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APPENDICES

APPENDIX A

EXPERIMENTAL RESULTS

Table A1. Treatment of 100 ppm TCE contaminated wastewater using Fenton's reagent

Sample	Condition	R	Reaction Time (min.)	TiO_2 (mg/L)	%TCE degradation	$\%H_2O_2$ degradation	Initial pH	Final pH
BR1/1	B	10:1:1	5	500	60.05	7.75	3.00	2.48
BR1/2	B	10:1:1	15	500	62.25	9.25	3.00	2.32
BR1/3	B	10:1:1	30	500	67.98	11.85	3.01	2.45
DR1/1	D	10:1:1	5	500	63.58	7.75	3.00	2.46
DR1/2	D	10:1:1	15	500	69.99	9.75	2.99	2.38
DR1/3	D	10:1:1	30	500	80.45	13.85	3.00	2.64
BR2/1	B	20:1:1	5	500	73.91	25.65	3.00	2.58
BR2/2	B	20:1:1	15	500	80.60	29.75	3.11	2.55
BR2/3	B	20:1:1	30	500	91.20	32.75	2.85	2.47
DR2/1	D	20:1:1	5	500	75.36	16.55	3.05	2.33
DR2/2	D	20:1:1	15	500	82.61	31.85	3.00	2.75
DR2/3	D	20:1:1	30	500	92.31	36.75	3.02	2.54
BR3/1	B	20:2:1	5	1000	84.03	34.52	2.95	2.53
BR3/2	B	20:2:1	15	1000	93.32	37.80	3.01	2.44
BR3/3	B	20:2:1	30	1000	96.18	38.92	3.00	2.36
DR3/1	D	20:2:1	5	1000	87.32	50.92	3.00	2.55
DR3/2	D	20:2:1	15	1000	95.44	45.98	3.10	2.33
DR3/3	D	20:2:1	30	1000	98.27	55.64	3.09	2.48
BR4/1	B	40:2:1	5	250	94.67	35.45	3.03	2.41
BR4/2	B	40:2:1	15	250	99.15	36.75	3.07	2.51
BR4/3	B	40:2:1	30	250	100	36.75	3.00	2.39
DR4/1	D	40:2:1	5	250	95.97	35.75	3.00	2.49
DR4/2	D	40:2:1	15	250	99.98	37.75	3.04	2.51
DR4/3	D	40:2:1	30	250	100	38.00	2.98	2.37

Table A2. Treatment of 100 ppm contaminated wastewater using Fenton's reagent from recycled reagent

Sample	Condition	R	Reaction Time (min.)	TiO_2 (mg/L)	%TCE degradation	%H_2O_2 degradation	Initial pH	Final pH
BR3re	B	20:2:1	15	1000	85.71	-	3.45	2.86
DR3re	D	20:2:1	15	1000	92.25	-	3.21	2.75
BR4re	B	40:2:1	15	250	90.26	-	3.01	2.56
DR4re	D	40:2:1	15	250	95.78	-	3.12	2.53

APPENDIX B

CALCULATION

Treatment of 100 ppm TCE contaminated wastewater using Fenton's reagent, R = 20:2:1, TiO_2 = 1,000 mg/L

Given data:

Density of standard concentrated TCE = 1.456 g/mL

Density of Hydrogen peroxide 35%w/w solution= 1.132 g/mL

Atomic and Molecular Weight

Fe = 55.847, S = 32.06, K = 39.098, Mn = 54.938 Cl = 35.453 $FeSO_4.7H_2O$ = 277.913, C_2HCl_3 = 131.39

Ratio of initial substance (R) = H_2O_2:Fe^{2+}TCE = 20:2:1 by molar

1.) **Amount of TCE in reactor**

155 mL of 100 ppm TCE solution

= (100 mg/L * 0.155 L) * 1 g/1000 mg

= 0.0155 g

= 0.0155 g * 1 mol/ 131.39 g

= $1.18 * 10^{-4}$ mol

2.) **Amount of Fe^{2+} in reactor**

= 2* $1.18 * 10^{-4}$ mol

= $2.36 * 10^{-4}$ mol

= $2.36 * 10^{-4}$ mol * 55.847 g/1 mol

= 0.013 g

= 13 mg

Fe^{2+} 13 mg in 155 mL solution

=13 mg/ 0.155L

= 83.87 mg/L

Prepare from 30,000 ppm Fe^{2-} stock solution

$C_1V_1 \quad = \quad C_2V_2$

(83.87 mg/L)(0.155 L) = (30,000 mg/L)(V_2)

V_2 = 0.43 mL

Then, add 0.43 mL of 30,000 ppm Fe^{2+} stock solution into the reactor

3.) Amount of H_2O_2 in reactor

= 20* 1.18 * 10^{-4} mol

= 2.36 * 10^{-3} mol

= 2.36 * 10^{-3} mol * 34 g/ 1 mol

= 0.08 g

Prepare from H_2O_2 35% w/w reagent

Then, add H_2O_2 35% w/w = 0.08 g * 100 / 35

= 0.23 g

= 0.23 g * 1.132 g / 1 mL

= 0.26 mL

4.) Amount of TiO_2 in reactor

= 1,000 mg/L * 0.155 L

= 155 mg

APPENDIX C

PICTURES OF ACCESORIES AND MATERIALS USED IN THIS RESEARCH

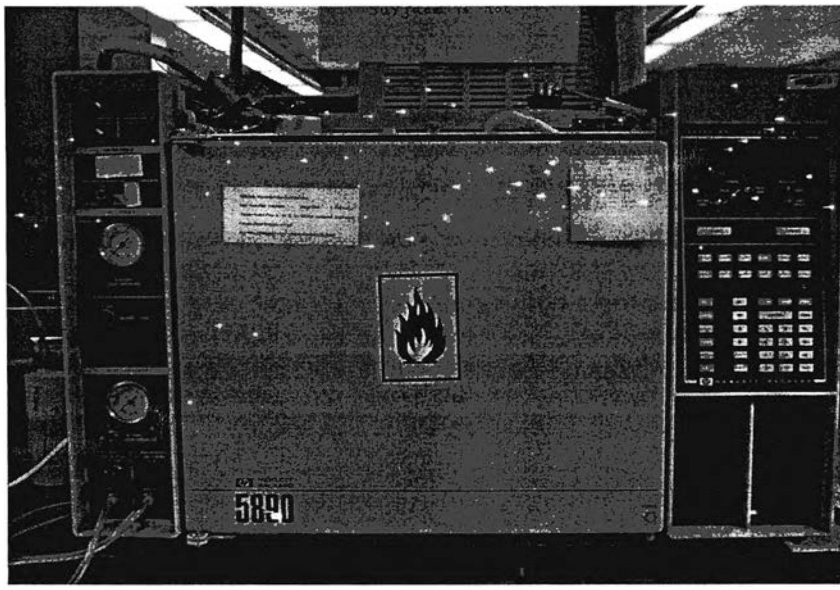

Figure C1 Gas Chromatographer (GC) Hewlett Packard model 5890 with Electron Capture Detector (ECD)

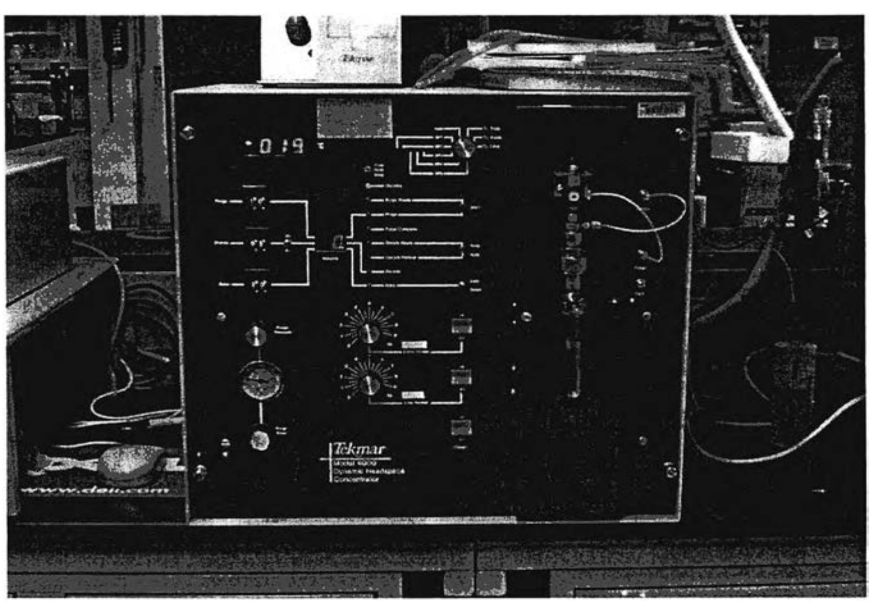

Figure C2 Dynamic Headspace Concentrator Tekmar model 4000

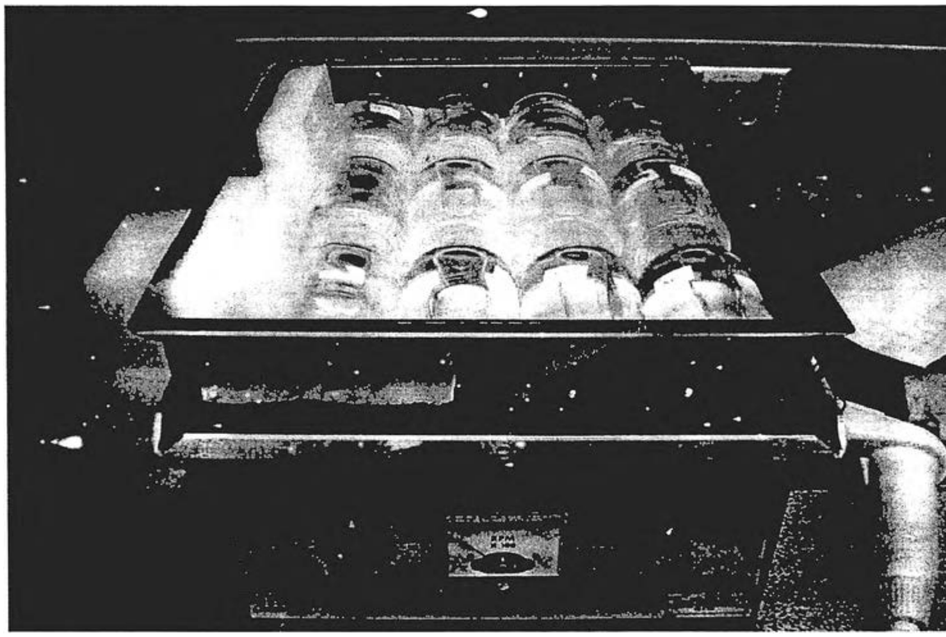

Figure C3 Junior Orbit Shaker from Lab-Line Instruments, Inc.

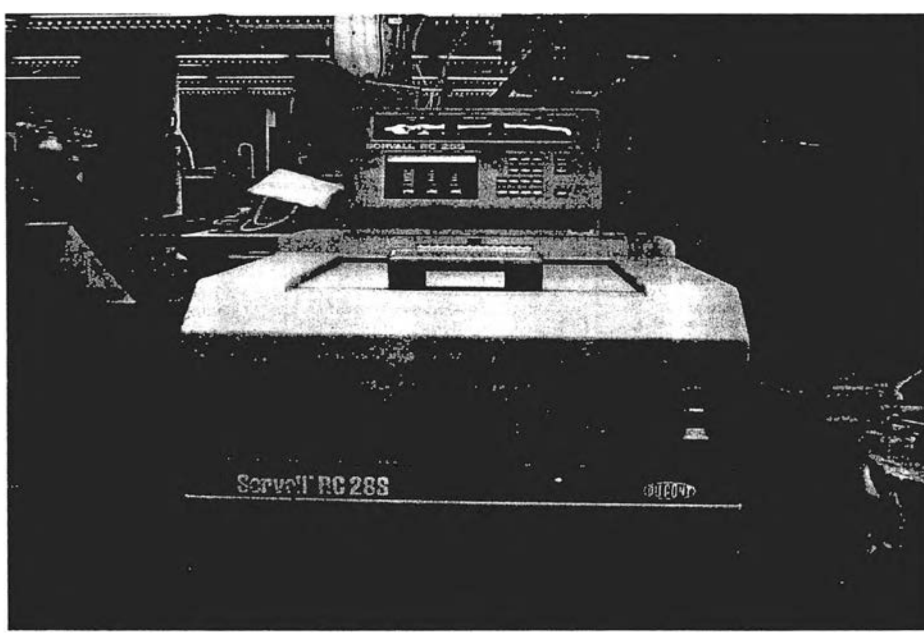

Figure C4 Centrifuger Sorwall RC 28S from Dupont

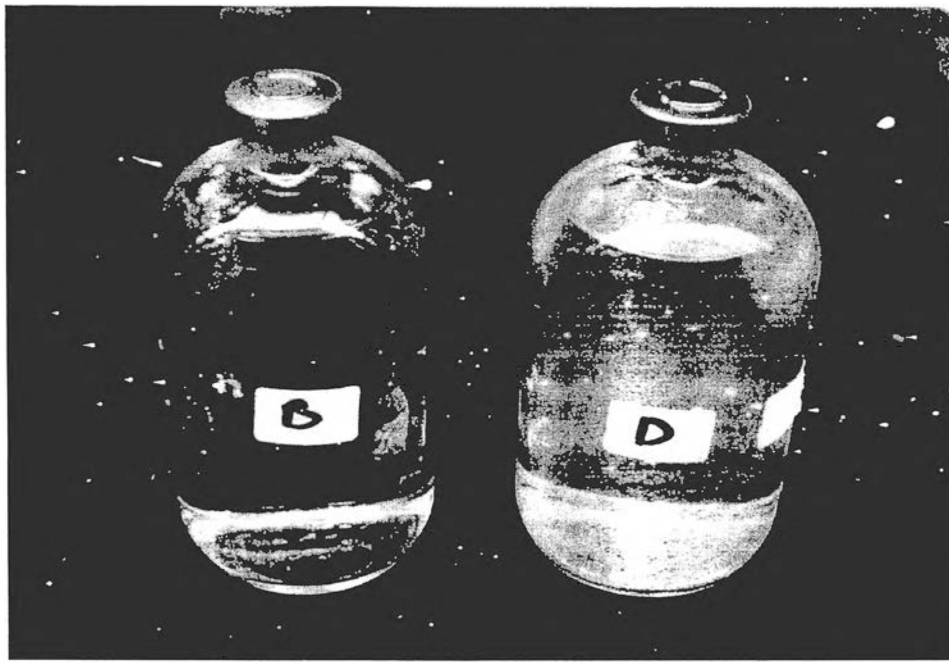

Figure C5 Comparison of sample in condition B on the left and condition D on the right

Figure C6 Recycled sludge; left: pure iron sludge, right: sludge of mixed iron and TiO_2

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