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2003/07/08

2003/10/02

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**Methyl orange, Azo carmine B, Coomassie Brilliant blue G250, Tartrazine, Calcon,
Eriochrome blue SE, Solamine Red 4BL, Bismarck brown Y(G), Methylen blue,
Black 5, Red 120, Morin.**

TiO2 (Degussa P25)

()

:

Dyes and pigmint 49, 117-125 (2001)

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Decolourization of Textile Industry Wastewater by the Photocatalytic degradation process. «Part 2»*

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ABSTRACT

During the past few years attention has been drawn on chemical techniques that could be used to discolour textile wastewaters. We have studied the photocatalytic degradation of various dyes (Methyl orange, Azo carmine B, Coomassie Brilliant blue G250, Tartrazine, Calcon, Eriochrome blue SE, Solamine Red 4BL, Bismarck brown Y(G), Methylen blue, Black 5, Red 120, Morin) using TiO₂ P25 Degussa as catalyst. All dye solutions underwent a decolourization. The kinetics of reaction have been studied and were found to be zero or first order with respect to the dye. It was compared with the adsorption properties. The effect of the addition of hydrogen peroxide has been studied. An enhancement of the rate has been observed in all cases and the order with respect to the dye's concentration in presence of the additive seemed not to change. It is difficult to give general view of the kinetics using these very different dyes but the process was found to be effective for the decolourization of textile wastewater.

Keywords: Dyes, Decolourization, Photocatalytic, Kinetics, Hydrogen peroxide, Textile industry, Wastewater treatment.

* Part1.Hashem, C.et al., Dyes and pigmint 49, 117-125 (2001)

(10-50 mg/l)

pH

[1] (Cu, Cr, Ni)

[2,4]

[5]

pH= 8-1

[6] %50

Advanced Oxidation Processes (AOPs)

(OH•)

)

[7]

H₂O₂/UV

-

(pH

[12,13]

[8,11]

UV

[14,16]

[17,18]

Methyl orange, Azo carmine B, Coomassie Brilliant blue :

G250, Tartrazine

Calcon, Eriochrome blue SE :

Bismarck brown Y(G), Methylen blue :

Morin :

Merck

Solamine Red 4BL :

Black 5, Red 120 :

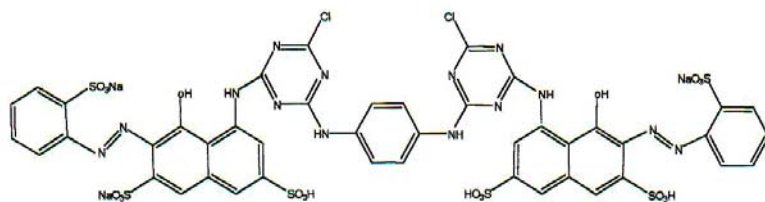
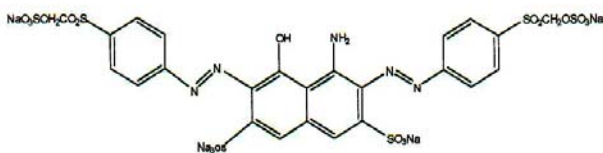
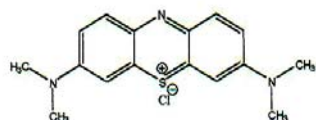
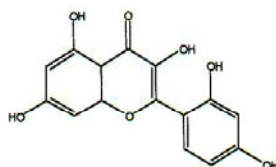
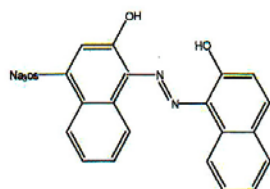
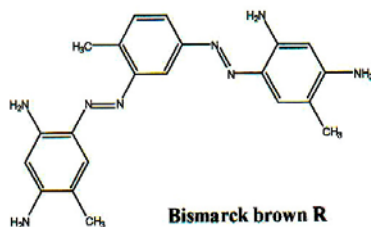
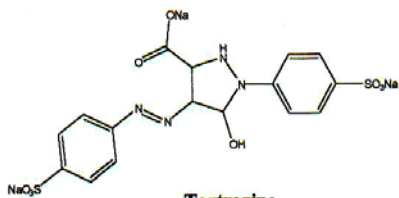
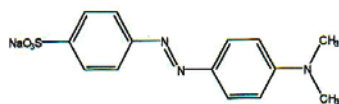
Azo :

carmine B, Bismarck brown Y(G), Coomassie Brilliant blue G250
[19-20] Mehta et al

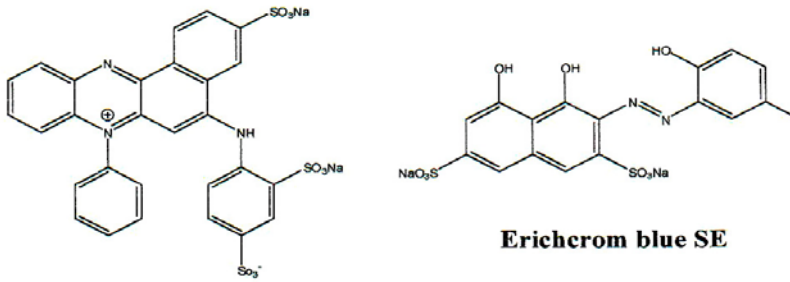
(1)

DMF

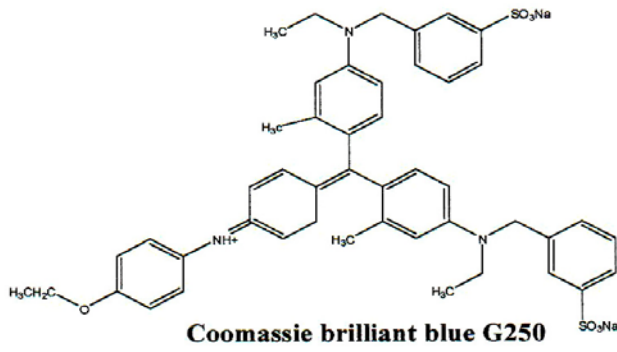
Titanium Fluka (30% w/w)
anatase %70 .HAMILTON
Dioxide P25 Degussa
[21]
Gemini N₂ 20nm
48.3m²g⁻¹ 2375 V5 Instrument ID 1476
3.8x48cm² [22]

**Red 120****Black 5****Methylene blue****Morin****Calcon****Bismarck brown R****Tartrazine****Methyl orange**

(1)



Azocarmine B



(1)

4g/l

pH= 3

475°C
OH
OH HF
NaOH
UV H₂O₂
0.6ℓ (2)
0.4ℓmin⁻¹
Hitachi 15W UV
0.2 ℓ
360nm
.[23] 2x10⁻³ E min⁻¹m⁻²



(2)

Jasco/UV/VIS

pH C_i

λ_{max}
 ϵ

7800

Spectrophotometer
(1)

C UV

C_0

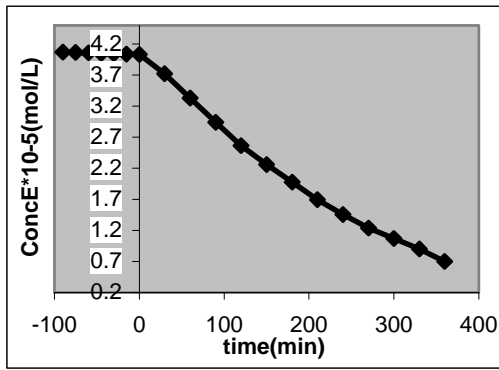
(4)

C_i

(3)

C/C_0
 $C_0 t$

MethylOrange



(4)

C_0

90

(1)

45

C_0

$$A = (C_i - C_0) / C_i \quad :$$

(1)

	Methyl orange	Azo carmine B	Coomassie Brilliant blue G250	Tartrazine	Caleon	Eriochrome blue SE	Solamine Red 4BL	Bismarck brown Y(G)	Methylen blue	Black 5	Red 120	Morin
	Azo	Azo	Triphenyl	Azo	Azo	Azo	Diazo	Diazo	Thiazine	Diazo	Diazo	Quinon
	13025	50090	42655	19140	15705	16680	29065	21010	52030	20505	25810	75660
λ_{max} nm	466	516	582	427	539	529	508	433	664	598	535	407
$C_i(\text{mol/l}) \cdot 10^5$	4.8	9.9	2.1	2.0	11.0	5.0	3.1	1.8	2.6	3.2	5.1	7.0
$A = (C_i - C_0) / C_i$	0.014	0.240	0.300	0.010	0.037	0.035	0.112	0.239	0.12	0.06	0.006	0.048
pH	3.27	6.05	6.86	3.52	5.35	4.03	5.79	5.00	6.7	3.54	3.9	4.99
$\epsilon(\text{l/mol/cm}) \cdot 10^{-5}$	0.24	0.07	0.42	0.51	0.07	0.42	0.37	0.25	0.68	0.31	0.30	0.12

Methyl Orange, Tartrazine

)

A%

Bismarck

(0.01

Brown Y(G), Methylene blue

(Higher solvation energy)

.[24]

Coomassie Brilliant blue G250, Azocarmine

Azine

Solamine Red 4BL

(A=0.112)

Meyer

[31]

.[32,33] Hodgson

Black 5

Red 120

(A= 0.06)

(A= 0.006)

pH≤1

OH⁻ H₂O

(3) ln(C/Co) C

H₂O₂

Langmuir-Hinshelwood

[25]

TiO₂

$$r_{LH} = -dC/dt = kKC/(1+KC) \quad (1)$$

:K () :k t :C :

(1)

$$t = [\ln(Co/C)]/Kk + (Co-C)/k \quad (2)$$

(2)

:

$$\ln(C_0/C) \approx kKt = k't$$

kKC r

k r

r_a k K (2)r_o

(2)

	Methyl orange	Azo carmine B	Coomassie Brilliant blue G250	Tartrazine	Calcon	Eriochrome blue SE	Solamine Red 4BL	Bismarck brown Y(G)	Methylen blue	Black 5	Red 120	Morin
pH	3.27	6.05	6.86	3.52	5.35	4.03	5.79	5.00	6.7	3.54	3.9	4.99
	1	1	0	0	1	1	0	1	1	0	1	1
Ci(mol ⁻¹)*10 ⁵	4.8	9.9	2.1	2.0	11.0	5.0	3.1	1.8	2.6	3.2	5.1	7.0
Co(mol ⁻¹)*10 ⁵	4.7	8.4	1.8	2.0	10.6	4.7	2.7	1.3	2.3	3.0	5.0	6.6
K (min ⁻¹)	0.0011	0.0277	0.0071	0.0003	0.0004	0.0007	0.0014	0.0060	0.0017	0.0022	0.0006	0.0006
A%	1	24	30.6	1	3	6	12	36	11.8	6	6	4
r _a (mol ⁻¹ min ⁻¹)*10 ⁵	0.005	0.273	0.014	0.0006	0.004	0.003	0.004	0.010	0.004	0.007	0.003	0.004
k (min ⁻¹)	0.0080	0.0022	0.0020	0.0008	0.0008	0.0041	0.0026	0.0029	0.0041	0.0055	0.0002	0.0027
r _o (mol ⁻¹ min ⁻¹)*10 ⁵	0.037	0.018	0.003	0.001	0.008	0.019	0.007	0.003	0.009	0.016	0.001	0.017
r _o / r _a	7.400	0.065	0.214	1.666	2.000	6.300	1.750	0.300	2.250	2.280	0.330	4.250
%	23.38	46.88	36.01	12.65	24.04	29.84	34.62	76.65	66.04	63.23	08.20	61.98

[26] Hashem (2)

) Methylene blue, Bismarck Brown Y(G)
 Comassie Brilliant, Azo carmine
 (

Methylene blue
 76% Bismarck Brown

Bismarck Brown
 66% Methylene blue
 Bismarck Brown

[24-27] -NH
 46.88 Comassie Brilliant, Azo carmine
 -NH

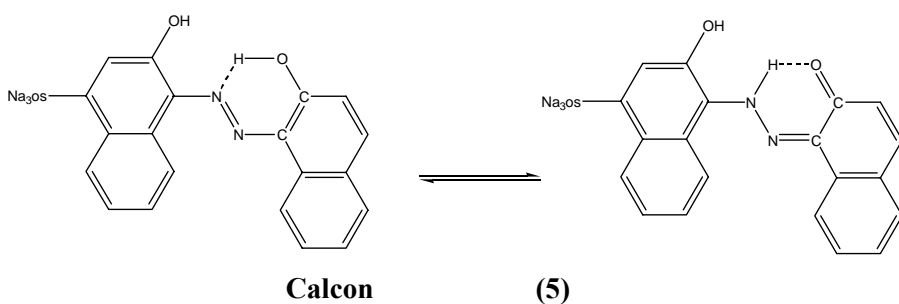
36.01

Eriochrom blue SE, Calcon

Tartrazine

-NH

(5)



Eriochrom blue SE, Calcon

-NH

Tartrazine

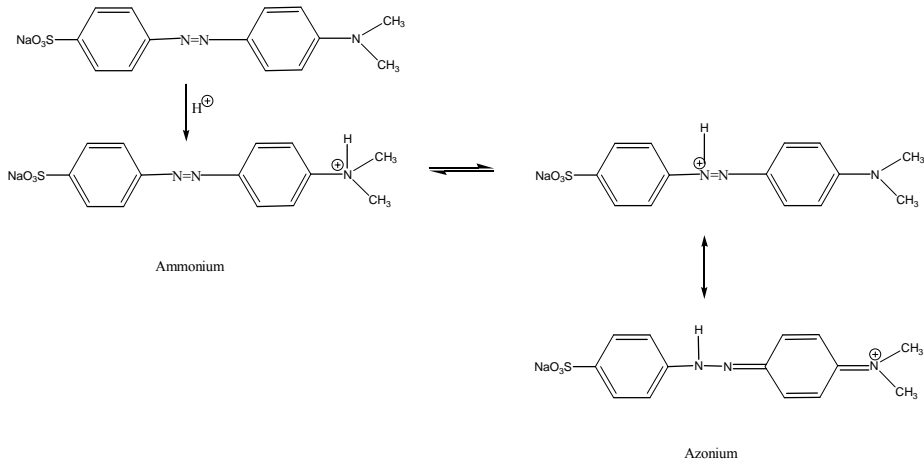
Tartrazine

Methyle Orange

-

protonation

(6) [28]



Methyle Orange

-

(6)

)

β

(hydrazone

Solamine Red 4BL

-NH

(
Red 120
Black5

Black5 (sulphatoethyl sulphone)
(Triazinyl dyes) ()

-NH

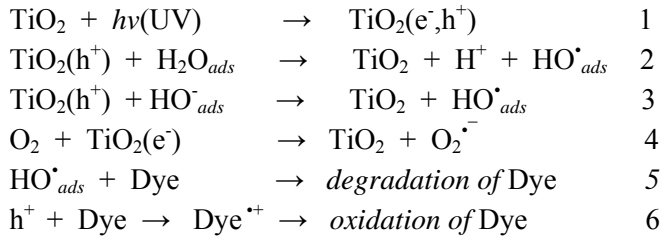
Red 120

[26,34] (sulphatoethyl sulphone)
()

8.2%
 (.15W () [35] 1600W
 Morin

.61.98%
 [2] Galindo

h⁺ : (2)
 . (e⁻,h⁺)
 :



COD
 (3)

17-50% COD

COD (3)

	Coomassie Brilliant blue G250	Tartrazine	Calcon	Eriochrome blue SE	Solamine Red 4BL	Red 120
COD (ppm)	153.6	153.6	153.6	192	1075.2	268.8
COD (ppm)	115.2	76.8	115.2	153.6	883.2	153.6
% COD	25	50	25	20	17.8	42.8

Limiting processes

r_o	r_a	
0.48	r_a	r_o
Morin	Bismarck Brown	($r_o/r_a = 0.33$) Red 120
Eriochrome blue SE		4.5 5.8

(transport process)

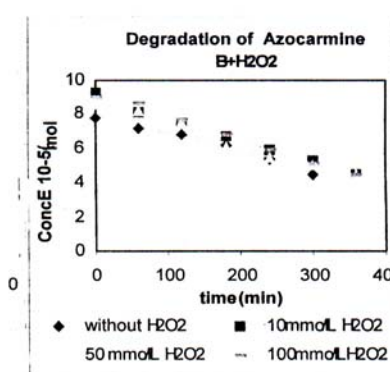
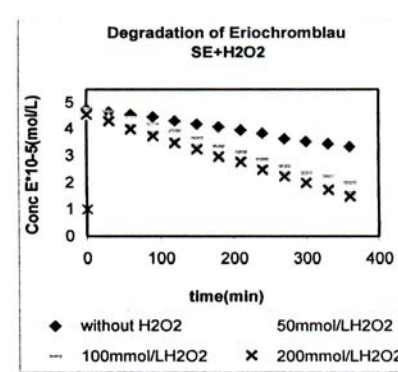
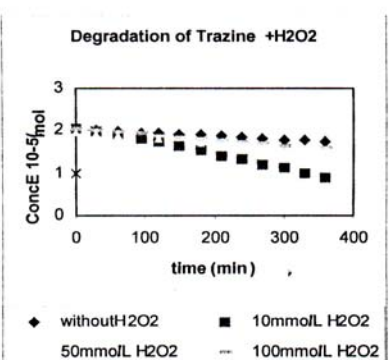
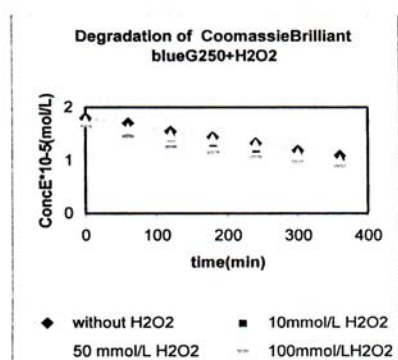
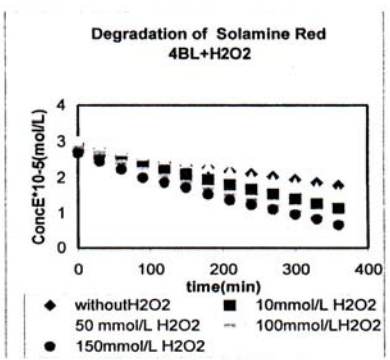
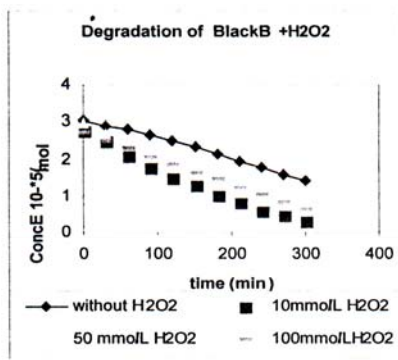
[29-30]

10^{-3} / $10^{-2} - 10^{-1}$ /

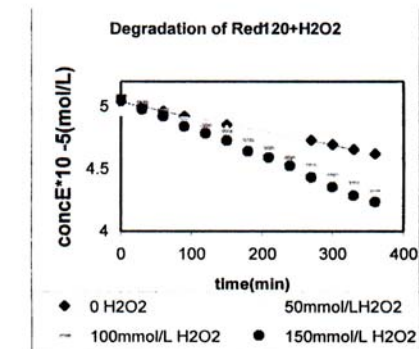
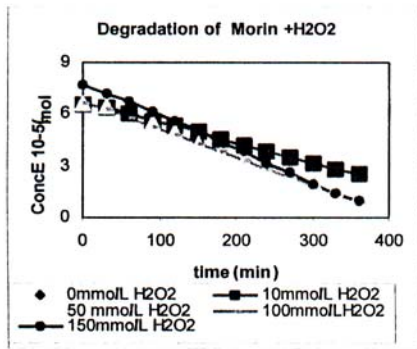
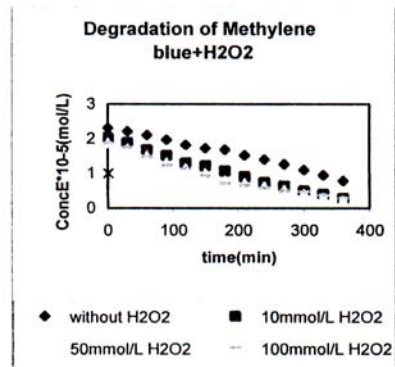
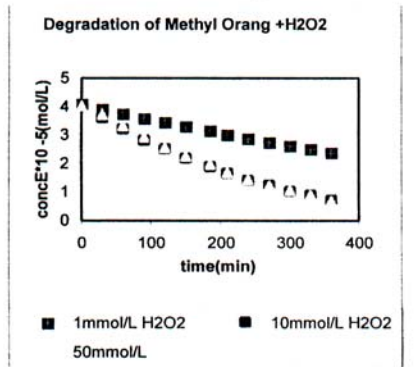
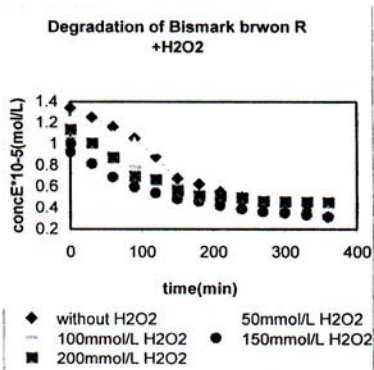
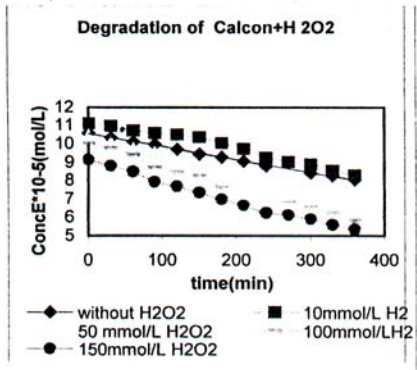
(4)

 H_2O_2 (4)

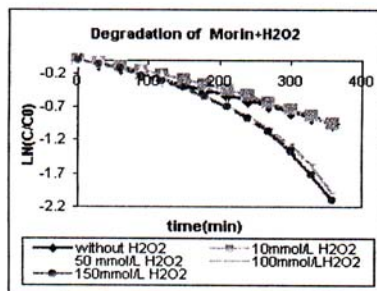
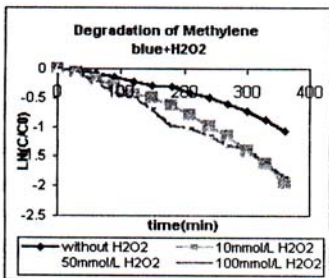
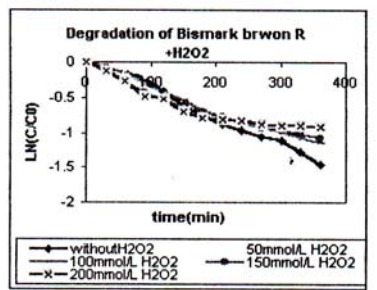
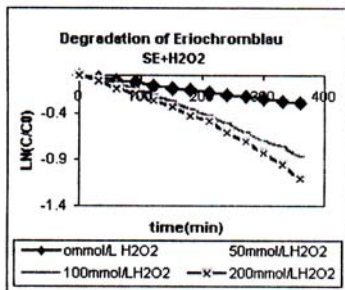
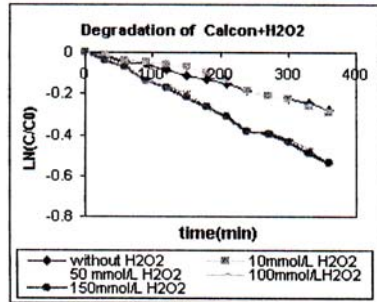
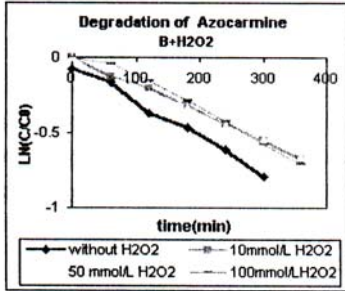
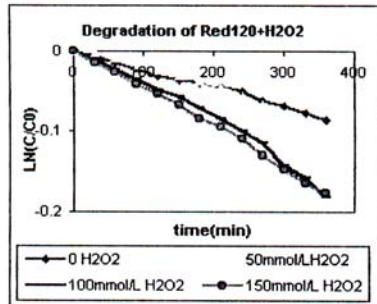
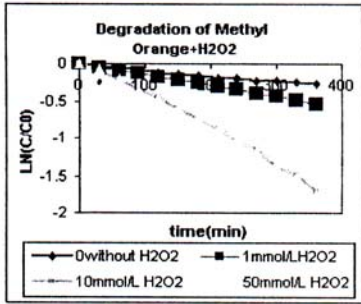
	Methyl orange	Azo carmine B	Coomassie Brilliant blue G250	Tartrazine	Calcon	Eriochrome blue SE	Solamine Red 4BL	Bismarck brown Y(G)	Methylen blue	Black 5	Red 120	Morin
% H_2O_2	23.38	46.88	36.01	12.65	24.04	29.84	34.62	76.65	66.04	63.23	8.2	61.98
% H_2O_2 (1mmol/l)	81.71	46.88	41.83	56.32	25.31	-	46.67	-	85.86	98.98	-	62.17
% H_2O_2 (10mmol/l)	82.62	48.07	43.08	26.96	39.93	60.03	59.32	54.85	87.85	81.05	9.34	80.35
% H_2O_2 (100mmol/l)	-	50.72	38.85	21.52	41.17	58.36	74.03	68.69	84.69	91.90	15.03	86.63



(3)



(3)



(3)

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