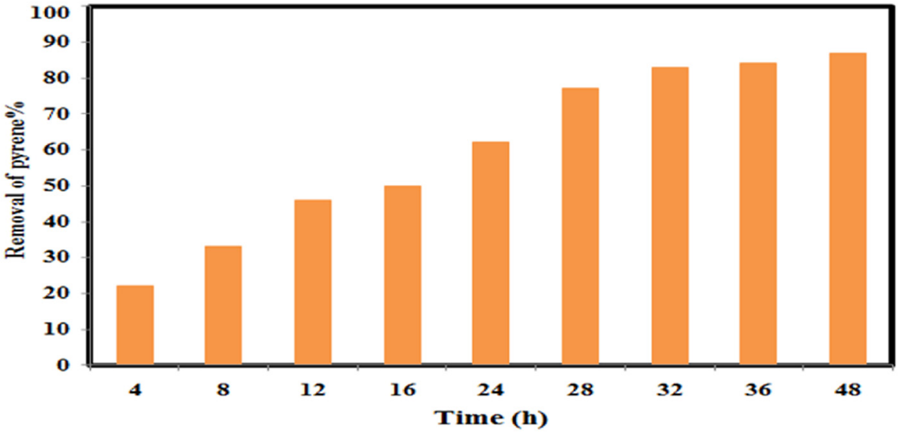


Fig. 6. Effect of contact time on the removal of pyrene in soil by electro kinetic-Fenton process (Fe_3O_4=0.5 g/l, H_2O_2=10 mM, voltage = 30 V).

EM-30AX Plus. Magnetization measurements were conducted by a vibrating sample magnetometer (VSM, 7400, Lakeshore, USA) [14–19].

2.6. Soil contamination with pyrene

Soil was unnaturally contaminated with pyrene solution completely dissolved in a mixture of acetone. Acetone was applied because of the low solubility of pyrene in water. The samples shacked with an orbital shaker and then placed under a ventilation hood until the solvents completely evaporated. Finally, since a portion of the pyrene may be volatilized along with the acetone, a sample was taken to determine the accurate initial concentration of pyrene in the soil. On the other hand, water was used to prepare electrical conductivity in the electrokinetic reactor. The contaminated soil was thoroughly mixed with a measured amount of water in a glass beaker so that the soil water content would be adjusted [20,21].

2.7. Analysis

Sample preparation for analyses of pyrene concentrations was conducted as follows: 2 g of sample was mixed with 10 ml of acetone in a glass beaker. The samples were shaking for the complete mixing of contaminated soil and transferred into the ultrasonic (BANDELIN SONOPULS- Germany) for 2 min to collect the organic compounds extracted from the soil texture into acetone solvent. The glass tubes were centrifuged at 4000 rpm for 60 min. Pyrene extracts were measured using a gas chromatography (GC) equipped with a flame ionization detector and a column C18 with dimensions (5 lm, 250 mm long × 4.6 mm ID). Nitrogen as a carrier gas was used to make-up flow at a constant pressure of 25 ml min^{-1}. The oven temperature was held at 100 °C for 3 min and then increased at 15 °C per minute to a final temperature of 280 °C [22–24].

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Transparency document. Supporting information

Transparency document associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.11.068.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.11.068.

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