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Treatment of methylene blue by mesoporous Fe/SiO<sub>2</sub> prepared from rice husk pyrolytic residues**AUTHORS**

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**PURPOSE OF THE ABSTRACT**Treatment of methylene blue by mesoporous Fe/SiO<sub>2</sub> prepared from rice husk pyrolytic residues

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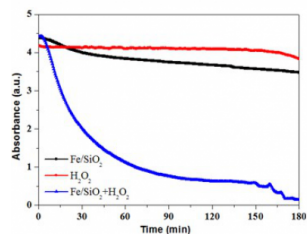
Abstract: Methylene blue (3,7-Bis(dimethylamino)phenothiazin-5-ium chloride, MB) is highly resistant to biodegradation with traditional physical and biologic treatment. Therefore, the discharge of MB effluent cause critical environment problems and thus harm human health. It can bring about permanent eye burns to human and animals. To explore methods for mineralizing MB has aroused much attention. Recently, various pyrolytic methods are applied to convert biomass to bio-oil, however, large amount of residues are produced as by-product. The residues, like rice husk pyrolytic residues (RHR), mainly contain C and Si element can be used to prepare functional materials<sup>1</sup>.

Fe/SiO<sub>2</sub> was prepared from rice husk pyrolytic residues through alkali-treatment, co-precipitation and calcination. The obtained Fe/SiO<sub>2</sub> was characterized by N<sub>2</sub> adsorption - desorption isotherm, XRD, FT - IR, UV - vis, ICP - AES, and XPS. The newly prepared Fe/SiO<sub>2</sub> possessed mesoporous structure with 674 m<sup>2</sup>/g of surface area and 5.03 wt.% of iron content. The results of XRD, FT - IR, UV - vis proved that part of iron species were incorporated into the silica framework. The Fe/SiO<sub>2</sub> was applied to treat methylene blue (150 mg/mL). The treatment result was detected by in-situ UV - vis (HITACHI UV 4100) at  $\lambda = 664$  nm, and the effect of temperature and pH was studied.

The blank experiment suggested that H<sub>2</sub>O<sub>2</sub> itself hardly showed effect on the treatment of MB, so did Fe/SiO<sub>2</sub> itself. However, an excellent result of about 96.6% color removal rate in 180 min was obtained when Fe/SiO<sub>2</sub> and H<sub>2</sub>O<sub>2</sub> presented at the same time. The treatment efficiency firstly increased with increasing temperature, and then weakly decreased when the temperature was higher than 60 °C, as shown in Figure 1. It indicated that the higher temperature was favor to the reaction rate, but higher temperature also accelerate the invalid decomposition of H<sub>2</sub>O<sub>2</sub>. Figure 2 presented that the effect decreased with the increasing pH value. Under pH 2.0, a sudden increase of absorbance at 5 min might be caused by the dissolution of iron species for about 18 mg/L iron content was detected in the reclaimed solution. So, pH 3.0 was the optimal condition. Furthermore, hydroxyl radical was detected by EPR using DMPO as scavenger<sup>2</sup>.

Fe/SiO<sub>2</sub> prepared from RHR was found effective for the treatment of MB, and almost 98% color was removed within 60 min under the optimal conditions. Fe/SiO<sub>2</sub> played a role of catalysis in the process with a heterogeneous Fenton-like reaction.

## FIGURES

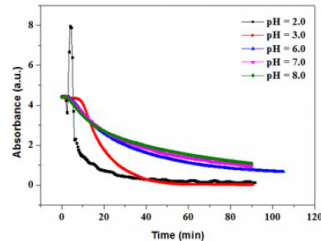
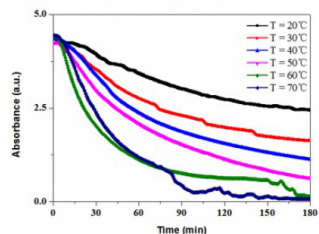


**FIGURE 1**

Figure 1.

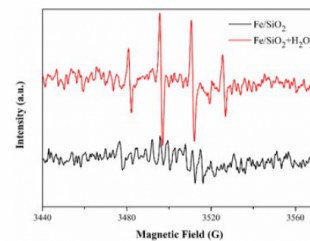
The results of blank experiment and the effect of temperature

(2.5 mL MB, 1.2 g/L Fe/SiO<sub>2</sub>, 0.28 M H<sub>2</sub>O<sub>2</sub>, pH6.0)



**FIGURE 2**

Figure 2.



## KEYWORDS

methylene blue | Fe/SiO<sub>2</sub> | catalysis | Fenton-like

## BIBLIOGRAPHY

(1) Li, Y.; Zhang, X.; Yang, R.; Li, G.; Hu, C. RSC Advances 2015, 5, 32626 - 32636.

(2) Ganiyu, S. O.; Zhou, M.; Martínez-Huitle, C. A. Appl. Catal. B-Environ 2018, 235, 103-129.