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APPENDIX

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APPENDIX A

Effect of Reactor

The objective of this section is to find the adsorption ability of copper on reactor wall and to confirm that copper does not disappear by other parameters, except transportation through the membrane phase. These experiments were conducted by without membrane phase, and fixed contacting time of 60 minutes. The concentrations of feed solution were varied from 10 ppm. to 1000 ppm. (10, 50, 100, 500 and 1000 ppm.) and the acidities (pH) were varied from 2 to 6. The remaining in feed and its in product was shown in Figure A-1 and A-2. It indicated that copper was not adsorbed on glass which is used to make the reactor and did not disappear by other parameters. The small difference of copper concentration between feed and product was not significantly difference, therefore, can be neglected the effect of reactor.



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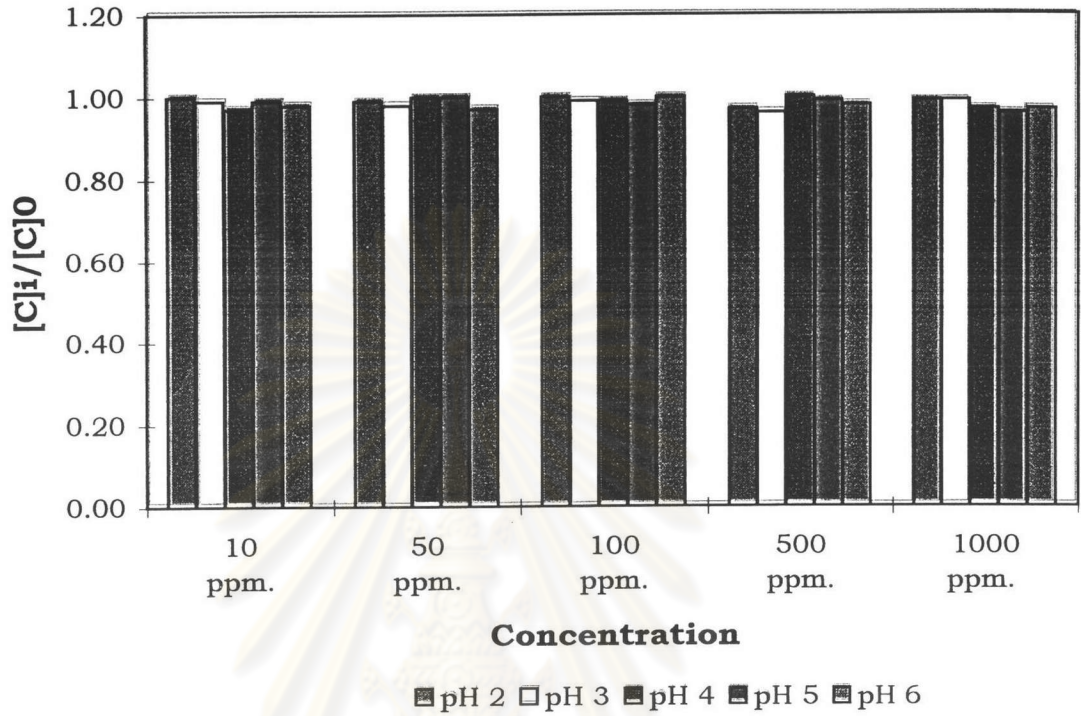


Figure A-1 Remaining Copper which study in the effect of reactor . (batch reactor.)

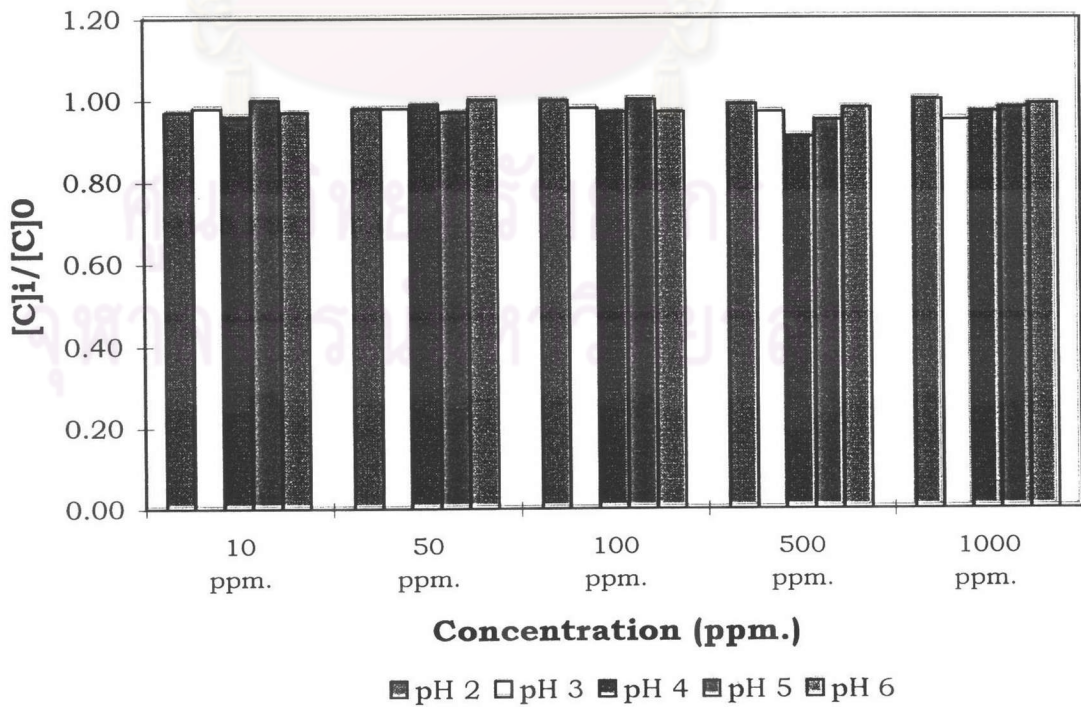


Figure A-2 Remaining Copper which study in the effect of reactor. (two compartment vessel.)

APPENDIX B

EXTRACTION EXPERIMENTAL DATA

Carrier Concentration Variable

Experimental condition:

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) depends on carrier concentration carrier (D2EHPA) various concentration surfactant (Span 80) 5%
Internal phase	1N HCl acid solution
Membrane preparation	Homogenized at speed = 8000 rpm. 10 min.
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

Table B-1 Experimental data of remaining copper concentration at various carrier concentration

Time (min.)	Concentration (ppm.)							
	0% D2EHPA	2% D2EHPA	3% D2EHPA	5% D2EHPA	7% D2EHPA	10% D2EHPA	15% D2EHPA	20% D2EHPA
0	115.2	111.3	114	114.2	113.8	108.1	116.2	103.2
1	110	107.1	110.4	96.03	89.97	87.88	81.51	66.13
2	109.6	95.51	103.5	77.46	65.44	58.66	49.03	53.22
3	113.2	88.51	91.1	62.59	58.99	34.14	31.75	33.23
5	111.2	71.28	76.06	45.16	29.7	15.24	16.18	19.07
7	110.4	60.27	59.28	33.72	19.67	8.69	6.59	10.32
10	111.6	51.6	44.55	24.58	11.13	0.19	2.48	6.39
15	112	44.1	35.31	17.24	5.6	0	2.43	4.18
20	112.1	37.03	30.42	10.26	3.43	0	1.76	2.56
25	114.2	32.56	24.03	7.52	2.14	0	1.8	2.69
30	110.7	29	20.47	5.44	1.7	0	1.83	1.78
40	114.4	25.89	14.56	4.32	1.28	0	1.59	1.96
50	113.3	22.46	11.8	2.89	0.88	0	1.24	1.95
60	112.5	18.08	8.72	1.93	0.74	0	1.01	1.54

TableB-2 Experimental data of copper concentration in the internal phase at various carrier concentration

Time (min.)	Concentration (ppm.)							
	0% D2EHPA	2% D2EHPA	3% D2EHPA	5% D2EHPA	7% D2EHPA	10% D2EHPA	15% D2EHPA	20% D2EHPA
0	0	0	0	0	0	0	0	0
1	93.6	75.6	64.8	327.06	428.94	363.96	624.42	667.26
2	100.8	284.22	189	661.32	870.48	889.92	1209.06	899.64
3	36	410.22	412.2	928.98	986.58	1331.28	1520.1	1259.46
5	72	720.36	682.92	1242.72	1513.8	1671.48	1800.36	1514.34
7	86.4	918.54	984.96	1448.64	1694.34	1789.38	1972.98	1671.84
10	64.8	1074.6	1250.1	1613.16	1848.06	1942.38	2046.96	1742.58
15	57.6	1209.6	1416.42	1745.28	1947.6	1945.8	2047.86	1782.36
20	55.8	1336.86	1504.44	1870.92	1986.66	1945.8	2059.92	1811.52
25	18	1417.32	1619.46	1920.24	2009.88	1945.8	2059.2	1809.18
30	81	1481.4	1683.54	1957.68	2017.8	1945.8	2058.66	1825.56
40	14.4	1537.38	1789.92	1977.84	2025.36	1945.8	2062.98	1822.32
50	34.2	1599.12	1839.6	2003.58	2032.56	1945.8	2069.28	1822.5
60	48.6	1677.96	1895.04	2020.86	2035.08	1945.8	2073.42	1829.88

Feed Solution pH Variable**Experimental conditions:**

External phase	100 ppm. Cu. various pH condition (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) 85% carrier (D2EHPA) 10% surfactant (Span 80) 5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

Table B-3 Experimental data of remaining copper concentration at various feed solution pH

Time (min.)	Concentration (ppm.)						
	pH 2.02	pH 3.06	pH 3.07	pH 4.01	pH 4.06	pH 5.11	pH 6.00
0	100.9	109.3	106.8	98.98	100.8	96.92	99.89
1	96.82	18.32	16.85	87.62	86.79	92.53	93.53
2	95.04	9.38	10.9	75.1	84.75	87.5	97.42
3	97.28	12.46	8	59.39	64.48	81.68	94.92
5	86	6.33	6.2	35.57	30.06	61.44	84.36
7	81.26	2.66	3.12	14.12	16.21	38.86	71.67
10	71.8	1.94	2.61	7.34	6.34	17.72	55.95
15	63.4	1.9	2.52	10.96	3.55	10.67	45.24
20	49.94	1.95	2.53	4.59	2.63	6.46	36.93
25	30.96	1.64	2.3	4.46	4.37	5.41	32.88
30	28.98	1.13	2.05	4.57	2.81	3.76	27.54
40	24.71	0.38	1.28	6.09	3.47	3.33	23.96
50	22.32	0.38	1.5	1.75	1.95	2.19	21.9
60	21.51	1.81	2.62	2.07	1.79	2.33	19.89

Table B-4 Experimental data of copper concentration in the internal phase various feed solution pH

Time (min.)	Concentration (ppm.)						
	pH 2.02	pH 3.06	pH 3.07	pH 4.01	pH 4.06	pH 5.11	pH 6.00
0	0	0	0	0	0	0	0
1	73.44	1637.64	1619.1	204.48	252.18	79.02	114.48
2	105.48	1798.56	1726.2	429.84	288.9	169.56	44.46
3	65.16	1743.12	1778.4	712.62	653.76	274.32	89.46
5	268.2	1853.46	1810.8	1141.38	1273.32	638.64	279.54
7	353.52	1919.52	1866.24	1527.48	1522.62	1045.08	507.96
10	523.8	1932.48	1875.42	1649.52	1700.28	1425.6	790.92
15	675	1933.2	1877.04	1584.36	1750.5	1552.5	983.7
20	917.28	1932.3	1876.86	1699.02	1767.06	1628.28	1133.28
25	1258.92	1937.88	1881	1701.36	1735.74	1647.18	1206.18
30	1294.56	1947.06	1885.5	1699.38	1763.82	1676.88	1302.3
40	1371.42	1960.56	1899.36	1672.02	1751.94	1684.62	1366.74
50	1414.44	1960.56	1895.4	1750.14	1779.3	1705.14	1403.82
60	1429	1934.8	1875.2	1744.4	1782.2	1702.6	1440

Surfactant Concentration Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene)
	depends on surfactant concentration
	carrier (D2EHPA) 10%
	surfactant (Span 80) various concentration
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

Table B-5 Experimental data of remaining copper concentration at various surfactant concentration

Time (min.)	Concentration (ppm.)						
	0% Span 80	1% Span 80	3% Span 80	5% Span 80	7% Span 80	10% Span 80	15% Span 80
0	110.3	99.59	101.7	108.1	110.3	107.7	106.6
1	94.08	93.95	97.07	87.88	104.5	100.4	99.9
2	88.11	82.24	77.83	58.66	94.12	92.01	90.97
3	82.28	69.82	57.28	34.14	74.83	76.24	78.76
5	77.04	60.17	36.73	15.24	52.96	57.46	59.26
7	75.69	55.42	24.77	8.69	37.14	29.03	46.33
10	74.43	49.96	11.99	0.19	29.25	18.36	34.58
15	74.92	54.76	7.73	0	16.57	11.45	21.36
20	72.55	59.89	5.9	0	13	4.04	13.05
25	70.63	63.33	4.39	0	9.14	3.35	8.91
30	72.51	64.66	5.03	0	6.55	3.31	6.55
40	71.23	67.63	6.46	0	5.86	2.18	3.99
50	70.86	66.09	9.25	0	4.95	1.53	3.04
60	70.66	67.22	10.75	0	1.12	1.11	2.47

Table B-6 Experimental data of copper concentration in the internal phase at various surface concentration

Time (min.)	Concentration (ppm.)						
	0% Span 80	1% Span 80	3% Span 80	5% Span 80	7% Span 80	10% Span 80	15% Span 80
0	0	0	0	0	0	0	0
1	291.96	101.52	83.34	363.96	104.4	131.4	120.6
2	399.42	312.3	429.66	889.92	291.24	282.42	281.34
3	504.36	535.86	799.56	1331.28	638.46	566.28	501.12
5	598.68	709.56	1169.46	1671.48	1032.12	904.32	852.12
7	622.98	795.06	1384.74	1789.38	1316.88	1416.06	1084.86
10	645.66	893.34	1614.78	1942.38	1458.9	1608.12	1296.36
15	636.84	806.94	1691.46	1945.8	1687.14	1732.5	1534.32
20	679.5	714.6	1724.4	1945.8	1751.4	1865.88	1683.9
25	714.06	652.68	1751.58	1945.8	1820.88	1878.3	1758.42
30	680.22	628.74	1740.06	1945.8	1867.5	1879.02	1800.9
40	703.26	575.28	1714.32	1945.8	1879.92	1899.36	1846.98
50	709.92	603	1664.1	1945.8	1896.3	1911.06	1864.08
60	713.52	582.66	1637.1	1945.8	1965.24	1918.62	1874.34

Emulsion Phase to Feed Solution Ratio Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	85%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	various ratio condition	
Agitation speed	350 rpm.	

Table B-7 Experimental data of remaining copper concentration at various emulsion phase to feed solution ratio

Time (min.)	Concentration (ppm.)							
	1:1	1:2	1:3	1:4	1:7	1:9	1:14	1:19
0	110.1	104.7	109.7	109.3	111.5	108.1	114.2	111.3
1	59.19	64.74	54.01	61.72	46.08	87.88	96.03	107.1
2	42.65	39.67	21.11	40.47	30.34	58.66	77.46	95.51
3	33.56	21.76	9.83	25.78	17.83	34.14	62.59	88.51
5	21.06	5.1	3.28	12.16	6.29	15.24	45.16	71.28
7	12.09	0.25	0.51	3.73	3.31	8.69	33.72	60.27
10	5.24	0	0	0.61	1.44	0.19	24.58	51.6
15	2.25	0	0	0	0.75	0	17.24	44.1
20	0.61	0	0	0	0.01	0	10.26	37.03
25	0.27	0	0	0	0	0	7.52	32.56
30	0.58	0	0	0	0	0	5.44	29
40	0	0	0	0	0	0	4.32	25.89
50	0	0	0	0	0	0	2.89	22.46
60	0	0	0	0	0	0	1.93	18.08

Table B-8 Experimental data of copper concentration in the internal phase at various emulsion phase to feed solution ratio

Time (min.)	Concentration (ppm.)							
	1:1	1:2	1:3	1:4	1:7	1:9	1:14	1:19
0	0	0	0	0	0	0	0	0
1	916.38	719.28	1002.4	856.44	1177.6	363.96	327.06	75.6
2	1214.1	1170.5	1594.6	1238.9	1460.9	889.92	661.32	284.22
3	1377.7	1492.9	1797.7	1503.4	1686.1	1331.3	928.98	410.22
5	1602.7	1792.8	1915.6	1748.5	1893.8	1671.5	1242.7	720.36
7	1764.2	1880.1	1965.4	1900.3	1947.4	1789.4	1448.6	918.54
10	1887.5	1884.6	1974.6	1956.4	1981.1	1942.4	1613.2	1074.6
15	1941.3	1884.6	1974.6	1967.4	1993.5	1945.8	1745.3	1209.6
20	1970.8	1884.6	1974.6	1967.4	2006.8	1945.8	1870.9	1336.9
25	1976.9	1884.6	1974.6	1967.4	2007	1945.8	1920.2	1417.3
30	1971.4	1884.6	1974.6	1967.4	2007	1945.8	1957.7	1481.4
40	1981.8	1884.6	1974.6	1967.4	2007	1945.8	1977.8	1537.4
50	1981.8	1884.6	1974.6	1967.4	2007	1945.8	2003.6	1599.1
60	1981.8	1884.6	1974.6	1967.4	2007	1945.8	2020.9	1678

Acid Concentration of Internal Phase Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	85%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	HCl acid solution	various concentration
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	350 rpm.	

TableB-9 Experimental data of remaining copper concentration at various acid concentration of internal phase

Time (min.)	Concentration (ppm.)						
	0.01 N	0.05 N	0.1 N	0.5 N	1.0 N	2.0 N	3.0 N
0	109.3	115.5	109.4	115	108.1	118.1	110.3
1	84.08	83.66	71.34	100.1	87.88	87.99	100.5
2	82.11	70.56	51.59	74.26	58.66	60.67	79.52
3	76.28	62.23	43.32	51.33	34.14	38.83	56.35
5	76.04	52.54	31.3	32.3	15.24	26.87	37.65
7	74.69	45.89	23.33	21.27	8.69	15.6	27.41
10	73.43	42.18	19.21	13.51	0.19	6.18	18.57
15	73.92	40.56	17.11	8.73	0	3.16	13.29
20	71.67	38.85	17.14	4.9	0	1.56	9.78
25	69.58	40.99	17.6	2.12	0	0.8	2.1
30	71.4	41.33	16.86	2.01	0	0.17	2.14
40	70.23	41.56	17.5	0.97	0	0	0.86
50	72.51	41.66	18.96	0.1	0	0	0.15
60	70.02	41.35	16.51	0.33	0	0	0.23

Table B-10 Experimental data of copper concentration in the internal phase at various acid concentration of internal phase

Time (min.)	Concentration (ppm.)						
	0.01 N	0.05 N	0.1 N	0.5 N	1.0 N	2.0 N	3.0 N
0	0	0	0	0	0	0	0
1	453.96	573.12	685.08	268.2	363.96	541.98	176.4
2	489.42	808.92	1040.6	733.32	889.92	1033.7	554.04
3	594.36	958.86	1189.4	1146.1	1331.3	1426.9	971.1
5	598.68	1133.3	1405.8	1488.6	1671.5	1642.1	1307.7
7	622.98	1253	1549.3	1687.1	1789.4	1845	1492
10	645.66	1319.8	1623.4	1826.8	1942.4	2014.6	1651.1
15	636.84	1348.9	1661.2	1912.9	1945.8	2068.9	1746.2
20	677.34	1379.7	1660.7	1981.8	1945.8	2097.7	1809.4
25	714.96	1341.2	1652.4	2031.8	1945.8	2111.4	1947.6
30	682.2	1335.1	1665.7	2033.8	1945.8	2122.7	1946.9
40	703.26	1330.9	1654.2	2052.5	1945.8	2125.8	1969.9
50	662.22	1329.1	1627.9	2068.2	1945.8	2125.8	1982.7
60	707.04	1334.7	1672	2064.1	1945.8	2125.8	1981.3

Agitation Speed Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	85%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1 N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	various speed condition	

Table B-11 Experimental data of remaining copper concentration at various agitation speed

Time (min.)	Concentration (ppm.)							
	200 rpm.	300 rpm.	300 rpm.	350 rpm.	400 rpm.	500 rpm.	600 rpm.	700 rpm.
0	112	112.8	120.8	108.1	117.8	113.7	122.8	111.3
1	111.5	89.78	114.4	87.88	98.33	59.24	48.47	22.44
2	109.4	85.86	113.3	58.66	74.14	26.24	11.9	7.83
3	106.7	70.54	103.4	34.14	57.75	15.41	6.73	4.64
5	104.3	46.54	81.46	15.24	33.35	6.73	3.91	3.86
7	99.68	36.15	57.53	8.69	18.72	3.93	3.09	3.24
10	92.3	24.9	35.85	0.19	15.23	3.68	2.54	3.01
15	86.24	11.14	25.82	0	3.96	3.68	3.95	2.77
20	80.6	3.87	18.25	0	2.1	3.52	2.77	4.39
25	75.9	0.92	14.48	0	1.5	3.19	2.53	4.69
30	71.31	0	12.3	0	0.9	3.73	2.99	4.74
40	68.39	0	7.58	0	0.6	3.72	9.29	9.43
50	64.33	0	5.18	0	0.98	3.68	10.54	13.52
60	56.62	0	3.83	0	0.95	3.68	12.68	15.41

Table B-12 Experimental data of copper concentration in the internal phase at various agitation speed

Time (min.)	Concentration (ppm.)							
	200 rpm.	300 rpm.	300 rpm.	350 rpm.	400 rpm.	500 rpm.	600 rpm.	700 rpm.
0	0	0	0	0	0	0	0	0
1	9	414.36	115.2	363.96	350.46	980.28	1337.9	1599.5
2	46.8	484.92	135	889.92	785.88	1574.3	1996.2	1862.5
3	95.4	760.68	313.2	1331.3	1080.9	1769.2	2089.3	1919.9
5	138.6	1192.7	708.12	1671.5	1520.1	1925.5	2140	1933.9
7	221.76	1379.7	1138.9	1789.4	1783.4	1975.9	2154.8	1945.1
10	354.6	1582.2	1529.1	1942.4	1846.3	1980.4	2164.7	1949.2
15	463.68	1829.9	1709.6	1945.8	2049.1	1980.4	2139.3	1953.5
20	565.2	1960.7	1845.9	1945.8	2082.6	1983.2	2160.5	1924.4
25	649.8	2013.8	1913.8	1945.8	2093.4	1989.2	2164.9	1919
30	732.42	2030.4	1953	1945.8	2104.2	1979.5	2156.6	1918.1
40	784.98	2030.4	2038	1945.8	2109.6	1979.6	2043.2	1833.7
50	858.06	2030.4	2081.2	1945.8	2102.8	1980.4	2020.7	1760
60	996.84	2030.4	2105.5	1945.8	2103.3	1980.4	1982.2	1726

Surfactant Concentration Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) depends on surfactant concentration carrier (D2EHPA) 7% surfactant (Span 80) various concentration
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

TableB-13 Experimental data of remaining copper concentration at various surfactant concentration

Time (min.)	Concentration (ppm.)						
	0% Span 80	1% Span 80	3% Span 80	5% Span 80	7% Span 80	10% Span 80	15% Span 80
0	120.5	101.23	103.8	110.2	109.7	112.6	108.6
1	103.4	95.68	100.5	89.56	103.5	108.5	101.4
2	95.99	84.45	81.57	71	94.87	96.57	98.2
3	92.90	71.26	60.85	56.4	78.46	76.54	89.6
5	85.00	65	38.26	32.5	54.4	57.1	71.7
7	83.34	61	25.4	18.6	41.1	44.5	57.1
10	80.93	57.1	10.65	7.3	26.5	35.2	40.5
15	78.3	60.4	7.56	4	14.04	21.2	28.5
20	76.78	63	6.18	0.11	8.25	13.27	21.9
25	76.21	63.12	4.59	0	6.31	9.31	16
30	77.60	65.21	5.44	0	3.31	7.99	12
40	77.94	66.09	8.6	0	2.53	4	4.67
50	76.77	67.86	13.3	0	2.21	3.3	3.55
60	78.30	68.39	17.3	0	1.26	1.53	2.89

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Feed Solution pH Variable**Experimental conditions:**

External phase	100 ppm. Cu. various pH condition (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) 88% carrier (D2EHPA) 7% surfactant (Span 80) 5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

Table B-14 Experimental data of remaining copper concentration at various feed solution pH

Time (min.)	Concentration (ppm.)				
	pH 2.00	pH 3.00	pH 4.00	pH 5.00	pH 6.00
0	97.9	101.2	98.98	96.92	100.9
1	95.2	44	87.62	91.2	98.5
2	92.6	31.2	78	87.5	97.9
3	89.3	24	67.3	86.1	93.1
5	82.9	17.8	46.3	70	78
7	77	14.5	26.9	50.6	68.9
10	71.6	5.4	14	32.3	61.3
15	61.9	2.27	9.7	20.4	45.2
20	54.3	1.82	6.5	12.9	40.9
25	45.2	1.9	5.4	10.2	29.1
30	41.4	1.34	4.59	7.5	30.7
40	38.7	1.25	4	4.8	26.9
50	34.4	1.18	1.75	2.19	26.9
60	33.9	1.55	2.07	2.33	23.7

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Emulsion Phase to Feed Solution Ratio Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	88%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	various ratio condition	
Agitation speed	350 rpm.	

TableB-15 Experimental data of remaining copper concentration at various emulsion phase to feed solution ratio

Time (min.)	Concentration (ppm.)							
	1:1	1:2	1:3	1:5	1:7	1:9	1:14	1:19
0	110.1	104.7	109.7	109.3	111.5	108.1	112	109.4
1	61.7	64.74	46	61.72	46.08	87.88	88.5	79.2
2	48.3	39.67	23.3	40.47	30.34	58.66	71.1	73.4
3	33.56	14.6	11.2	25.78	21.2	34.14	52	67
5	22.9	5.1	3.28	14	8.7	18.2	44.7	60
7	10	0.25	0.51	3.73	6.5	9.3	37.3	52.4
10	6.5	0	0	0.61	1.44	3.5	32	43.5
15	1.2	0	0	0	0.75	0	26.8	37.6
20	0.61	0	0	0	0.01	0	21.8	30.3
25	0.27	0	0	0	0	0	19.2	28.5
30	0.58	0	0	0	0	0	16.9	25.6
40	0	0	0	0	0	0	16.3	24
50	0	0	0	0	0	0	15.1	26.8
60	0	0	0	0	0	0	14.6	25

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Acid Concentration of Internal Phase Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	88%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	HCl acid solution	various acid concentration
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	350 rpm.	

Table B-16 Experimental data of remaining copper concentration at various acid concentration of internal phase

Time (min.)	Concentration (ppm.)						
	0.01 N	0.05 N	0.1 N	0.5 N	1.0 N	2.0 N	3.0 N
0	109.3	108.5	109.4	107.3	108.1	110.8	110.3
1	84.08	90	75.6	100.1	87.88	87.99	100.5
2	82.11	75	62.9	74.26	58.66	60.67	79.52
3	79.6	70.4	54.8	51.33	37.5	45.6	56.35
5	80.8	64	43.3	32.9	20.8	30.6	37.65
7	79	59.4	34.6	21.27	10.4	17.9	27.41
10	79	57.1	31.2	15.6	2.9	6.18	20
15	78.5	54.8	28	11	0	3.16	15.6
20	76	54.8	24	8.7	0	1.56	12
25	76	52.5	21.3	5.8	0	0.8	7.5
30	77.3	52	18.5	3.5	0	0.17	5.2
40	75	50.2	15	2.3	0	0.6	2.3
50	76.7	49.6	12.7	0.1	0	0	0.15
60	76.7	49	9.8	0.33	0	0	0.23

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Agitation Speed Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) 88% carrier (D2EHPA) 7% surfactant (Span 80) 5%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1 N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	various speed condition

Table B-17 Experimental data of remaining copper concentration at various agitation speed

Time (min.)	Concentration (ppm.)					
	200 rpm.	600 rpm.	700 rpm.	500 rpm.	300 rpm.	400 rpm.
0	112	113.5	117.8	113.7	114.8	111.3
1	111.5	109.8	98.33	71.7	48.47	36
2	110.9	106.4	85.3	33	11.9	13.1
3	109.2	93.3	70	22.2	6.73	9.7
5	106.4	77.3	52	10.8	3.91	3.86
7	102.4	59.1	28.4	3.93	3.09	3.24
10	97.8	35.3	19.3	3.68	2.54	3.01
15	91	23.3	12.5	3.68	3.95	5.1
20	85.9	23.3	4	3.52	2.77	6.8
25	78.5	21	1.5	3.19	4	8.5
30	73.4	20	0.9	3.73	5.7	8
40	70	16	0.6	3.72	6.3	9.1
50	62.6	11.4	0	5.7	6.8	9.7
60	60	6.8	0	5.7	6.8	10.2

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Carrier Concentration Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)
Membrane phase	organic solvent (Kerosene) depends on carrier concentration carrier (D2EHPA) various concentration surfactant (Span 80) 7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.
Internal phase	1N HCl acid solution
Membrane phase : Internal phase	50:50
Emulsion phase : Feed solution	50:450
Agitation speed	350 rpm.

Table B-18 Experimental data of remaining copper concentration at various carrier concentration

Time (min.)	Concentration (ppm.)						
	0% D2EHPA	2% D2EHPA	5% D2EHPA	7% D2EHPA	10% D2EHPA	15% D2EHPA	20% D2EHPA
0	115.2	112.3	114.2	113.8	108.1	116.2	103.2
1	114.8	109.1	100.7	93.3	87.88	84.7	79.1
2	113.7	96.51	85.3	74.5	58.66	49.03	55.2
3	114.2	91.6	73.9	63.1	34.14	34.1	40.4
5	112.7	76.8	56	38.1	19.3	19.3	26.7
7	113.2	69.4	42.1	28	10.8	10.8	16
10	113.7	56	32	18.2	4	5.1	9.7
15	112.7	44.1	22.7	9.7	2.8	3.4	5.7
20	111.1	41.5	17.1	5.7	1.7	1.76	4
25	112.7	37	13.6	2.14	0	1.8	2.8
30	112	34.1	11.4	1.7	0	1.83	2.3
40	112	30.7	9.7	1.28	0	1.59	1.96
50	111.1	29	8	0.88	0	1.24	1.95
60	112	27.3	6.8	0.84	0	1.01	0

Feed Solution pH Variable**Experimental conditions:**

External phase	100 ppm. Cu. various pH condition (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	86%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1 N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	350 rpm.	

TableB-19 Experimental data of remaining copper concentration at various feed solution pH

Time (min.)	Concentration (ppm.)				
	pH 2.00	pH 3.00	pH 4.00	pH 5.00	pH 6.00
0	100.9	98.98	96.92	102.5	99.89
1	99.2	87.62	92.36	67.4	93.53
2	98.6	66.8	89.3	51.5	93.7
3	97.28	45.5	84.4	49.9	91.5
5	91	21.9	65.8	34	86
7	86.6	14.8	41.6	25.8	78.9
10	77.3	7.34	28	16.4	64
15	71.2	6.6	18.6	11	57
20	60.8	4.59	8	4.4	44
25	42.2	4.9	7.1	1.9	32.88
30	35.1	4.59	3.76	1.34	31.2
40	29.71	6.09	3.33	1.25	26.3
50	27.35	1.75	2.19	1.18	25.2
60	25.47	2.07	2.33	1.55	19.2

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Experimental conditions:

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	86%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1 N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	various ratio condition	
Agitation speed	350 rpm.	

Table B-20 Experimental data of remaining copper concentration at various emulsion phase to feed solution ratio

Time (min.)	Concentration (ppm.)							
	1:1	1:2	1:3	1:4	1:7	1:9	1:14	1:19
0	105.87	106.77	105.47	104.77	105.47	103.37	101.8	102.9
1	63.34	70.31	57.08	62.74	49.15	92.84	88.5	94.1
2	46.32	43.75	24.18	41.31	33.41	62.63	74.08	85.3
3	37.76	24.42	12.9	27.04	20.9	38.34	54.5	74.3
5	25.58	9.28	6.35	14.9	9.36	19.49	40.7	61.7
7	19.3	3.45	3.58	6.03	6.38	8.8	33	52
10	9.5	3.11	3.07	3.53	4.51	3.24	28.6	43.5
15	6.31	3.06	2.45	3.07	3.82	3.15	24.8	35.2
20	3.58	2.92	2.13	2.76	3.61	3.07	15.4	32.5
25	3.41	1.57	1.97	2.04	3.08	3.12	12.7	31.4
30	3.55	1.23	0.87	1.63	2.54	2.89	11.6	27
40	3.07	0	0	0	1.32	0	9.4	26.4
50	0	0	0	0	0	0	8	22.6
60	0	0	0	0	0	0	6.1	21.5

Acid Concentration of Internal Phase Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	86%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	HCl acid solution	various acid concentration
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	350 rpm.	

Table B-21 Experimental data of remaining copper concentration at various acid concentration of internal phase

Time (min.)	Concentration (ppm.)						
	0.01 N	0.05 N	0.1 N	0.5 N	1.0 N	2.0 N	3.0 N
0	100.7	101.3	98.5	101.8	101.8	100	101.3
1	84.08	86.4	71.34	100.1	87.88	87.99	100.5
2	82.11	76	51.59	74.26	58.66	64.4	79.52
3	76.28	69.9	43.32	51.33	40.7	49	56.35
5	78.7	58.3	31.3	32.3	27	28.6	37.65
7	77.1	52	32	21.27	17.1	20.4	27.41
10	76.5	47.3	26.4	13.51	13.2	16	23.1
15	76	46.2	23.1	8.73	4.4	7.2	17.1
20	73.8	42.4	22	4.9	0	4	14.9
25	77.1	45.1	21.5	2.12	0	0.8	9.9
30	73.8	44	21.5	2.01	0	0.17	8
40	72.7	45.7	24.8	0.97	0	0	5.5
50	71	45.1	25.3	0.1	0	0	4
60	70.02	43.5	24	0.33	0	0	4.4

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Agitation Speed Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	86%
	carrier (D2EHPA)	7%
	surfactant (Span 80)	7%
Membrane preparat	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1 N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	various speed condition	

Table B-22 Experimental data of remaining copper concentration at various agitation speed

Time (min.)	Concentration (ppm.)					
	200 rpm.	300 rpm.	400 rpm.	500 rpm.	600 rpm.	700 rpm.
0	102.8	102.3	101.7	103.3	106	101.7
1	99	97.4	98.33	64	48.47	22.44
2	96.9	93.1	78	41.4	24	7
3	94.2	87.2	66.7	28	14	2.7
5	92	71	43.6	16	8.6	1.6
7	90.4	53.3	26.9	8.6	3.09	1.6
10	89.3	36	14.5	5.9	2.54	2.2
15	83.4	25.3	3.96	3.68	3.95	2.77
20	84.5	18.8	2.1	3.52	2.77	4.39
25	82.9	12.4	1.5	3.19	2.53	4.69
30	82.3	7.5	0.9	3.73	2.99	4.74
40	77.5	5.9	0.6	3.72	4	5.43
50	76.4	5.18	0.98	3.68	4.8	6.52
60	73.2	3.83	0.95	3.68	8.01	8.41

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Feed Solution pH Variable**Experimental conditions:**

External phase	100 ppm. Cu. various pH condition (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	83%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	350 rpm.	

Table B-23 Experimental data of remaining copper concentration at various feed solution pH

Time (min.)	Concentration (ppm.)				
	pH 2.00	pH 3.00	pH 4.00	pH 5.00	pH 6.00
0	100.9	100.6	98.98	96.92	102.4
1	101.2	50.3	87.62	94.25	93.53
2	100	39.4	75.1	90.9	97.42
3	97.28	16.4	59.39	86.7	94.92
5	88.5	12	41.2	68	84.36
7	81.26	11.5	23	47.3	74.5
10	69.7	4.58	13.9	29.1	66.1
15	59.4	2.27	10.96	20.6	53.3
20	49.94	3	4.59	12.7	44
25	41.8	1.9	4.35	8	38.2
30	38.2	1.34	4.59	3.76	36
40	34.5	1.25	6.09	2.4	30.9
50	30.3	1.18	1.75	1.8	25.5
60	26.7	1.55	2.07	0.6	24

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Emulsion Phase to Feed Solution Ratio Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	83%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	various ratio condition	
Agitation speed	350 rpm.	

Table B-24 Experimental data of remaining copper concentration at various emulsion phase to feed solution ratio

Time (min.)	Concentration (ppm.)							
	1:1	1:2	1:3	1:4	1:7	1:9	1:14	1:19
0	110.1	104.7	106.2	105	103.2	104	103.2	104.4
1	59.19	64.74	54.01	61.72	46.08	87.88	88.5	97.8
2	42.65	39.67	21.11	40.47	30.34	58.66	74.08	88
3	33.56	21.76	16.8	25.78	17.83	34.14	61.2	81.6
5	14.4	5.1	10.2	12.16	6.29	15.24	46.2	71.4
7	6	0.25	6	3.73	3.31	8.69	35.4	63
10	2.4	0	0	0.61	1.44	0.19	31.2	54.6
15	2.25	0	0	0	0.75	0	25.2	49.2
20	0.61	0	0	0	0.01	0	20.4	47.4
25	0.27	0	0	0	0	0	13.8	46.8
30	0.58	0	0	0	0	0	11.4	45.6
40	0	0	0	0	0	0	9	46.2
50	0	0	0	0	0	0	8.4	44.4
60	0	0	0	0	0	0	5.4	42

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Acid Concentration of Internal Phase Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)		
Membrane phase	organic solvent (Kerosene)	83%	
	carrier (D2EHPA)	10%	
	surfactant (Span 80)	7%	
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.		
Internal phase	HCl acid solution various acid concentration		
Membrane phase : Internal phase	50:50		
Emulsion phase : Feed solution	50:450		
Agitation speed	350 rpm.		

Table B-25 Experimental data of remaining copper concentration at various acid concentration of internal phase

Time (min.)	Concentration (ppm.)						
	0.01 N	0.05 N	0.1 N	0.5 N	1.0 N	2.0 N	3.0 N
0	111.63	110.6	111.73	111.2	110.43	112.9	112.63
1	86.41	88.8	78.2	102.43	90.21	94.1	102.83
2	86.5	76	61.2	76.59	60.99	67.6	81.85
3	81.8	68.8	52.9	53.66	36.47	47.1	61.2
5	80	57.6	33.63	38.8	22.9	35.3	42.4
7	80	51.2	25.66	30.6	13.5	20	34.7
10	77.1	47.1	21.54	18.2	4.7	12	24.7
15	77.1	41.2	16	11.06	4	5.49	17.1
20	72.4	42.9	17.6	9.4	2.33	3.89	16.5
25	72.4	41.8	17.6	4.45	2.33	3.13	12.9
30	72	44	17.1	4.34	2.33	2.5	11.2
40	75.3	42.4	17.1	3.3	2.33	2.33	3.19
50	72.9	44.7	17.6	2.43	2.33	2.33	2.48
60	72.9	41.8	18.84	2.66	2.33	2.33	2.56

Agitation Speed Variable**Experimental conditions:**

External phase	100 ppm. Cu. at pH 3.00 (adjust by HCl acid solution)	
Membrane phase	organic solvent (Kerosene)	83%
	carrier (D2EHPA)	10%
	surfactant (Span 80)	7%
Membrane preparation	Homogenized at speed =8000 rpm. 10 min.	
Internal phase	1N HCl acid solution	
Membrane phase : Internal phase	50:50	
Emulsion phase : Feed solution	50:450	
Agitation speed	various speed condition	

TableB-26 Experimental data of remaining copper concentration at various agitation speed

Time (min.)	Concentration (ppm.)					
	200 rpm.	300 rpm.	400 rpm.	500 rpm.	600 rpm.	700 rpm.
0	112	120.8	117.8	113.7	122.8	111.3
1	110	117.9	100.7	59.24	48.47	25.7
2	107.8	109.3	80.7	37.9	31.4	17.1
3	105	96	62.9	30.7	25	16.4
5	104.3	76.4	43.6	20	10.7	3.86
7	102.1	57.53	38.6	14.3	6.4	2.9
10	96	35.85	15.23	10	2.54	3.01
15	90.7	25.82	3.96	3.68	3.95	2.77
20	87.1	18.25	2.1	3.52	2.77	4.39
25	87.1	14.48	1.5	3.19	2.53	4.69
30	80.7	12.3	0.9	3.73	2.99	8
40	78.6	7.58	0.6	3.72	8	10
50	73.6	5.18	0.98	3.68	10.24	10.7
60	72	3.83	0.95	3.68	9.3	12.9

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TableB-27 Initial rate of copper extraction by emulsion liquid membrane at various condition

Carrier	ppm./min.	Feed pH	ppm./min.	Surfactant	ppm./min.
0%	0.3676	2.02	2.6046	0%	6.192
2%	7.9819	3.06	15.988	1%	8.3753
3%	8.2493	4.01	12.893	3%	13.995
5%	13.882	5.11	7.053	5%	19.258
7%	16.288	6.00	2.6577	7%	12.076
10%	19.258			10%	10.401
15%	19.767			15%	9.7066
20%	16.018				
Ratio E/F	ppm./min.	Acid conc.	ppm./min.	Speed	ppm./min.
1:1	15.943	0.01 N	5.665	200 rpm	1.6676
1:2	19.208	0.05 N	11.602	300 rpm	7.763
1:3	19.819	0.1 N	14.48	400 rpm	12.589
1:4	18.104	0.5 N	17.329	500 rpm	17.054
1:7	18.567	1 N	19.258	600 rpm	19.953
1:9	19.258	2 N	18.327	700 rpm	21.241
1:14	13.882	3 N	15.45		
1:19	8.2493				

Table B-28 Copper extracted in each consecutive stage using Solvent extraction and Emulsion liquid membrane.

Step	Emul II	Emull	Sol. Ext.
1	100	95	100
2	100	92.9	84.7
3	100	82	60
4	99	77	15
5	98	65.7	7.7
6	96	50	0
7	94	38	
8	95	30	
9	91.9	16	
10	90	12	
11	87	3.6	
12	86	0	
13	83.5		
14	81.6		
15	80		
16	75		
17	70		

Table B-29 Remaining Copper which study in the effect of reactor.
(batch reactor.)

pH	$[C]_i/[C]_o$				
	10 ppm.	50 ppm.	100 ppm.	500 ppm.	1000 ppm.
pH 2	1.00	0.99	1.00	0.97	0.99
pH 3	0.99	0.98	0.99	0.96	0.99
pH 4	0.97	1.00	0.99	1.00	0.97
pH 5	0.99	1.00	0.98	0.99	0.96
pH 6	0.98	0.97	1.00	0.98	0.97

Table B-30 Remaining Copper which study in the effect of reactor.
(two compartment vessel.)

pH	$[C]_i/[C]_o$				
	10 ppm.	50 ppm.	100 ppm.	500 ppm.	1000 ppm.
pH 2	0.97	0.98	1.00	0.99	1.00
pH 3	0.98	0.98	0.98	0.97	0.95
pH 4	0.96	0.99	0.97	0.91	0.97
pH 5	1.00	0.97	1.00	0.95	0.98
pH 6	0.97	1.00	0.97	0.98	0.99

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APPENDIX C

EXTRACTION EQUILIBRIUM CALCULATION DATA

Table C-1 Extracion coefficient calculation data on pH variable at 10% carrier concentration (0.3100 M.)

pH	pHeq	[H+]	-Log [H+]	[Cu ²⁺]	[Cu ²⁺]	[CuR ₂ (HR) ₂]	D+	Log D+	[(HR) ₂] _i	[(HR) ₂] _{eq}	K _{ex}
2.0	1.92	0.012023	1.92	66.61	1.048217	0.525483	0.5013	-0.29999	0.155	0.15395	0.00306
3.0	1.99	0.010233	1.99	58.23	0.9163441	0.657356	0.7174	-0.14424	0.155	0.15369	0.00318
4.0	2.13	0.007413	2.13	49.71	0.7823126	0.791387	1.0116	0.005009	0.155	0.15342	0.00236
5.0	2.26	0.005495	2.26	35.20	0.5539294	1.019771	1.8410	0.265007	0.155	0.15296	0.00238
6.0	2.28	0.005248	2.28	22.58	0.3553331	1.218367	3.4288	0.535003	0.155	0.15256	0.00406

Table C-2 Extracion coefficient calculation data on pH variable at 7% carrier concentration (0.2170 M.)

pH	pHeq	[H+]	-Log [H+]	[Cu ²⁺]	[Cu ²⁺]	[CuR ₂ (HR) ₂]	D+	Log D+	[(HR) ₂] _i	[(HR) ₂] _{eq}	K _{ex}
2.0	1.90	0.012589	1.90	78.22	1.2309193	0.342781	0.2785	-0.5553	0.1085	0.10604	0.00393
3.0	1.97	0.010715	1.97	71.50	1.1251692	0.448531	0.3986	-0.3995	0.1085	0.10625	0.00405
4.0	2.08	0.008318	2.08	64.02	1.0074592	0.566241	0.5620	-0.2503	0.1085	0.10649	0.00343
5.0	2.21	0.006166	2.21	49.44	0.7780191	0.795681	1.0227	0.0097	0.1085	0.10694	0.00340
6.0	2.32	0.004786	2.32	34.43	0.5418122	1.031888	1.9045	0.2797	0.1085	0.10742	0.00378

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Table C-3 Extracion coefficient calculation data on carrier variable at external phase pH = 3.0

Carrier	[(HR)2] _i	Equi pH	[H ⁺] _{eq}	[Cu ²⁺] _{eq}	[Cu ²⁺] _{eq}	[CuR ₂ (HR)2]	D ⁺	D+[H ⁺]	[(HR)2] _{eq}	Log [(HR)2] _{eq}	Log D+[H ⁺]	K _{ex}
1%	0.0310	1.98	0.010471	92.69	1.4586	0.1151	0.0789	8.65E-06	0.0308	-1.5119	-5.0630	1.44E-04
3%	0.0930	1.99	0.010233	68.13	1.0721	0.5016	0.4678	4.90E-05	0.0920	-1.0362	-4.3099	9.11E-05
5%	0.1550	1.97	0.010715	40.98	0.6449	0.9288	1.4403	1.65E-04	0.1531	-0.8149	-3.7816	1.11E-04
7%	0.2170	1.92	0.012023	30.88	0.4859	1.0878	2.2384	3.24E-04	0.2148	-0.6679	-3.4901	1.10E-04
10%	0.3100	1.89	0.012882	16.32	0.2568	1.3169	5.1276	8.51E-04	0.3074	-0.5123	-3.0701	1.42E-04
15%	0.4650	1.86	0.013804	5.94	0.0935	1.4802	15.8354	3.02E-03	0.4620	-0.3353	-2.5204	2.22E-04

Table C-4 Extracion coefficient calculation data on carrier variable at external phase pH = 5.0

Carrier	[(HR)2] _i	Equi pH	[H ⁺] _{eq}	[Cu ²⁺] _{eq}	[Cu ²⁺] _{eq}	[CuR ₂ (HR)2]	D ⁺	D+[H ⁺]	[(HR)2] _{eq}	Log [(HR)2] _{eq}	Log D+[H ⁺]	K _{ex}
1%	0.0310	2.31	0.004898	92.69	1.4586	0.1151	0.0789	1.89E-06	0.0308	-1.5119	-5.7230	3.15E-05
3%	0.0930	2.26	0.005495	68.13	1.0721	0.5016	0.4678	1.41E-05	0.0920	-1.0362	-4.8499	2.63E-05
5%	0.1550	2.27	0.00537	40.98	0.6449	0.9288	1.4403	4.15E-05	0.1531	-0.8149	-4.3816	2.79E-05
7%	0.2170	2.25	0.005623	30.88	0.4859	1.0878	2.2384	7.08E-05	0.2148	-0.6679	-4.1501	2.41E-05
10%	0.3100	2.23	0.005888	16.32	0.2568	1.3169	5.1276	1.78E-04	0.3074	-0.5123	-3.7501	2.96E-05
15%	0.4650	2.20	0.00631	5.94	0.0935	1.4802	15.8354	6.30E-04	0.4620	-0.3353	-3.2004	4.65E-05

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