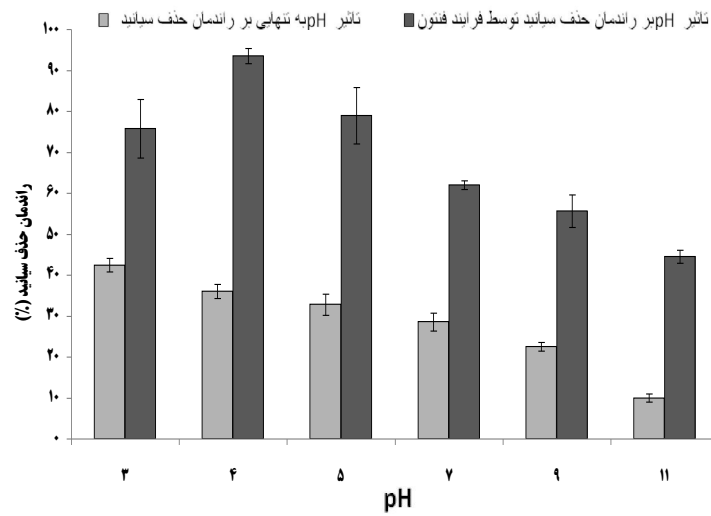




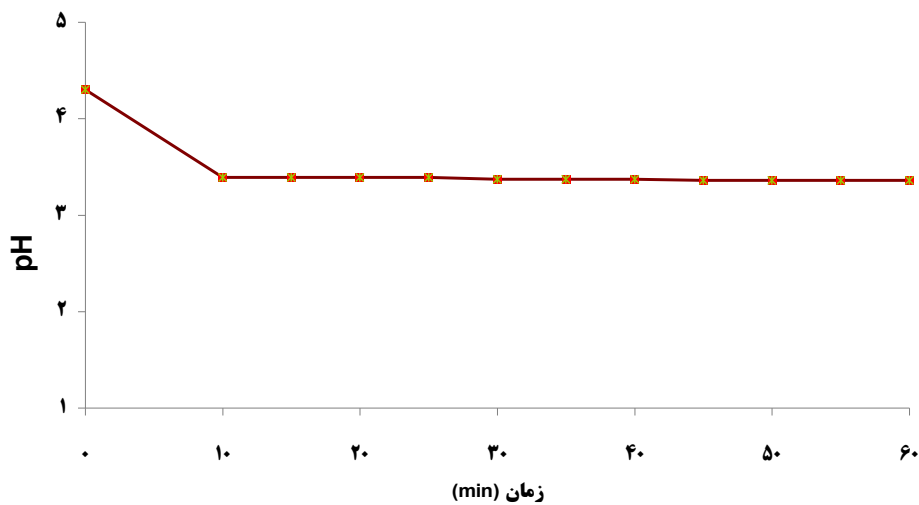


$Fe^{2+} = \frac{A}{\epsilon \cdot l \cdot c}$  (mmol/L)  $Fe^{2+} / H_2O_2 = \frac{A}{\epsilon \cdot l \cdot c}$   
 ppm  
 pH  
 / - /  
 " ( )  
 $Fe^{2+}$  one factor at a time  
 mmol  $H_2O_2$  (mmol)  $- \frac{A}{\epsilon \cdot l \cdot c}$   
 "  $(\epsilon - \epsilon)$   $Fe^{2+} / H_2O_2$  pH  
 "  $\frac{A}{\epsilon \cdot l \cdot c}$  (mmol)  
 (CECIL-model 7100) vis-uv  
 "  $\hat{i} \hat{i}$  nm  
 "  $\hat{i} \hat{i}$   
 4500-E - CN  
 ( )  
 " Merck  
 " Excel  
 "  $Fe^{2+} / H_2O_2$  pH  
 " pH  
 "  $\frac{A}{\epsilon \cdot l \cdot c}$  mg/L  
 $pH = \frac{A}{\epsilon \cdot l \cdot c}$  mg/L  
 "  $\frac{A}{\epsilon \cdot l \cdot c}$  (mmol/L)  
 / L  
 L  
 $\frac{A}{\epsilon \cdot l \cdot c}$  mmol  
 pH pH " " N  
 pH= " !  $\frac{A}{\epsilon \cdot l \cdot c}$  N

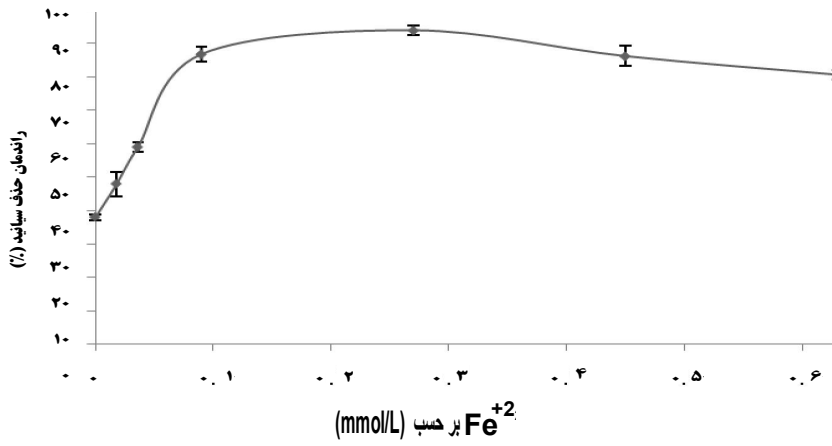


تأثیر pH نهایی بر راندمان حذف سیانید توسط فرایند فنتون

در این مطالعه، راندمان حذف سیانید توسط فرایند فنتون در pH های مختلف (3، 4، 5، 7، 9، 11) بررسی شد. نتایج نشان داد که راندمان حذف سیانید در pH 4 بیشترین مقدار را دارد (92٪). همچنین، راندمان حذف سیانید با افزایش pH کاهش می‌یابد. این امر می‌تواند به دلیل تغییر در تعادل شیمیایی گونه‌های سیانید و همچنین تغییر در پتانسیل اکسیداسیون فرایند فنتون در pH های مختلف باشد.

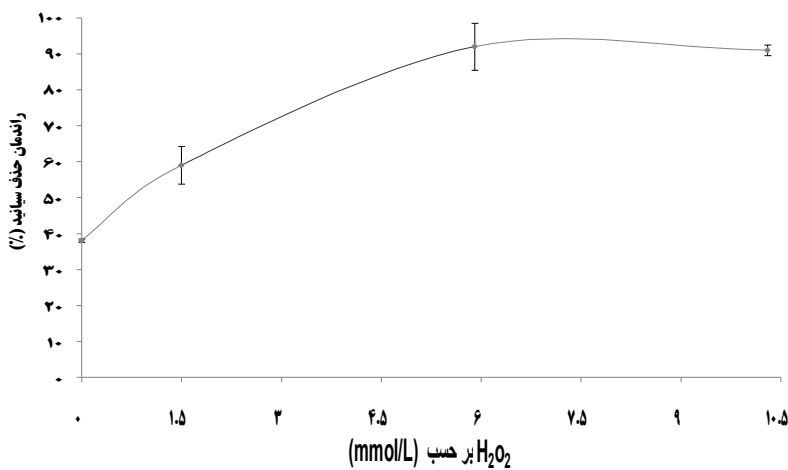


تأثیر زمان بر تغییر pH



( $\text{H}_2\text{O}_2 = 1 \text{ mmol/L}$  |  $\text{pH} = 5$  |  $\text{Time} = 10 \text{ min}$  |  $\text{Temperature} = 25^\circ\text{C}$ )

The effect of  $\text{Fe}^{2+}$  concentration on the removal percentage of  $\text{H}_2\text{O}_2$  was studied. The results showed that the removal percentage of  $\text{H}_2\text{O}_2$  increased with increasing  $\text{Fe}^{2+}$  concentration up to  $0.3 \text{ mmol/L}$  and then decreased. The maximum removal percentage was  $95\%$  at  $0.3 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $45\%$  at  $0.05 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $65\%$  at  $0.1 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $85\%$  at  $0.2 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $90\%$  at  $0.4 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $88\%$  at  $0.5 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration. The removal percentage of  $\text{H}_2\text{O}_2$  was  $85\%$  at  $0.6 \text{ mmol/L}$   $\text{Fe}^{2+}$  concentration.



( $\text{Fe}^{2+} = 1 \text{ mM/L}$  |  $\text{pH} = 5$  |  $\text{Time} = 10 \text{ min}$  |  $\text{Temperature} = 25^\circ\text{C}$ )



$\text{Fe}^{2+} / \text{H}_2\text{O}_2 < \text{pH} = \dots$   
 ( )  
 " Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> < ...  
 i y<sub>min</sub> ...  
 n y ...  
 y Lipczynska ...  
 ( )  
 Kavitha ...  
 y mmol ...  
 fl ...  
 ( ) y<sub>min</sub> ...  
 " H<sub>2</sub>O<sub>2</sub> ...  
 q ...  
 n q d q mM ...  
 " H<sub>2</sub>O<sub>2</sub> :CN ...  
 mmol/L (H<sub>2</sub>O<sub>2</sub>:CN) = ...  
 è mg/L q<sub>min</sub> (Fe<sup>2+</sup>L y) ...  
 Masahafi " ...  
 (H<sub>2</sub>O<sub>2</sub>:CN) = ...  
 mg/L èq<sub>min</sub> : éç mg/L ...  
 (é L ...  
 = y mmol/L pH= ... q mmol/L ...  
 fFe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> = y/y ) H<sub>2</sub>O<sub>2</sub> = / mmol/L iFe<sup>2+</sup> ...  
 n q<sub>min</sub> ...  
 " ...  
 q mmol ...  
 n q d q

$\text{Fe}^{2+} / \text{H}_2\text{O}_2 = \dots$   
 pH = ...  
 ( )  
 Fe<sup>2+</sup> ... pH ...  
 OH<sup>0</sup> H<sup>+</sup> ... H<sub>2</sub>O<sub>2</sub> ...  
 fl L OH<sup>0</sup> ...  
 Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> = y/y ...  
 H<sub>2</sub>O<sub>2</sub> Fe<sup>2+</sup> " ...  
 ( )  
 $\text{Fe}^{2+} + \text{H}_2\text{O}_2 \rightarrow \text{Fe}^{3+} + \text{OH}^0 + \text{OH}^-$  ( )  
 y/y Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> ...  
 " fl ...  
 : ( )  
 $\text{Fe}^{2+} + \text{OH}^0 \rightarrow \text{Fe}^{3+} + \text{OH}^-$  ( )  
 Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> < Neyens ...  
 y mmolL ...  
 " fl L fl ...  
 " y mmol ...  
 Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> ... y / mmol/L ...  
 y/y ...  
 H<sub>2</sub>O<sub>2</sub> ...  
 ( )  
 $2\text{H}_2\text{O}_2 \rightarrow 2\text{H}_2\text{O} + \text{O}_2$  ( )  
 $\text{H}_2\text{O}_2 + \text{OH}^0 \rightarrow \text{H}_2\text{O} + \text{HO}_2^0$  ( )  
 Fe<sup>2+</sup> / H<sub>2</sub>O<sub>2</sub> ...

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## The Study of Fenton Performance in Removal of Cyanide from Aqueous Solution

Somayeh Golbaz<sup>1</sup>, \*Ahmad Jonidi Jafari<sup>2</sup>, Roshanak Rezaei Kalantari<sup>3</sup>

<sup>1</sup>Department of Environmental Health, Faculty of Health, Alborz University of Medical Sciences, Alborz, Iran

<sup>2</sup>Department of Environmental health Engineering, School of Medical Sciences, Tarbiat Modares University, Tehran, Iran

<sup>3</sup>Department of Environmental Health, Faculty of Health, Tehran University of Medical Sciences, Tehran, Iran

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### ABSTRACT

**Background and Objectives:** Cyanide is a toxic pollutant existing in the various industrial effluents such as iron and steel, coal mining, non-ferrous metals manufacturing and metal plating. Its presence in water resources and wastewater, as serious hazardous substances leads to undesirable effects on both the environment and human. Thus, its concentration control is essential for human health. The main goal of this study was to evaluate Fenton process efficiency in cyanide removal from aqueous solution.

**Materials and Methods:** This is an experimental study Conducted at Lab scale in a batch system. We investigated effect of different variables including; pH, mole ratio of  $\text{Fe}^{2+}/\text{H}_2\text{O}_2$ , contact time, and initial concentration of cyanide. Data were analyzed using Excel software.

**Results:** We found that cyanide with initial concentrations of 0.4 mM/L was reduced by 92 %. This removal result was related to oxidizing agent of hydroxyl radicals under optimum conditions including; pH = 4, molar ratio  $\text{Fe}^{2+}/\text{H}_2\text{O}_2 = 0.046$  ( $\text{Fe}^{2+} = 0.27$  mM/L) after 60 min reaction time. An increase in reaction time was not improved cyanide removal efficiency. Moreover, the Fenton process efficiency in cyanide removal decreased from 92 to 60 %, by increasing the initial cyanide concentration from 0.4 to 0.6 mM/L.

**Conclusion:** It can be concluded that Fenton oxidation Process can be considered as a suitable alternative for cyanide removal to achieve environmental standards.

**Keywords:** Advanced oxidation, Hydrogen peroxide, Fenton, Wastewater treatment, Cyanide

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\*Corresponding Author: [a.jonidi@modares.ac.ir](mailto:a.jonidi@modares.ac.ir)

Tel: +98 21 883563 Fax: +98 21 82883825