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Soft synthesis of highly dispersed magnetic iron oxide onto natural clay as a heterogeneous catalyst in Fenton process and its application as post-treatment following chemical precipitation of municipal wastewater of Fez city-Morocco

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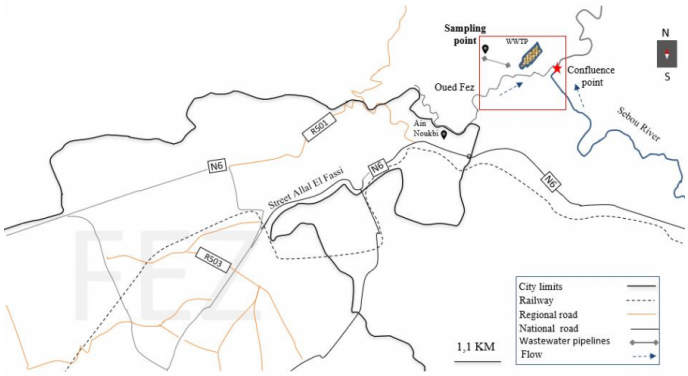
PURPOSE OF THE ABSTRACT

Municipal wastewater of Fez city (Morocco) is considered one of the contamination sources of the Sebou River in Morocco [1,2]. The present study deals with the treatment of raw municipal wastewater collected upstream wastewater treatment plant (WWTP) of Fez. After a periodic sampling, an exhaustive physicochemical characterization was carried out before and after primary treatment of coagulation-flocculation-precipitation using ferric chloride and cationic flocculant. Turbidity, chemical oxygen demand (COD), and color index were optimized using response surface methodology (RSM) design. Subsequent treatment of the pretreated and simulated wastewaters spiked with phenol was performed by heterogeneous Fenton-like using synthesized magnetic iron oxide-supported clay material.

Results obtained from wastewater surveys confirm the moderate to high contamination strength. The coagulation process showed an optimum coagulant dose ranging between 750 and 1000 mg/L. The flocculation had no significant effect upon different responses, while the pH effect showed almost a steady removal over a wide range of 4 to 10, including the natural pH of the wastewater. As a result, COD, turbidity, and color removals have reached 50-70 %, 94-98%, and 90-96 %, respectively. On the other side, the results of catalyst characterization by X-ray photoelectron microscopy (XPS), X-ray diffraction (XRD), Scanning Electron Microscopy (SEM), and nitrogen adsorption-desorption isotherms showed the presence of superparamagnetic iron oxide nanoparticles highly dispersed onto natural clay with an increase of surface area from 30 m2/g in natural clay up to 65.6 m2/g in the composite. The performance of heterogeneous Fenton in pretreated and synthetic wastewaters showed almost total degradation of the initial phenol concentration of 0.53 mM within 180 min at pH 3. The catalyst showed excellent stability after several treatment cycles. Therefore, coagulation-flocculation-precipitation coupled with heterogeneous Fenton might be a promising combination for wastewater treatment.

FIGURES



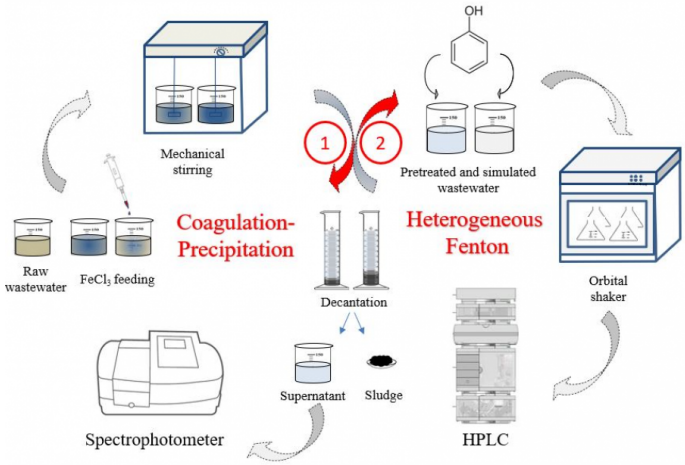


FIGURE 1

Location of the sampling point upstream WWTP in Fez city (Morocco)

By crossing the city of Fez and heading towards the Sebou watershed, the Oued Fez receives a significant load of anthropogenic pollution generated by various activities before reaching WWTP.

FIGURE 2

Treatment scheme adopted in the present study for the treatment of raw municipal wastewater in the city of Fez (Morocco)

Pre-treatment by coagulation-flocculation-precipitation was performed on a pilot scale to reduce organic load and turbidity before heterogeneous Fenton treatment, spectrophotometer and HPLC were used for the study of different analytical parameters.

KEYWORDS

Wastewater | Coagulation-precepitation | Heterogenous Fenton-like | composite material

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