

mesdaghinia@sina.tums.ac.ir :

(II)

(Chemical Oxygen Demand)

(OH

).(Glaze et al.1987)

OH

(AOPs)

Advanced Oxidation Processes

COD

2,4-DCP

Oxidation – Reduction Potential (ORP)

$$E^{\circ} = + 3.06 \text{ V}$$

Fe²⁺ H₂O₂

2,4-DCP

OH

)

(

:(Freeman 1998)

() AOPs

DCP

COD BOD₅

BOD₅/COD

H₂O₂ /

UV /

H₂O₂/ UV /

UV/H₂O₂

Fe²⁺/ H₂O₂

H.J.H Fenton

()

(Fenton Reaction)

(Fenton Reagent)

.(Nesheiwat et al. 2000)

OH

H₂O₂

2,4-)

(DCP

.(Bigda 1995)

2,4-DCP

()

:
H₂O₂
H₂O₂
(Chamarro et al. 2001)
pH pH : pH
pH
pH
(Adams et al. 1994)
(Chlorophenols)
H₂O₂
:
 $\frac{Fe^{2+}}{Fe^{3+}}$
(Fares 2003)
2,4-DCP
(2,4-D)
(2,4-DP)
DCP
(Chen et al. 1997)
(high-production volume chemicals) (H₂O₂/substrate)
H₂O₂
(US EPA)
/
(BUA 1988)
(Adams et al. 1994)

Fe=15 mg/L

2,4-DCP=100 mg/L

pH

mg/L

2,4-DCP

pH=3

Fe=15 mg/L

(II)

() H₂O₂H₂O₂

Fe=15 mg/L

pH

)

2,4-DCP=50 mg/L

pH (

2,4-DCP=100 mg/L

pH

H₂O₂H₂O₂H₂O₂ (II)H₂O₂

COD

.(Chamaro et al. 2001)

H₂O₂ =50 mg/LBOD₅ CODH₂O₂

COD

.(APHA 1998)

(II)

H₂O₂=50 mg/L

COD %

Fe(II) =5 mg/L H₂O₂=50 mg/L

COD %

COD

%

COD

COD

Fe(II) =5 mg/L

2,4-DCP=100 mg/L

BOD₅H₂O₂=50, 75, 100 mg/L

mg/L	COD		COD	H ₂ O ₂	H ₂ O ₂
BOD ₅	/	/	/	/	mg/L
/	/	/	mg/L		
			.()	COD	
	COD				% % %
	COD	%			
BOD ₅ /COD			COD	(II)	H ₂ O ₂
	/				
COD					
			(II)		H ₂ O ₂ = 100 mg/L
	Fe=15 mg/L	H ₂ O ₂ =100 mg/L	COD		
		BOD ₅ /COD			%
	.()	/			5 mg/L
			%		COD
		BOD ₅ /COD			
				H ₂ O ₂ = 100 mg/L	
				10 min	Fe(II) =5 mg/L
				%	COD
BOD ₅ /COD	Fe=10 mg/L	H ₂ O ₂ =50 mg/L	COD		
/	2,4-DCP=50 mg/L				
					.()
	H ₂ O ₂ =100 mg/L	Fe=15 mg/L			
	/	BOD ₅ /COD		H ₂ O ₂	
		.()		COD %	%
		BOD ₅ /COD	COD	(II)	
	Fe=15 mg/L				
Fe=15 mg/L				H ₂ O ₂ =75 mg/L	
	BOD ₅ /COD				Fe(II) =10 mg/L
			COD		2,4-DCP=100 mg/L
		BOD ₅ /COD			

	H ₂ O ₂			
pH	(II)		2,4-DCP=100 mg/L	
/	/	/	/	
	()	pH	2,4-DCP=100 mg/L	BOD ₅ /COD
pH	pH	2,4-DCP=100 mg/L	H ₂ O ₂ =100 mg/L	/
	Fe=10 mg/L	H ₂ O ₂ =75 mg/L		Fe=15 mg/L
	COD		H ₂ O ₂	(BOD ₅ /COD)
	Fe	H ₂ O ₂		
pH	pH	Fe ²⁺	H ₂ O ₂	
		/		
			()	/
			BOD ₅ /COD	(II)
	%			
	%		H ₂ O ₂	
		(Ma et al. 2000)	H ₂ O ₂	
		pH		
(Bum et al. 1999)				BOD ₅ /COD
		pH=3-4		pH
		pH		
	(Chamarro et al. 2001)	NaOH	pH	
				pH
			pH	2,4-DCP=50 mg/L

/...

%

)

COD

()

.(

;

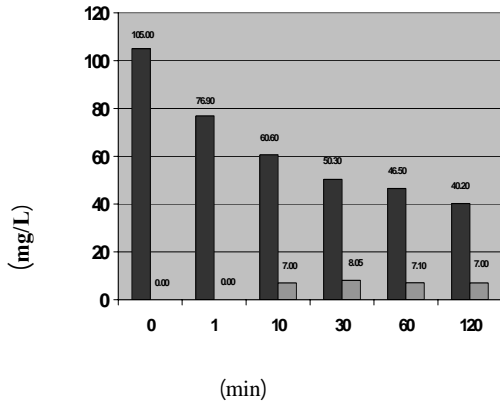
Fe(II)=10 mg/L	H ₂ O ₂		2,4-DCP=50 mg/L				$\frac{BOD_5}{COD}$		BOD ₅ · COD			
	Fe=10 mg/L											
	H ₂ O ₂ =100 mg/L		H ₂ O ₂ =75 mg/L		H ₂ O ₂ =50 mg/L							
$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	min
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/

Fe(II)=15 mg/L	H ₂ O ₂		2,4-DCP=50 mg/L				$\frac{BOD_5}{COD}$		BOD ₅ · COD			
	Fe=15 mg/L											
	H ₂ O ₂ =100 mg/L		H ₂ O ₂ =75 mg/L		H ₂ O ₂ =50 mg/L							
$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	min
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/

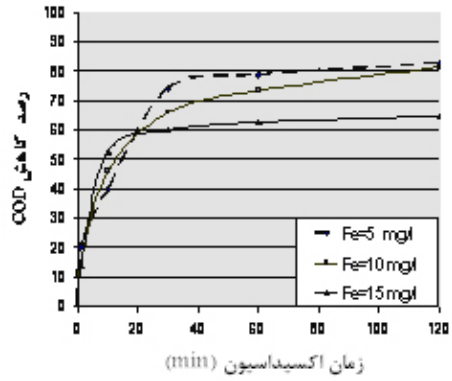
/ ...

Fe(II)=10 mg/L	H ₂ O ₂		2,4-DCP=100 mg/L				$\frac{BOD_5}{COD}$		BOD ₅ · COD			
	Fe=10 mg/L											
	H ₂ O ₂ =100 mg/L			H ₂ O ₂ =75 mg/L			H ₂ O ₂ =50 mg/L					
$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	min
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/

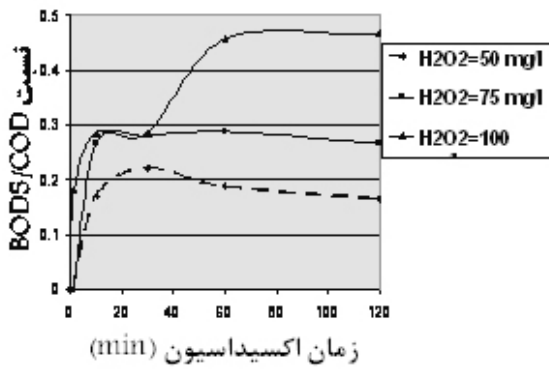
Fe(II)=15 mg/L	H ₂ O ₂		2,4-DCP=100 mg/L				$\frac{BOD_5}{COD}$		BOD ₅ · COD			
	Fe=15 mg/L											
	H ₂ O ₂ =100 mg/L			H ₂ O ₂ =75 mg/L			H ₂ O ₂ =50 mg/L					
$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	$\frac{BoD_5}{COD}$	BOD ₅ mg/L	COD	COD mg/L	min
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/
/	/	/	/	/	/	/	/	/	/	/	/	/



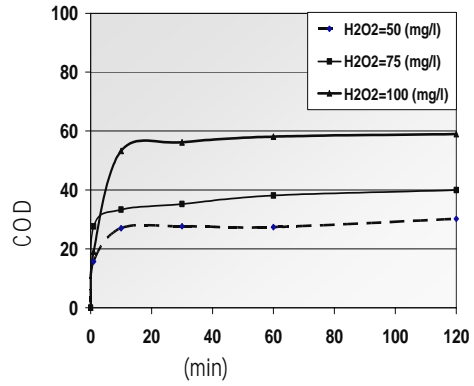
BOD₅ COD
 2,4-DCP=100 mg/L
 Fe=10(mg/L) H₂O₂=75(mg/L)



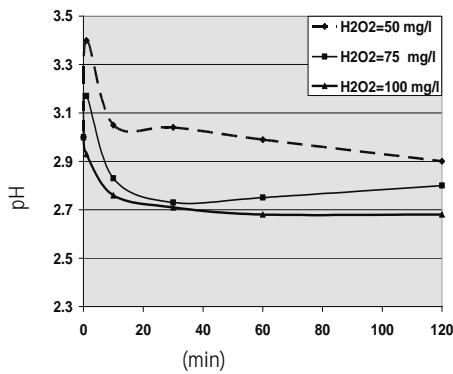
COD Fe(II)
 H₂O₂=50 mg/L 2,4-DCP=50 mg/L



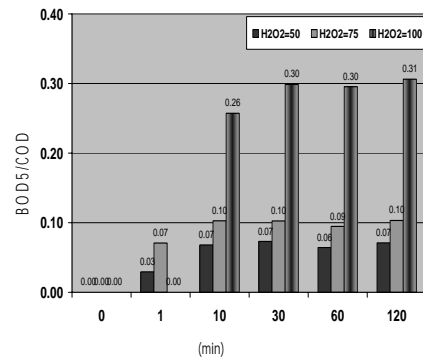
BOD₅/COD
 Fe=15 mg/L H₂O₂ 2,4-DCP=50 mg/L



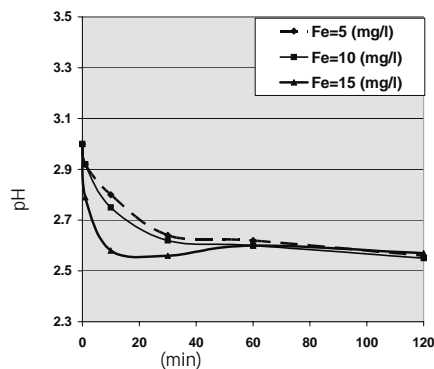
COD H₂O₂
 Fe(II)=15 mg/L 2,4-DCP=100 mg/L



pH
 2,4-DCP=100 mg/L
 Fe(II)=10 mg/L



BOD₅/COD
 2,4-DCP=100 mg/L
 Fe=15 mg/L H₂O₂



pH :
2,4-DCP=100 mg/L

Sedlak , D. and Andren , A. , 1991. Aqueous oxidation of polychlorinated biphenyl's by hydroxyl radicals. *Environmental Science & Technology* . **25**, pp.1419-1427 .

Chen , R. and Pignatello , J. 1997. Role of quinone intermediate as electron shuttles in Fenton and photo-assisted Fenton oxidation of aromatic components. *Env. Sci. & Tec.* **31**, pp. 2399-2409.

Adamas, C.D., Scanlan , P.A. and Secristan , S. 1994. Oxidation and biodegradability enhancement of 1,4-dioxane using Hydrogen Peroxide and ozone. *Env. Sci. & Tec.* **28**, pp. 1812-1818.

Fares al momani. , 2003. Combination of photo-oxidation process with biological treatment, *Barcelona* ,pp. 26-30.

BUA. , 1988. 2,4-dichlorophenol, BUA report 31, German , Chemical safety .

APHA, AWWA, WEF. , 1998. Standard methods for the examination of water and wastewater, 20 th Edition, United Book Press Inc., Baltimore, Maryland .

Ma, Y.S., Huang , S.T. and Clin, J., 2000. Degradation of 4-nitrophenol using Fenton process. *Water Science and Technology.* **42**(3-4) , pp. 155-160.

Gankwon , B., Soolee, D., Kung , N. and Yoon, J. , 1999. Characteristics of P-chlorophenol oxidation by Fenton reagent. *Water Rresearch.* **33**(9), pp. 2110-2118

Glaze , W. H., Kang , J.W. and Chapin , D.H. , 1987. The chemistry of water treatment process involving ozone, hydrogen peroxide and ultraviolet radiation. *Ozone Sci. & Eng.* **9**(4), pp. 335-349.

Freeman , H.M. , 1998. Standard handbook of hazardous waste treatment and disposal, second edition, Mc Graw Hill ,New York . pp. 7-45.

Nesheiwat , F.K. and Awanson , A.G. , 2000. Clean contaminated sites using Fenton reagent. *Chemical Engineering progress,* **96**(4) , pp. 61-66.

Bigda , R. J. , 1995. Consider Fenton's chemistry for wastewater treatment. *Chem. Eng. Pro.* **91**(12) , pp. 62-66.

Chamarro, E., Marco , A. and Esplugas , S. , 2001. Use of Fenton reagent to improve organic chemical biodegradability. *Water Research.* **35**(4) , pp. 1047-1051