

**DATA FOR CHAPTER 2**  
**MODELING NITROGEN TRANSPORT IN DUCKWEED POND FOR SECONDARY TREATMENT OF**  
**SWINE WASTEWATER**

**Fig.2**

**First Order Ammonium Uptake**

Time (hr)	NH4+ Conc. (mg/L)	NH4+ conc. 1st order
0	63.1	-
48	45.67	45.67
96	25.27	21.59888358
144	13.1	10.21484064
192	3.89	4.830942713
240	0	2.28471577
288	0	1.080519158
336	0	0.511013959
384	0	0.241675739
432	0	0.114296609
480	0	0.054054722

**Fig.3**

**Computed Ammonia Concentration for k-D**

		Distance from Bottom																
Time, hrs.	Inches	0	0.225	0.450	0.675	0.900	1.125	1.350	1.575	1.800	2.025	2.250	2.475	2.700	2.925	3.150	3.375	3.600
	Meters	0	0.0057	0.0114	0.0171	0.0229	0.0286	0.0343	0.0400	0.0457	0.0514	0.0572	0.0629	0.0686	0.0743	0.0800	0.0857	0.0914
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
120		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
144		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
Time, hrs.	Inches	3.825	4.050	4.275	4.500	4.725	4.950	5.175	5.400	5.625	5.850	6.075	6.300	6.525	6.750	6.975	7.200	7.425
	Meters	0.0972	0.1029	0.1086	0.1143	0.1200	0.1257	0.1314	0.1372	0.1429	0.1486	0.1543	0.1600	0.1657	0.1715	0.1772	0.1829	0.1886
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
120		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
144		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
Time, hrs.	Inches	7.650	7.875	8.100	8.325	8.550	8.775	9.000	9.225	9.450	9.675	9.900	10.125	10.350	10.575	10.800	11.025	11.250
	Meters	0.1943	0.2000	0.2057	0.2115	0.2172	0.2229	0.2286	0.2343	0.2400	0.2457	0.2515	0.2572	0.2629	0.2686	0.2743	0.2800	0.2858
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	64	63.99999	63.99998	63.99997	63.99993	63.99985
120		64	64	64	64	64	64	64	64	63.99999	63.99999	63.99997	63.99994	63.99989	63.99979	63.99961	63.99928	63.99868
144		64	64	64	64	63.99999	63.99999	63.99998	63.99996	63.99993	63.99988	63.99978	63.99996	63.99929	63.99877	63.99788	63.99641	63.99399
Time, hrs.	Inches	11.475	11.700	11.925	12.150	12.375	12.600	12.825	13.050	13.275	13.500	13.725	13.950	14.175	14.400	14.625	14.850	15.075
	Meters	0.2915	0.2972	0.3029	0.3086	0.3143	0.3200	0.3258	0.3315	0.3372	0.3429	0.3486	0.3543	0.3600	0.3658	0.3715	0.3772	0.3829
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	63.99998	63.99994	63.99977	63.99921	63.99742
48		64	64	64	64	64	63.99999	63.99997	63.99992	63.99979	63.99946	63.99866	63.99678	63.99252	63.98317	63.96344	63.92332	63.84484
72		63.99999	63.99997	63.99993	63.99985	63.99966	63.99926	63.99842	63.99672	63.99334	63.98681	63.97452	63.95201	63.91189	63.84229	63.72493	63.53251	63.22594
94		63.99997	63.99994	63.99882	63.99774	63.99574	63.99213	63.98573	63.97463	63.95577	63.92441	63.87335	63.792	63.66516	63.47168	63.18303	62.76185	62.16094
120		63.99763	63.9958	63.99269	63.98746	63.97884	63.96486	63.94259	63.90771	63.85404	63.7729	63.65237	63.47651	63.22448	62.86978	62.37953	61.71423	60.82777
144		63.99009	63.98387	63.9741	63.95898	63.93591	63.90124	63.84989	63.77498	63.66731	63.51486	63.30226	63.01024	62.61519	62.0889	61.39846	60.50654	59.37202
Time, hrs.	Inches	15.300	15.525	15.750	15.975	16.200	16.425	16.650	16.875	17.100	17.325	17.550	17.775	18.000				
	Meters	0.3886	0.3943	0.4001	0.4058	0.4115	0.4172	0.4229	0.4286	0.4343	0.4401	0.4458	0.4515	0.4572				
0		64	64	64	64	64	64	64	64	64	64	64	64	64				
24		63.99199	63.97653	63.93508	63.83095	63.58656	63.05245	61.9693	59.93792	56.42659	50.85015	42.73559	31.93905	18.82034				
48		63.69727	63.43074	62.96877	62.201	60.9784	59.11443	56.39546	52.60304	47.54768	41.11004	33.28104	24.19001	14.11087				
72		62.75149	62.03841	60.99794	59.52451	57.49993	54.80132	51.31268	46.93947	41.62432	35.3618	28.20908	20.29016	11.79179				
94		61.32277	60.17993	58.65694	56.67348	54.14936	51.01091	47.1985	42.67436	37.42995	31.49162	24.92368	17.82813	10.34059				
120		59.66819	58.17917	56.30229	53.98021	51.16055	47.80026	43.87022	39.35954	34.2791	28.66388	22.57367	16.09182	9.32215				
144		57.95119	56.19925	54.07253	51.53092	48.54076	45.0777	41.12957	36.69876	31.80405	26.48149	20.78431	14.78163	8.556044				

**Fig.4****Predicted Cumulative Nitrogen Removal**

Time Mark (hr)	Cumulative Nitrogen Removal (mg/m2)				
	k-D	0.1k-D	10k-D	k-0.1D	k-10D
0	0	0	0	0	0
1	0.05069	0.00572	0.20537	0.04982	0.05395
2	0.09180	0.01132	0.26843	0.08667	0.10438
3	0.12761	0.01683	0.32016	0.11444	0.15280
4	0.16010	0.02227	0.36610	0.13587	0.19971
5	0.19029	0.02765	0.40775	0.15284	0.24536
6	0.21871	0.03299	0.44605	0.16668	0.28995
7	0.24572	0.03828	0.48167	0.17830	0.33361
8	0.27154	0.04354	0.51509	0.18835	0.37643
9	0.29634	0.04876	0.54666	0.19727	0.41848
10	0.32026	0.05395	0.57666	0.20537	0.45984
11	0.34338	0.05910	0.60530	0.21287	0.50056
12	0.36579	0.06423	0.63274	0.21993	0.54068
13	0.38756	0.06933	0.65913	0.22665	0.58025
14	0.40875	0.07441	0.68457	0.23310	0.61929
15	0.42940	0.07946	0.70917	0.23934	0.65783
16	0.44955	0.08449	0.73299	0.24542	0.69591
17	0.46924	0.08949	0.75611	0.25134	0.73355
18	0.48851	0.09447	0.77859	0.25715	0.77076
19	0.50738	0.09944	0.80047	0.26284	0.80757
20	0.52587	0.10438	0.82180	0.26843	0.84400
21	0.54401	0.10930	0.84263	0.27394	0.88005
22	0.56182	0.11420	0.86298	0.27936	0.91576
23	0.57922	0.11906	0.88278	0.28467	0.95092
24	0.59643	0.12393	0.90227	0.28993	0.98596
25	0.61335	0.12877	0.92137	0.29513	1.02068
26	0.63000	0.13361	0.94011	0.30026	1.05510
27	0.64640	0.13842	0.95850	0.30532	1.08923
28	0.66256	0.14322	0.97656	0.31032	1.12307
29	0.67848	0.14801	0.99430	0.31526	1.15663
30	0.69419	0.15277	1.01175	0.32014	1.18993
31	0.70968	0.15753	1.02892	0.32496	1.22297
32	0.72497	0.16227	1.04582	0.32973	1.25576
33	0.74006	0.16699	1.06246	0.33444	1.28830
34	0.75496	0.17170	1.07886	0.33911	1.32061
35	0.76968	0.17640	1.09502	0.34372	1.35268
36	0.78423	0.18108	1.11096	0.34828	1.38453
37	0.79861	0.18575	1.12668	0.35280	1.41616
38	0.81282	0.19040	1.14219	0.35727	1.44758
39	0.82688	0.19505	1.15751	0.36170	1.47879
40	0.84079	0.19968	1.17263	0.36608	1.50979
41	0.85455	0.20430	1.18757	0.37042	1.54060
42	0.86817	0.20890	1.20233	0.37471	1.57121
43	0.88165	0.21350	1.21692	0.37897	1.60164
44	0.89499	0.21808	1.23134	0.38319	1.63187
45	0.90821	0.22265	1.24560	0.38737	1.66193
46	0.92130	0.22721	1.25971	0.39151	1.69181
47	0.93427	0.23176	1.27366	0.39562	1.72151
48	0.94712	0.23630	1.28747	0.39969	1.75105
49	0.95985	0.24082	1.30114	0.40372	1.78041
50	0.97247	0.24534	1.31468	0.40772	1.80962
51	0.98498	0.24984	1.32808	0.41169	1.83866
52	0.99739	0.25434	1.34135	0.41563	1.86755
53	1.00969	0.25882	1.35449	0.41953	1.89628
54	1.02189	0.26329	1.36751	0.42340	1.92486
55	1.03399	0.26776	1.38042	0.42725	1.95329
56	1.04600	0.27221	1.39321	0.43106	1.98158
57	1.05791	0.27666	1.40589	0.43484	2.00972
58	1.06972	0.28109	1.41845	0.43860	2.03772
59	1.08145	0.28551	1.43091	0.44233	2.06558
60	1.09309	0.28993	1.44327	0.44603	2.09331
61	1.10465	0.29434	1.45553	0.44970	2.12090
62	1.11612	0.29873	1.46768	0.45335	2.14837
63	1.12751	0.30312	1.47974	0.45697	2.17570
64	1.13882	0.30750	1.49171	0.46057	2.20290
65	1.15005	0.31187	1.50358	0.46414	2.22998
66	1.16120	0.31623	1.51536	0.46769	2.25694
67	1.17228	0.32058	1.52706	0.47121	2.28377

Time Mark (hr)	k-D	Cumulative Nitrogen Removal (mg/m2)			k-10D
		0.1k-D	10k-D	k-0.1D	
68	1.18328	0.32492	1.53867	0.47471	2.31049
69	1.19415	0.32923	1.55013	0.47817	2.33693
70	1.20501	0.33356	1.56157	0.48163	2.36341
71	1.21580	0.33788	1.57293	0.48506	2.38978
72	1.22652	0.34219	1.58422	0.48848	2.41604
73	1.23718	0.34649	1.59542	0.49187	2.44218
74	1.24777	0.35078	1.60655	0.49524	2.46821
75	1.25830	0.35507	1.61761	0.49859	2.49414
76	1.26876	0.35935	1.62859	0.50192	2.51996
77	1.27916	0.36361	1.63950	0.50523	2.54567
78	1.28950	0.36788	1.65035	0.50853	2.57128
79	1.29977	0.37213	1.66112	0.51180	2.59679
80	1.30999	0.37638	1.67182	0.51505	2.62220
81	1.32016	0.38062	1.68246	0.51829	2.64751
82	1.33026	0.38485	1.69304	0.52151	2.67272
83	1.34031	0.38907	1.70355	0.52471	2.69783
84	1.35030	0.39329	1.71400	0.52789	2.72285
85	1.36024	0.39750	1.72438	0.53105	2.74777
86	1.37013	0.40170	1.73471	0.53420	2.77260
87	1.37996	0.40589	1.74498	0.53733	2.79734
88	1.38974	0.41008	1.75518	0.54045	2.82198
89	1.39947	0.41426	1.76533	0.54355	2.84654
90	1.40915	0.41843	1.77543	0.54663	2.87101
91	1.41879	0.42260	1.78547	0.54970	2.89539
92	1.42837	0.42676	1.79545	0.55275	2.91968
93	1.43790	0.43091	1.80538	0.55578	2.94389
94	1.44739	0.43506	1.81526	0.55881	2.96801
95	1.45683	0.43920	1.82509	0.56181	2.99205
96	1.46623	0.44333	1.83486	0.56480	3.01601
97	1.47558	0.44746	1.84458	0.56778	3.03988
98	1.48489	0.45158	1.85426	0.57074	3.06367
99	1.49415	0.45569	1.86388	0.57369	3.08739
100	1.50337	0.45980	1.87346	0.57663	3.11102
101	1.51255	0.46390	1.88299	0.57955	3.13458
102	1.52168	0.46799	1.89247	0.58246	3.15805
103	1.53078	0.47208	1.90191	0.58536	3.18146
104	1.53983	0.47616	1.91130	0.58824	3.20478
105	1.54884	0.48023	1.92065	0.59111	3.22803
106	1.55782	0.48430	1.92995	0.59397	3.25121
107	1.56675	0.48836	1.93921	0.59681	3.27431
108	1.57564	0.49242	1.94843	0.59964	3.29734
109	1.58450	0.49647	1.95760	0.60246	3.32030
110	1.59332	0.50052	1.96673	0.60527	3.34319
111	1.60210	0.50455	1.97582	0.60806	3.36600
112	1.61085	0.50859	1.98487	0.61085	3.38875
113	1.61956	0.51261	1.99388	0.61362	3.41143
114	1.62823	0.51663	2.00286	0.61638	3.43404
115	1.63682	0.52063	2.01174	0.61912	3.45645
116	1.64542	0.52463	2.02063	0.62185	3.47892
117	1.65399	0.52864	2.02948	0.62458	3.50133
118	1.66252	0.53264	2.03830	0.62730	3.52367
119	1.67102	0.53663	2.04708	0.63000	3.54595
120	1.67949	0.54061	2.05583	0.63270	3.56816
121	1.68792	0.54460	2.06454	0.63538	3.59031
122	1.69632	0.54857	2.07321	0.63806	3.61239
123	1.70469	0.55254	2.08184	0.64072	3.63442
124	1.71303	0.55651	2.09045	0.64337	3.65638
125	1.72134	0.56046	2.09901	0.64602	3.67827
126	1.72961	0.56442	2.10755	0.64865	3.70011
127	1.73785	0.56837	2.11605	0.65127	3.72189
128	1.74607	0.57231	2.12451	0.65389	3.74360
129	1.75425	0.57625	2.13295	0.65649	3.76526
130	1.76240	0.58018	2.14135	0.65909	3.78686
131	1.77053	0.58411	2.14972	0.66167	3.80840
132	1.77862	0.58803	2.15806	0.66425	3.82988
133	1.78669	0.59194	2.16636	0.66681	3.85130
134	1.79473	0.59586	2.17464	0.66937	3.87267
135	1.80274	0.59976	2.18288	0.67192	3.89398
136	1.81072	0.60366	2.19110	0.67446	3.91523
137	1.81867	0.60756	2.19928	0.67699	3.93643

Time Mark (hr)	k-D	Cumulative Nitrogen Removal (mg/m2)			k-10D
		0.1k-D	10k-D	k-0.1D	
138	1.82660	0.61145	2.20744	0.67951	3.95757
139	1.83450	0.61534	2.21556	0.68203	3.97866
140	1.84237	0.61922	2.22366	0.68453	3.99970
141	1.85022	0.62310	2.23173	0.68703	4.02068
142	1.85804	0.62697	2.23976	0.68951	4.04160
143	1.86583	0.63083	2.24778	0.69199	4.06248
144	1.87360	0.63470	2.25576	0.69447	4.08330

**Fig.5****Predicted Change of Nitrogen Removal from Changes in k and D**

Time Mark (hr)	Relative Difference of Nitrogen Removal (%)			
	0.1k-D vs k-D	10k-D vs k-D	k-0.1D vs k-D	k-10D vs k-D
1	-88.71197	305.17192	-1.70180	6.43258
2	-86.38274	53.40673	-10.37803	22.67360
3	-84.61584	44.45124	-22.44725	35.21765
4	-83.25744	41.36142	-34.06923	44.33528
5	-82.15940	37.97736	-43.76536	51.27719
6	-81.22511	34.75446	-51.31219	56.88441
7	-80.39863	31.89613	-56.96299	61.63863
8	-79.64817	29.42246	-61.08867	65.80886
9	-78.95499	27.29194	-64.04246	69.55040
10	-78.30736	25.45049	-66.11932	72.95861
11	-77.69738	23.84802	-67.55147	76.09636
12	-77.11941	22.44263	-68.51594	79.00792
13	-76.56919	21.20055	-69.14505	81.72613
14	-76.04342	20.09479	-69.53633	84.27643
15	-75.53940	19.10384	-69.76092	86.67907
16	-75.05494	18.21041	-69.87025	88.95058
17	-74.58818	17.40050	-69.90123	91.10465
18	-74.13758	16.66267	-69.88013	93.15284
19	-73.70178	15.98749	-69.82550	95.10496
20	-73.27963	15.36713	-69.75032	96.96948
21	-72.87011	14.79503	-69.66359	98.75373
22	-72.47232	14.26562	-69.57147	100.46411
23	-72.08655	13.77553	-69.47835	102.10173
24	-71.71100	13.31925	-69.38667	103.67635
25	-71.34395	12.89207	-69.29788	105.19684
26	-70.98594	12.49237	-69.21330	106.66251
27	-70.63646	12.11751	-69.13347	108.07694
28	-70.29504	11.76521	-69.05865	109.44336
29	-69.96126	11.43344	-68.98886	110.76471
30	-69.63472	11.12042	-68.92399	112.04365
31	-69.31507	10.82458	-68.86385	113.28259
32	-69.00197	10.54451	-68.80818	114.48378
33	-68.69513	10.27895	-68.75674	115.64923
34	-68.39427	10.02680	-68.70923	116.78085
35	-68.09911	9.78704	-68.66537	117.88034
36	-67.80943	9.55875	-68.62491	118.94932
37	-67.52500	9.34114	-68.58758	119.98927
38	-67.24560	9.13344	-68.55314	121.00156
39	-66.97103	8.93498	-68.52138	121.98748
40	-66.70112	8.74516	-68.49207	122.94822
41	-66.43569	8.56341	-68.46503	123.88488
42	-66.17457	8.38922	-68.44007	124.79853
43	-65.91762	8.22212	-68.41704	125.69013
44	-65.66469	8.06168	-68.39578	126.56059
45	-65.41564	7.90750	-68.37615	127.41079
46	-65.17034	7.75922	-68.35803	128.24152
47	-64.92867	7.61650	-68.34129	129.05355
48	-64.69051	7.47903	-68.32584	129.84759
49	-64.45576	7.34652	-68.31156	130.62434
50	-64.22431	7.21871	-68.29838	131.38442
51	-63.99606	7.09534	-68.28620	132.12845
52	-63.77092	6.97619	-68.27496	132.85700
53	-63.54879	6.86104	-68.26458	133.57061
54	-63.32959	6.74968	-68.25499	134.26980
55	-63.11324	6.64194	-68.24615	134.95507
56	-62.89966	6.53763	-68.23798	135.62688
57	-62.68877	6.43660	-68.23045	136.28567
58	-62.48051	6.33869	-68.22350	136.93187
59	-62.27480	6.24376	-68.21710	137.56588
60	-62.07158	6.15166	-68.21120	138.18809
61	-61.87078	6.06228	-68.20577	138.79886
62	-61.67235	5.97549	-68.20077	139.39855
63	-61.47622	5.89119	-68.19617	139.98749
64	-61.28235	5.80926	-68.19195	140.56600
65	-61.09067	5.72960	-68.18808	141.13439
66	-60.90114	5.65213	-68.18452	141.69295
67	-60.71370	5.57675	-68.18127	142.24197
68	-60.52831	5.50338	-68.17830	142.78171

Time Mark (hr)	Relative Difference of Nitrogen Removal (%)			
	0.1k-D vs k-D	10k-D vs k-D	k-0.1D vs k-D	k-10D vs k-D
69	-60.34544	5.43213	-68.17560	143.31094
70	-60.16452	5.36273	-68.17313	143.83144
71	-59.98500	5.29491	-68.17089	144.34492
72	-59.80734	5.22880	-68.16885	144.85010
73	-59.63151	5.16434	-68.16701	145.34721
74	-59.45748	5.10146	-68.16535	145.83645
75	-59.28521	5.04011	-68.16385	146.31803
76	-59.11465	4.98024	-68.16252	146.79215
77	-58.94578	4.92178	-68.16134	147.25899
78	-58.77856	4.86470	-68.16029	147.71875
79	-58.61296	4.80894	-68.15937	148.17159
80	-58.44894	4.75445	-68.15856	148.61769
81	-58.28648	4.70119	-68.15787	149.05721
82	-58.12554	4.64913	-68.15729	149.49031
83	-57.96610	4.59822	-68.15679	149.91714
84	-57.80813	4.54841	-68.15639	150.33786
85	-57.65160	4.49969	-68.15608	150.75260
86	-57.49649	4.45201	-68.15584	151.16150
87	-57.34276	4.40533	-68.15568	151.56469
88	-57.19040	4.35963	-68.15558	151.96232
89	-57.03938	4.31488	-68.15555	152.35449
90	-56.88967	4.27105	-68.15558	152.74134
91	-56.74125	4.22810	-68.15566	153.12297
92	-56.59411	4.18602	-68.15579	153.49951
93	-56.44821	4.14477	-68.15598	153.87107
94	-56.30355	4.10433	-68.15620	154.23774
95	-56.16009	4.06468	-68.15647	154.59964
96	-56.01781	4.02579	-68.15678	154.95687
97	-55.87671	3.98765	-68.15713	155.30951
98	-55.73675	3.95023	-68.15750	155.65768
99	-55.59792	3.91350	-68.15791	156.00145
100	-55.46021	3.87746	-68.15835	156.34093
101	-55.32358	3.84208	-68.15882	156.67618
102	-55.18804	3.80735	-68.15931	157.00731
103	-55.05355	3.77324	-68.15983	157.33439
104	-54.92011	3.73974	-68.16037	157.65751
105	-54.78770	3.70684	-68.16092	157.97673
106	-54.65630	3.67451	-68.16150	158.29214
107	-54.52590	3.64274	-68.16209	158.60380
108	-54.39648	3.61153	-68.16270	158.91179
109	-54.26802	3.58084	-68.16333	159.21618
110	-54.14052	3.55068	-68.16396	159.51704
111	-54.01396	3.52102	-68.16461	159.81443
112	-53.88833	3.49186	-68.16528	160.10842
113	-53.76361	3.46318	-68.16595	160.39906
114	-53.63979	3.43497	-68.16663	160.68642
115	-53.51720	3.40729	-68.16732	160.96976
116	-53.39549	3.38007	-68.16802	161.24994
117	-53.27429	3.35320	-68.16872	161.52783
118	-53.15393	3.32675	-68.16943	161.80266
119	-53.03442	3.30072	-68.17015	162.07450
120	-52.91574	3.27510	-68.17088	162.34339
121	-52.79787	3.24987	-68.17160	162.60938
122	-52.68081	3.22504	-68.17234	162.87252
123	-52.56455	3.20058	-68.17307	163.13287
124	-52.44906	3.17649	-68.17381	163.39046
125	-52.33436	3.15276	-68.17455	163.64536
126	-52.22041	3.12938	-68.17530	163.89759
127	-52.10723	3.10636	-68.17605	164.14721
128	-51.99478	3.08367	-68.17679	164.39426
129	-51.88308	3.06131	-68.17754	164.63877
130	-51.77209	3.03927	-68.17829	164.88080
131	-51.66183	3.01755	-68.17904	165.12038
132	-51.55227	2.99614	-68.17979	165.35755
133	-51.44342	2.97503	-68.18054	165.59236
134	-51.33525	2.95422	-68.18129	165.82482
135	-51.22777	2.93370	-68.18204	166.05500
136	-51.12096	2.91347	-68.18279	166.28291
137	-51.01482	2.89351	-68.18354	166.50860
138	-50.90933	2.87382	-68.18428	166.73209

Time Mark (hr)	Relative Difference of Nitrogen Removal (%)			
	0.1k-D vs k-D	10k-D vs k-D	k-0.1D vs k-D	k-10D vs k-D
139	-50.80450	2.85441	-68.18503	166.95343
140	-50.70031	2.83525	-68.18577	167.17265
141	-50.59675	2.81635	-68.18651	167.38977
142	-50.49382	2.79770	-68.18725	167.60484
143	-50.39151	2.77930	-68.18799	167.81787
144	-50.28982	2.76114	-68.18873	168.02891

**Fig.6****Nitrogen Removal at Different D**

Time (hr)	Cumulative Nitrogen Removal (mg/m2)								
	k1-D	k1-10D	k1-20D	k1-40D	k1-80D	k1-160D	k1-320D	K1-640D	Completely Mixed
0	0	0	0	0	0	0	0	0	0
1	0.05069	0.05395	0.05497	0.05579	0.05641	0.05686	0.05719	0.05743	0.05795
2	0.09180	0.10438	0.10741	0.10975	0.11150	0.11279	0.11372	0.11438	0.11578
3	0.12761	0.15280	0.15834	0.16259	0.16578	0.16812	0.16981	0.17103	0.17350
4	0.16010	0.19971	0.20810	0.21456	0.21941	0.22297	0.22556	0.22743	0.23111
5	0.19029	0.24536	0.25689	0.26579	0.27248	0.27742	0.28102	0.28362	0.28860
6	0.21871	0.28995	0.30483	0.31637	0.32508	0.33152	0.33622	0.33962	0.34598
7	0.24572	0.33361	0.35204	0.36638	0.37723	0.38529	0.39118	0.39544	0.40324
8	0.27154	0.37643	0.39856	0.41586	0.42899	0.43876	0.44592	0.45112	0.46040
9	0.29634	0.41848	0.44447	0.46486	0.48039	0.49197	0.50047	0.50664	0.51743
10	0.32026	0.45984	0.48981	0.51341	0.53144	0.54491	0.55482	0.56203	0.57436
11	0.34338	0.50056	0.53463	0.56154	0.58217	0.59762	0.60900	0.61728	0.63117
12	0.36579	0.54068	0.57894	0.60928	0.63260	0.65009	0.66301	0.67240	0.68787
13	0.38756	0.58025	0.62280	0.65665	0.68273	0.70235	0.71686	0.72741	0.74446
14	0.40875	0.61929	0.66621	0.70366	0.73260	0.75441	0.77055	0.78229	0.80093
15	0.42940	0.65783	0.70920	0.75034	0.78220	0.80626	0.82410	0.83706	0.85730
16	0.44955	0.69591	0.75180	0.79670	0.83155	0.85793	0.87750	0.89171	0.91355
17	0.46924	0.73355	0.79402	0.84275	0.88067	0.90941	0.93077	0.94625	0.96969
18	0.48851	0.77076	0.83588	0.88850	0.92954	0.96071	0.98390	1.00068	1.02572
19	0.50738	0.80757	0.87740	0.93397	0.97820	1.01184	1.03690	1.05501	1.08164
20	0.52587	0.84400	0.91858	0.97917	1.02664	1.06281	1.08978	1.10922	1.13744
21	0.54401	0.88005	0.95944	1.02410	1.07487	1.11361	1.14253	1.16333	1.19314
22	0.56182	0.91576	0.99999	1.06878	1.12290	1.16426	1.19516	1.21733	1.24873
23	0.57922	0.95092	1.04001	1.11296	1.17046	1.21448	1.24738	1.27091	1.30420
24	0.59643	0.98596	1.07998	1.15715	1.21810	1.26483	1.29978	1.32470	1.35957
25	0.61335	1.02068	1.11967	1.20111	1.26556	1.31503	1.35207	1.37839	1.41483
26	0.63000	1.05510	1.15909	1.24485	1.31283	1.36510	1.40424	1.43197	1.46997
27	0.64640	1.08923	1.19825	1.28836	1.35993	1.41503	1.45631	1.48545	1.52501
28	0.66256	1.12307	1.23715	1.33166	1.40686	1.46483	1.50826	1.53882	1.57994
29	0.67848	1.15663	1.27581	1.37476	1.45362	1.51449	1.56012	1.59209	1.63476
30	0.69419	1.18993	1.31423	1.41765	1.50021	1.56403	1.61186	1.64526	1.68947
31	0.70968	1.22297	1.35242	1.46034	1.54664	1.61344	1.66350	1.69833	1.74408
32	0.72497	1.25576	1.39038	1.50284	1.59292	1.66273	1.71504	1.75129	1.79857
33	0.74006	1.28830	1.42811	1.54515	1.63904	1.71189	1.76647	1.80415	1.85296
34	0.75496	1.32061	1.46563	1.58727	1.68502	1.76094	1.81780	1.85691	1.90724
35	0.76968	1.35268	1.50294	1.62922	1.73084	1.80987	1.86903	1.90957	1.96141
36	0.78423	1.38453	1.54005	1.67099	1.77652	1.85869	1.92016	1.96213	2.01548
37	0.79861	1.41616	1.57695	1.71258	1.82206	1.90739	1.97120	2.01458	2.06944
38	0.81282	1.44758	1.61366	1.75401	1.86746	1.95598	2.02213	2.06694	2.12329
39	0.82688	1.47879	1.65018	1.79527	1.91273	2.00446	2.07296	2.11919	2.17703
40	0.84079	1.50979	1.68651	1.83636	1.95786	2.05283	2.12370	2.17135	2.23067
41	0.85455	1.54060	1.72265	1.87730	2.00285	2.10109	2.17434	2.22340	2.28420
42	0.86817	1.57121	1.75861	1.91808	2.04772	2.14925	2.22488	2.27535	2.33763
43	0.88165	1.60164	1.79440	1.95870	2.09246	2.19731	2.27533	2.32721	2.39095
44	0.89499	1.63187	1.83001	1.99917	2.13707	2.24526	2.32568	2.37896	2.44416
45	0.90821	1.66193	1.86546	2.03950	2.18156	2.29311	2.37593	2.43062	2.49727
46	0.92130	1.69181	1.90073	2.07968	2.22593	2.34086	2.42609	2.48217	2.55028
47	0.93427	1.72151	1.93585	2.11971	2.27018	2.38851	2.47615	2.53363	2.60317
48	0.94712	1.75105	1.97080	2.15961	2.31431	2.43606	2.52612	2.58499	2.65597
49	0.95985	1.78041	2.00560	2.19936	2.35833	2.48352	2.57600	2.63624	2.70866
50	0.97247	1.80962	2.04024	2.23898	2.40223	2.53088	2.62578	2.68740	2.76124
51	0.98498	1.83866	2.07473	2.27846	2.44601	2.57814	2.67546	2.73847	2.81372
52	0.99739	1.86755	2.10907	2.31781	2.48969	2.62531	2.72506	2.78943	2.86610
53	1.00969	1.89628	2.14326	2.35703	2.53326	2.67238	2.77456	2.84030	2.91838
54	1.02189	1.92486	2.17731	2.39612	2.57671	2.71936	2.82397	2.89106	2.97054
55	1.03399	1.95329	2.21122	2.43509	2.62006	2.76625	2.87328	2.94173	3.02261
56	1.04600	1.98158	2.24499	2.47393	2.66331	2.81305	2.92250	2.99231	3.07457
57	1.05791	2.00972	2.27862	2.51265	2.70645	2.85975	2.97163	3.04278	3.12644
58	1.06972	2.03772	2.31211	2.55124	2.74948	2.90637	3.02067	3.09316	3.17819
59	1.08145	2.06558	2.34547	2.58972	2.79242	2.95289	3.06962	3.14345	3.22985
60	1.09309	2.09331	2.37870	2.62807	2.83525	2.99933	3.11847	3.19363	3.28140
61	1.10465	2.12090	2.41180	2.66631	2.87799	3.04568	3.16723	3.24372	3.33285
62	1.11612	2.14837	2.44477	2.70444	2.92062	3.09194	3.21591	3.29371	3.38420
63	1.12751	2.17570	2.47762	2.74245	2.96316	3.13811	3.26449	3.34361	3.43545
64	1.13882	2.20290	2.51034	2.78035	3.00561	3.18419	3.31298	3.39341	3.48659
65	1.15005	2.22998	2.54294	2.81814	3.04795	3.23019	3.36138	3.44312	3.53764
66	1.16120	2.25694	2.57543	2.85582	3.09021	3.27610	3.40969	3.49273	3.58858
67	1.17228	2.28377	2.60779	2.89339	3.13237	3.32193	3.45790	3.54224	3.63943

Time (hr)	Cumulative Nitrogen Removal (mg/m2)								
	k1-D	k1-10D	k1-20D	k1-40D	k1-80D	k1-160D	k1-320D	K1-640D	Completely Mixed
68	1.18328	2.31049	2.64003	2.93086	3.17444	3.36767	3.50603	3.59166	3.69017
69	1.19415	2.33693	2.67198	2.96801	3.21617	3.41306	3.55380	3.64070	3.74081
70	1.20501	2.36341	2.70400	3.00526	3.25806	3.45864	3.60175	3.68993	3.79135
71	1.21580	2.38978	2.73590	3.04242	3.29986	3.50412	3.64961	3.73907	3.84179
72	1.22652	2.41604	2.76769	3.07947	3.34156	3.54953	3.69738	3.78811	3.89213
73	1.23718	2.44218	2.79938	3.11642	3.38319	3.59485	3.74506	3.83706	3.94237
74	1.24777	2.46821	2.83095	3.15328	3.42472	3.64009	3.79265	3.88591	3.99252
75	1.25830	2.49414	2.86242	3.19003	3.46617	3.68524	3.84016	3.93467	4.04256
76	1.26876	2.51996	2.89378	3.22669	3.50753	3.73031	3.88757	3.98333	4.09250
77	1.27916	2.54567	2.92504	3.26325	3.54881	3.77530	3.93490	4.03190	4.14235
78	1.28950	2.57128	2.95620	3.29972	3.59000	3.82021	3.98214	4.08038	4.19209
79	1.29977	2.59679	2.98725	3.33609	3.63111	3.86504	4.02929	4.12877	4.24174
80	1.30999	2.62220	3.01821	3.37237	3.67214	3.90978	4.07635	4.17706	4.29129
81	1.32016	2.64751	3.04906	3.40856	3.71308	3.95445	4.12332	4.22526	4.34074
82	1.33026	2.67272	3.07982	3.44465	3.75394	3.99903	4.17021	4.27337	4.39009
83	1.34031	2.69783	3.11048	3.48066	3.79473	4.04354	4.21701	4.32138	4.43935
84	1.35030	2.72285	3.14104	3.51658	3.83543	4.08796	4.26372	4.36930	4.48850
85	1.36024	2.74777	3.17151	3.55241	3.87605	4.13230	4.31034	4.41713	4.53757
86	1.37013	2.77260	3.20189	3.58815	3.91660	4.17657	4.35688	4.46487	4.58653
87	1.37996	2.79734	3.23217	3.62380	3.95706	4.22075	4.40333	4.51252	4.63539
88	1.38974	2.82198	3.26236	3.65937	3.99745	4.26485	4.44970	4.56007	4.68416
89	1.39947	2.84654	3.29246	3.69486	4.03776	4.30888	4.49597	4.60753	4.73284
90	1.40915	2.87101	3.32247	3.73026	4.07800	4.35283	4.54217	4.65491	4.78141
91	1.41879	2.89539	3.35239	3.76557	4.11815	4.39670	4.58827	4.70219	4.82989
92	1.42837	2.91968	3.38223	3.80081	4.15824	4.44049	4.63429	4.74938	4.87828
93	1.43790	2.94389	3.41197	3.83596	4.19824	4.48420	4.68022	4.79648	4.92657
94	1.44739	2.96801	3.44164	3.87103	4.23818	4.52783	4.72607	4.84349	4.97476
95	1.45683	2.99205	3.47121	3.90602	4.27803	4.57139	4.77183	4.89041	5.02286
96	1.46623	3.01601	3.50070	3.94094	4.31782	4.61486	4.81751	4.93724	5.07086
97	1.47558	3.03988	3.53011	3.97577	4.35753	4.65827	4.86310	4.98397	5.11877
98	1.48489	3.06367	3.55944	4.01052	4.39717	4.70159	4.90861	5.03062	5.16658
99	1.49415	3.08739	3.58868	4.04520	4.43673	4.74484	4.95403	5.07718	5.21429
100	1.50337	3.11102	3.61784	4.07980	4.47623	4.78801	4.99937	5.12365	5.26192
101	1.51255	3.13458	3.64693	4.11433	4.51565	4.83110	5.04462	5.17003	5.30945
102	1.52168	3.15805	3.67593	4.14878	4.55500	4.87411	5.08979	5.21632	5.35688
103	1.53078	3.18146	3.70485	4.18315	4.59428	4.91705	5.13487	5.26253	5.40422
104	1.53983	3.20478	3.73370	4.21745	4.63348	4.95992	5.17987	5.30864	5.45147
105	1.54884	3.22803	3.76247	4.25168	4.67262	5.00271	5.22479	5.35467	5.49862
106	1.55782	3.25121	3.79117	4.28583	4.71169	5.04542	5.26962	5.40060	5.54568
107	1.56675	3.27431	3.81978	4.31991	4.75069	5.08806	5.31437	5.44645	5.59265
108	1.57564	3.29734	3.84833	4.35392	4.78962	5.13062	5.35903	5.49221	5.63952
109	1.58450	3.32030	3.87679	4.38786	4.82848	5.17310	5.40361	5.53788	5.68630
110	1.59332	3.34319	3.90519	4.42173	4.86728	5.21551	5.44811	5.58347	5.73299
111	1.60210	3.36600	3.93351	4.45552	4.90600	5.25785	5.49253	5.62896	5.77959
112	1.61085	3.38875	3.96176	4.48925	4.94466	5.30011	5.53686	5.67437	5.82609
113	1.61956	3.41143	3.98994	4.52291	4.98325	5.34229	5.58111	5.71970	5.87250
114	1.62823	3.43404	4.01804	4.55650	5.02177	5.38440	5.62528	5.76493	5.91882
115	1.63682	3.45645	4.04592	4.58983	5.06000	5.42620	5.66911	5.80982	5.96505
116	1.64542	3.47892	4.07389	4.62328	5.09839	5.46816	5.71311	5.85488	6.01118
117	1.65399	3.50133	4.10179	4.65667	5.13671	5.51005	5.75703	5.89986	6.05723
118	1.66252	3.52367	4.12962	4.68999	5.17497	5.55187	5.80087	5.94475	6.10318
119	1.67102	3.54595	4.15738	4.72325	5.21316	5.59361	5.84463	5.98955	6.14904
120	1.67949	3.56816	4.18507	4.75644	5.25129	5.63527	5.88831	6.03427	6.19482
121	1.68792	3.59031	4.21270	4.78956	5.28935	5.67687	5.93190	6.07890	6.24050
122	1.69632	3.61239	4.24026	4.82262	5.32734	5.71839	5.97541	6.12344	6.28609
123	1.70469	3.63442	4.26775	4.85562	5.36527	5.75983	6.01885	6.16790	6.33159
124	1.71303	3.65638	4.29518	4.88855	5.40314	5.80121	6.06220	6.21228	6.37700
125	1.72134	3.67827	4.32255	4.92142	5.44094	5.84251	6.10547	6.25657	6.42232
126	1.72961	3.70011	4.34985	4.95422	5.47867	5.88373	6.14866	6.30077	6.46755
127	1.73785	3.72189	4.37708	4.98697	5.51635	5.92489	6.19176	6.34489	6.51269
128	1.74607	3.74360	4.40426	5.01965	5.55396	5.96597	6.23479	6.38892	6.55774
129	1.75425	3.76526	4.43137	5.05227	5.59150	6.00698	6.27774	6.43287	6.60270
130	1.76240	3.78686	4.45842	5.08482	5.62899	6.04792	6.32061	6.47674	6.64758
131	1.77053	3.80840	4.48540	5.11732	5.66641	6.08878	6.36340	6.52052	6.69236
132	1.77862	3.82988	4.51233	5.14976	5.70377	6.12958	6.40610	6.56421	6.73706
133	1.78669	3.85130	4.53919	5.18214	5.74106	6.17030	6.44873	6.60782	6.78166
134	1.79473	3.87267	4.56600	5.21445	5.77829	6.21095	6.49128	6.65135	6.82618
135	1.80274	3.89398	4.59274	5.24671	5.81546	6.25153	6.53375	6.69480	6.87061
136	1.81072	3.91523	4.61943	5.27891	5.85257	6.29203	6.57614	6.73816	6.91496
137	1.81867	3.93643	4.64606	5.31105	5.88962	6.33247	6.61845	6.78144	6.95921

Time (hr)	Cumulative Nitrogen Removal (mg/m2)								Completely Mixed
	k1-D	k1-10D	k1-20D	k1-40D	k1-80D	k1-160D	k1-320D	K1-640D	
138	1.82660	3.95757	4.67262	5.34313	5.92661	6.37283	6.66069	6.82463	7.00338
139	1.83450	3.97866	4.69913	5.37516	5.96353	6.41312	6.70284	6.86774	7.04746
140	1.84237	3.99970	4.72559	5.40713	6.00039	6.45334	6.74491	6.91077	7.09145
141	1.85022	4.02068	4.75198	5.43904	6.03719	6.49350	6.78691	6.95372	7.13536
142	1.85804	4.04160	4.77832	5.47089	6.07394	6.53357	6.82883	6.99658	7.17917
143	1.86583	4.06248	4.80460	5.50269	6.11062	6.57358	6.87067	7.03937	7.22291
144	1.87360	4.08330	4.83083	5.53443	6.14724	6.61352	6.91243	7.08207	7.26655

**Fig.7**

**Experimental TAN Profile in 1:1 Lagoon Liquid**

Time (hr)	Distance from bottom, m									
	0.4572 AVG	0.4572 Std. Dev.	0.4064 AVG	0.4064 Std. Dev.	0.3556 AVG	0.3556 Std. Dev.	0.2032 AVG	0.2032 Std. Dev.	0.0127 AVG	0.0127 Std. Dev.
0	64.00	0.00	64.00	0.00	64.00	0.00	64.00	0.00	64.00	0.00
24	59.80	2.00	61.30	0.95	61.13	0.25	61.73	0.31	63.37	0.25
48	43.27	1.22	45.50	1.51	46.33	0.23	48.40	1.57	51.53	2.65
96	47.73	7.15	53.13	3.56	53.53	2.53	58.43	5.19	64.80	1.71
144	28.20	9.99	43.63	2.54	45.43	2.21	50.03	0.21	52.63	3.52

**Computed TAN Concentration Profile for k-D**

Distance from Bottom

Time, hrs.	Inches	0	0.225	0.450	0.675	0.900	1.125	1.350	1.575	1.800	2.025	2.250	2.475	2.700	2.925	3.150	3.375	3.600
	Meters	0	0.0057	0.0114	0.0171	0.0229	0.0286	0.0343	0.0400	0.0457	0.0514	0.0572	0.0629	0.0686	0.0743	0.0800	0.0857	0.0914
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
120		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
144		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
Time, hrs.	Inches	3.825	4.050	4.275	4.500	4.725	4.950	5.175	5.400	5.625	5.850	6.075	6.300	6.525	6.750	6.975	7.200	7.425
	Meters	0.0972	0.1029	0.1086	0.1143	0.1200	0.1257	0.1314	0.1372	0.1429	0.1486	0.1543	0.1600	0.1657	0.1715	0.1772	0.1829	0.1886
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
120		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
144		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
Time, hrs.	Inches	7.650	7.875	8.100	8.325	8.550	8.775	9.000	9.225	9.450	9.675	9.900	10.125	10.350	10.575	10.800	11.025	11.250
	Meters	0.1943	0.2000	0.2057	0.2115	0.2172	0.2229	0.2286	0.2343	0.2400	0.2457	0.2515	0.2572	0.2629	0.2686	0.2743	0.2800	0.2858
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
48		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
72		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
94		64	64	64	64	64	64	64	64	64	64	64	63.99999	63.99998	63.99997	63.99993	63.99985	
120		64	64	64	64	64	64	64	64	63.99999	63.99999	63.99997	63.99994	63.99989	63.99979	63.99961	63.99928	63.99868
144		64	64	64	64	63.99999	63.99999	63.99998	63.99996	63.99993	63.99988	63.99978	63.9996	63.99929	63.99877	63.99788	63.99641	63.99399
Time, hrs.	Inches	11.475	11.700	11.925	12.150	12.375	12.600	12.825	13.050	13.275	13.500	13.725	13.950	14.175	14.400	14.625	14.850	15.075
	Meters	0.2915	0.2972	0.3029	0.3086	0.3143	0.3200	0.3258	0.3315	0.3372	0.3429	0.3486	0.3543	0.3600	0.3658	0.3715	0.3772	0.3829
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		64	64	64	64	64	64	64	64	64	64	64	64	63.99998	63.99994	63.99977	63.99921	63.99742
48		64	64	64	64	64	63.99999	63.99997	63.99992	63.99979	63.99946	63.99866	63.99678	63.99252	63.98317	63.96344	63.92332	63.84484
72		63.99999	63.99997	63.99993	63.99985	63.99966	63.99926	63.99842	63.99672	63.99334	63.98681	63.97452	63.95201	63.91189	63.84229	63.72493	63.53251	63.22594
94		63.99997	63.99994	63.99882	63.99774	63.99574	63.99213	63.98573	63.97463	63.95577	63.92441	63.87335	63.792	63.66516	63.47168	63.18303	62.76185	62.16094
120		63.99763	63.9958	63.99269	63.98746	63.97884	63.96486	63.94259	63.90771	63.85404	63.7729	63.65237	63.47651	63.22448	62.86978	62.37953	61.71423	60.82777
144		63.99009	63.98387	63.9741	63.95898	63.93591	63.90124	63.84989	63.77498	63.66731	63.51486	63.30226	63.01024	62.61519	62.0889	61.39846	60.50654	59.37202
Time, hrs.	Inches	15.300	15.525	15.750	15.975	16.200	16.425	16.650	16.875	17.100	17.325	17.550	17.775	18.000				
	Meters	0.3886	0.3943	0.4001	0.4058	0.4115	0.4172	0.4229	0.4286	0.4343	0.4401	0.4458	0.4515	0.4572				
0		64	64	64	64	64	64	64	64	64	64	64	64	64				
24		63.99199	63.97653	63.93508	63.83095	63.58656	63.05245	61.9693	59.93792	56.42659	50.85015	42.73559	31.93905	18.82034				
48		63.69727	63.43074	62.96877	62.201	60.9784	59.11443	56.39546	52.60304	47.54768	41.11004	33.28104	24.19001	14.11087				
72		62.75149	62.03841	60.99794	59.52451	57.49993	54.80132	51.31268	46.93947	41.62432	35.3618	28.20908	20.29016	11.79179				
94		61.32277	60.17993	58.65694	56.67348	54.14936	51.01091	47.1985	42.67436	37.42995	31.49162	24.92368	17.82813	10.34059				
120		59.66819	58.17917	56.30229	53.98021	51.16055	47.80026	43.87022	39.35954	34.2791	28.66388	22.57367	16.09182	9.32215				
144		57.95119	56.19925	54.07253	51.53092	48.54076	45.0777	41.12957	36.69876	31.80405	26.48149	20.78431	14.78163	8.556044				

**Computed TAN Concentration Profile for k-85D**

		Distance from Bottom																
Time, hrs.	Inches	0	0.225	0.450	0.675	0.900	1.125	1.350	1.575	1.800	2.025	2.250	2.475	2.700	2.925	3.150	3.375	3.600
	Meters	0	0.0057	0.0114	0.0171	0.0229	0.0286	0.0343	0.0400	0.0457	0.0514	0.0572	0.0629	0.0686	0.0743	0.0800	0.0857	0.0914
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		63.93433	63.93396	63.93288	63.93106	63.92849	63.92516	63.92105	63.91612	63.91035	63.90369	63.89610	63.88753	63.87793	63.86723	63.85538	63.84230	63.82791
48		63.10510	63.10363	63.09921	63.09184	63.08151	63.06821	63.05191	63.03259	63.01024	62.98481	62.95628	62.92461	62.88976	62.85169	62.81033	62.76566	62.71760
72		61.50604	61.50396	61.49772	61.48732	61.47275	61.45401	61.43109	61.40398	61.37267	61.33715	61.29740	61.25340	61.20515	61.15261	61.09578	61.03462	60.96911
94		59.55267	59.55036	59.54340	59.53182	59.51559	59.49473	59.46923	59.43908	59.40428	59.36483	59.32073	59.27196	59.21852	59.16041	59.09762	59.03015	58.95797
120		57.47885	57.47647	57.46934	57.45746	57.44082	57.41943	57.39328	57.36238	57.32673	57.28632	57.24115	57.19123	57.13656	57.07713	57.01294	56.94400	56.87030
144		55.39238	55.39002	55.38296	55.37118	55.35469	55.33350	55.30759	55.27698	55.24166	55.20164	55.15692	55.10749	55.05337	54.99455	54.93103	54.86283	54.78994
Time, hrs.	Inches	3.825	4.050	4.275	4.500	4.725	4.950	5.175	5.400	5.625	5.850	6.075	6.300	6.525	6.750	6.975	7.200	7.425
	Meters	0.0972	0.1029	0.1086	0.1143	0.1200	0.1257	0.1314	0.1372	0.1429	0.1486	0.1543	0.1600	0.1657	0.1715	0.1772	0.1829	0.1886
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		63.81213	63.79487	63.77604	63.75553	63.73323	63.70904	63.68282	63.65447	63.62383	63.59077	63.55515	63.51682	63.47560	63.43135	63.38388	63.33302	63.27858
48		62.66611	62.61112	62.55256	62.49037	62.42449	62.35483	62.28132	62.20388	62.12244	62.03691	61.94720	61.85323	61.75491	61.65216	61.54487	61.43296	61.31634
72		60.89924	60.82497	60.74628	60.66313	60.57550	60.48337	60.38669	60.28543	60.17957	60.06907	59.95389	59.83400	59.70937	59.57995	59.44571	59.30662	59.16264
94		58.88110	58.79951	58.71320	58.62217	58.52639	58.42587	58.32060	58.21056	58.09574	57.97613	57.85173	57.72253	57.58850	57.44965	57.30597	57.15744	57.00405
120		56.79184	56.70863	56.62066	56.52793	56.43045	56.32821	56.22122	56.10947	55.99297	55.87171	55.74570	55.61494	55.47943	55.33918	55.19417	55.04443	54.88994
144		54.71236	54.63011	54.54317	54.45157	54.35529	54.25435	54.14875	54.03850	53.92360	53.80406	53.67988	53.55107	53.41764	53.27959	53.13693	52.98967	52.83781
Time, hrs.	Inches	7.650	7.875	8.100	8.325	8.550	8.775	9.000	9.225	9.450	9.675	9.900	10.125	10.350	10.575	10.800	11.025	11.250
	Meters	0.1943	0.2000	0.2057	0.2115	0.2172	0.2229	0.2286	0.2343	0.2400	0.2457	0.2515	0.2572	0.2629	0.2686	0.2743	0.2800	0.2858
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		63.22038	63.15822	63.09190	63.02120	62.94593	62.86585	62.78076	62.69043	62.59462	62.49312	62.38567	62.27205	62.15201	62.02532	61.89173	61.75101	61.60292
48		61.19490	61.06856	60.93722	60.80078	60.65915	60.51222	60.35991	60.20212	60.03876	59.86972	59.69492	59.51426	59.32766	59.13503	58.93627	58.73131	58.52006
72		59.01373	58.85986	58.70098	58.53707	58.36808	58.19398	58.01474	57.83032	57.64068	57.44579	57.24563	57.04015	56.82934	56.61315	56.39156	56.16454	55.93207
94		56.84580	56.68267	56.51466	56.34176	56.16395	55.98124	55.79361	55.60106	55.40358	55.20117	54.99381	54.78151	54.56426	54.34206	54.11490	53.88279	53.64572
120		54.73072	54.56676	54.39807	54.22465	54.04651	53.86365	53.67607	53.48379	53.28681	53.08513	52.87877	52.66772	52.45200	52.23161	52.00657	51.77689	51.54257
144		52.68137	52.52035	52.35477	52.18462	52.00993	51.83070	51.64694	51.45867	51.26589	51.06862	50.86686	50.66064	50.44996	50.23484	50.01530	49.79134	49.56298
Time, hrs.	Inches	11.475	11.700	11.925	12.150	12.375	12.600	12.825	13.050	13.275	13.500	13.725	13.950	14.175	14.400	14.625	14.850	15.075
	Meters	0.2915	0.2972	0.3029	0.3086	0.3143	0.3200	0.3258	0.3315	0.3372	0.3429	0.3486	0.3543	0.3600	0.3658	0.3715	0.3772	0.3829
0		64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
24		61.44720	61.28364	61.11198	60.93201	60.74349	60.54620	60.33991	60.12443	59.89954	59.66505	59.42077	59.16651	58.90211	58.62740	58.34224	58.04649	57.74002
48		58.30244	58.07838	57.84780	57.61062	57.36678	57.11622	56.85886	56.59466	56.32357	56.04552	55.76047	55.46839	55.16923	54.86297	54.54957	54.22901	53.90127
72		55.69413	55.45068	55.20172	54.94721	54.68714	54.42151	54.15028	53.87345	53.59101	53.30296	53.00928	52.70997	52.40504	52.09447	51.77829	51.45648	51.12906
94		53.40370	53.15671	52.90478	52.64789	52.38606	52.11928	51.84757	51.57093	51.28937	51.00290	50.71153	50.41527	50.11414	49.80815	49.49731	49.18164	48.86117
120		51.30363	51.06007	50.81191	50.55917	50.30185	50.03997	49.77355	49.50259	49.22713	48.94717	48.66273	48.37383	48.08049	47.78273	47.48057	47.17403	46.86314
144		49.33024	49.09314	48.85168	48.60589	48.35579	48.10139	47.84271	47.57977	47.31259	47.04119	46.76559	46.48581	46.20187	45.91380	45.62162	45.32535	45.02502
Time, hrs.	Inches	15.300	15.525	15.750	15.975	16.200	16.425	16.650	16.875	17.100	17.325	17.550	17.775	18.000				
	Meters	0.3886	0.3943	0.4001	0.4058	0.4115	0.4172	0.4229	0.4286	0.4343	0.4401	0.4458	0.4515	0.4572				
0		64	64	64	64	64	64	64	64	64	64	64	64					
24		57.42272	57.09449	56.75524	56.40491	56.04344	55.67078	55.28691	54.89181	54.48550	54.06800	53.63934	53.19958	52.74879				
48		53.56634	53.22422	52.87490	52.51837	52.15466	51.78377	51.40572	51.02054	50.62825	50.22889	49.82250	49.40913	48.98883				
72		50.79604	50.45743	50.11326	49.76352	49.40826	49.04748	48.68122	48.30951	47.93237	47.54983	47.16195	46.76875	46.37027				
94		48.53591	48.20587	47.87110	47.53160	47.18740	46.83853	46.48502	46.12690	45.76419	45.39693	45.02516	44.64890	44.26819				
120		46.54792	46.22838	45.90457	45.57650	45.24420	44.90769	44.56701	44.22219	43.87325	43.52022	43.16314	42.80204	42.43694				
144		44.72064	44.41225	44.09987	43.78353	43.46325	43.13906	42.81099	42.47906	42.14331	41.80376	41.46045	41.11341	40.76265				

**Fig.8**

**Experimental pH Profile**

Raw Lagoon Water

Time (hr)	0.4572		0.4064		0.3556		0.2032		0.0127	
	Avg. pH	Std. Dev.	Avg. pH	Std. Dev.	Avg. pH	Std. Dev.	Avg. pH	Std. Dev.	Avg. pH	Std. Dev.
0	7.43	0	7.430	0	7.43	0	7.43	0	7.43	0
24	7.41	0.0265	7.410	0.0265	7.42	0.0306	7.43	0.0346	7.43	0.0265
48	7.26	0.1286	7.347	0.0473	7.36	0.0643	7.38	0.0808	7.35	0.0404
144	6.98	0.0850	7.280	0.0624	7.28	0.0557	7.32	0.0666	7.33	0.0569

**Fig.9 and Fig.10**  
**Mixing Cycle Experiment**

Time	Experimental Data						Model Prediction	
	48h Cycle			3h Cycle			48h Cycle	3h Cycle
hr	TAN DW mgN/L	TAN Plastic DW mgN/L	Adj. TAN mgN/L	TAN DW mgN/L	TAN Plastic DW mgN/L	Adj. TAN mgN/L	Model TAN mgN/L	Model TAN mgN/L
0	65.3	65.3	65.3	65.3	65.3	65.3	65.3	65.3
24				57.7	61.3	61.7		60.15238
48	47.7	61.0	52	46.5	57.0	54.8	55.97229	55.41056
72				45.6	59.2	51.7		51.04253
96	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	47.97699	47.01883
120				#N/A	#N/A	#N/A		43.31233
144	37.0	60.0	42.25	30.1	59.6	35.8	41.12377	39.89801
168				25.3	58.0	32.6		36.75284
192	29.3	58.4	36.2	22.0	56.7	30.55	35.24949	33.85560
216				#N/A	#N/A	#N/A		31.18676
240	22.5	56.4	31.45	15.7	55.9	25.05	30.21432	28.72830

Data in Fig.10 in shaded cells

**DATA FOR CHAPTER 3**  
**ROLE OF INTERNAL NUTRIENT STORAGE IN DUCKWEED FOR SECONDARY SWINE WASTEWATER TREATMENT**

Time (d)	Biomass Full St. (g)	Biomass Half St. (g)	TAN Full St. (mg/L)	TAN Half St. (mg/L)	PO4 Full St. (mg/L)	PO4 Half St. (mg/L)	N Content Full St. (mg/g)	P Content Full St. (mg/g)	N Content Half St. (mg/g)	P Content Half St. (mg/g)
0	0.1505	0.1361	343.00	174.00	135.00	65.15	51.33	13.97	50.81	14.14
2	0.3177	0.1989	316.33	118.33	123.00	57.47	55.60	14.10	57.00	14.16
4	0.3461	0.2799	222.33	61.03	100.20	41.37	59.73	14.13	61.16	15.97
6	0.4790	0.4190	184.50	4.11	81.15	19.53	58.60	14.60	55.26	16.16
8	0.6094	0.6139	97.80	0.00	64.80	6.88	57.90	14.80	41.25	13.21
10	0.8071	0.7618	28.90	0.00	44.20	2.06	51.80	12.75	33.54	11.16
12	1.0880	0.9959	0.03	0.00	18.85	0.05	44.20	12.35	26.64	9.03
14	1.2303	1.1716	0.00	0.00	15.30	0.26	37.85	11.10	20.52	7.56
16	1.3910	1.2872	0.00	0.00	6.44	0.06	32.80	9.80	17.48	6.74
18	1.5297	1.3571	0.00	0.01	3.79	0.08	30.80	9.75	18.15	6.55
20	1.4941	1.4393	0.00	0.01	2.24	0.09	30.65	9.70	17.72	6.32
22	1.9274	1.3893	0.00	0.02	0.15	0.15	23.65	7.70	16.50	6.30
24	2.1310	1.3789	0.00	0.07	0.13	0.19	20.60	7.00	16.47	6.46
26	2.1075	1.3584	0.00	0.04	0.26	0.03	20.35	6.90	16.79	6.78
28	2.2459	1.3483	0.00	0.02	#N/A	0.19	19.65	6.75	17.18	6.52
30	2.3709	1.3229	0.00	0.00	#N/A	0.16	19.67	7.13	17.50	6.83

Adj. Time (d)	N Content Full St. (mg/g)	mu Full St. (1/d)	N Content Half St. (mg/g)	mu Half St. (1/d)	mu Monod Half St. (1/d)	Biomass Density Full St. (g/m <sup>2</sup> )	Biomass Density Half St. (g/m <sup>2</sup> )
1	53.1667	0.3735	53.9050	0.1898	0.1792	58.0528	41.5297
3	57.3667	0.0429	59.0767	0.1710	0.1848	82.3114	59.3713
5	59.1667	0.1624	58.2083	0.2017	0.1839	102.3105	86.6679
7	58.2500	0.1204	48.2550	0.1910	0.1717	134.9495	128.0799
9	54.8500	0.1405	37.3950	0.1079	0.1500	175.6340	170.5871
11	48.0000	0.1493	30.0883	0.1340	0.1251	234.9805	217.9511
13	41.0250	0.0615	23.5783	0.0812	0.0872	287.4636	268.7623
15	35.3250	0.0614	18.9975	0.0471	0.0406	325.0357	304.8918
17	31.8000	0.0475	17.8142	0.0264	0.0235	362.1551	327.9021
19	30.7250	0.0611	17.9350	0.0294	0.0253	404.0114	346.7543
21	27.1500	0.0544	17.1100	0.0000	0.0118	453.3263	350.7388
23	22.1250	0.0502	16.4867	0.0000	0.0003	503.2364	343.2534
25	20.4750	0.0133	16.6275	0.0000	0.0030	535.6129	339.4300
27	20.0000	0.0130	16.9808	0.0000	0.0095	549.8605	335.6397
29	19.6583	0.0271	17.3400	0.0000	0.0157	572.4781	331.2274

Adj. Time (d)	N Content Full St. (mg/g)	mu Full St. (1/d)	mu Monod wo/ Denisty Eff. (1/d)	[mu Full] / [mu Monod]	Density of Full St. (g/m2)	Predicted mu Full St. (1/d)
1	53.1667	0.3735	0.1783	2.0946	58.0528	0.1693
3	57.3667	0.0429	0.1830	0.2344	82.3114	0.1657
5	59.1667	0.1624	0.1848	0.8785	102.3105	0.1597
7	58.2500	0.1204	0.1839	0.6545	134.9495	0.1459
9	54.8500	0.1405	0.1803	0.7792	175.6340	0.1281
11	48.0000	0.1493	0.1713	0.8719	234.9805	0.1050
13	41.0250	0.0615	0.1586	0.3876	287.4636	0.0871
15	35.3250	0.0614	0.1441	0.4259	325.0357	0.0741
17	31.8000	0.0475	0.1321	0.3598	362.1551	0.0642
19	30.7250	0.0611	0.1278	0.4781	404.0114	0.0590
21	27.1500	0.0544	0.1107	0.4920	453.3263	0.0485
23	22.1250	0.0502	0.0750	0.6697	503.2364	0.0315
25	20.4750	0.0133	0.0585	0.2274	535.6129	0.0239
27	20.0000	0.0130	0.0531	0.2440	549.8605	0.0215
29	19.6583	0.0271	0.0490	0.5523	572.4781	0.0196

Adj. Time (d)	TKN Full St. (mg/L)	u(N) Full St. (mg/g/d)	TKN Half St. (mg/L)	u(N) Half St. (mg/g/d)	TP Full St. (mg/L)	u(P) Full St. (mg/g/d)	TP Half St. (mg/L)	u(P) Half St. (mg/g/d)
1	458.50	11.61	205.08	13.20	138.00	3.27	70.12	2.67
3	384.00	11.32	137.42	12.08	118.53	1.90	56.08	3.45
5	269.00	8.96	63.13	8.63	94.96	2.55	36.07	3.29
7	175.75	6.63	18.10	2.10	78.65	1.86	18.35	1.29
9	89.43	4.61	12.31	0.17	62.28	0.90	8.47	0.28
11	32.58	3.32	14.83	0.56	37.60	1.66	4.58	0.28
13	18.30	-0.66	14.79	-1.15	20.75	0.09	3.34	-0.06
15	21.10	-0.36	14.09	-0.63	13.57	-0.01	2.02	-0.07
17	25.13	0.51	14.20	0.81	8.48	0.44	0.53	0.08
19	27.53	-0.40	13.93	0.31	6.67	-0.13	0.62	0.08
21	30.48	-0.06	14.90	-0.91	4.68	0.10	0.76	-0.12
23	37.58	-0.41	16.35	-0.08	3.46	0.02	0.89	0.05
25	38.55	-0.23	16.30	0.03	5.72	-0.09	0.97	0.11
27	#N/A	0.28	8.25	0.13	#N/A	0.14	#N/A	-0.16
29	#N/A	0.54	0.00	0.00	#N/A	0.38	#N/A	0.09