

Memorandum

To: Clear Roads Technical Advisory Committee
From: Keith Pilgrim
Subject: Quarterly Project Update
Date: 10/23/2012
Project: Determining the Toxicity of Deicing Materials: MnDOT Contract #99083

The primary project activity during this quarter was the completion of a series of whole effluent toxicity tests with five deicing chemicals and four doses per chemical. This test series, which included testing with *Ceriodaphnia dubia*, fathead minnow, and *Selenastrum capricornutum*, designated as “range finding tests,” was conducted to identify the doses that would be needed in a full scale test. These tests were executed properly and provided a good foundation from which to determine deicing chemical doses for the final round of tests. Results are provided in the attached tables.

Product: Inhibitor A1 with Sodium Chloride *Ceriodaphnia dubia*

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Young Production
0	8.1	7.9	8.3	320	100	17
5	8.8	7.8	9.7	313	100	13.5
100	8.8	7.7	9.9	313	90	16.1
1000	8.9	7.8	9.9	703	60	9.5
3000	8.7	7.5	9.8	1450	100	9.9

Product: Potassium Acetate

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Young Production
0	8.1	7.9	8.3	320	100	17
10	8.8	7.7	9.7	317	90	6.4
50	8.8	7.6	9.8	335	100	5.6
200	8.9	5.5	9.8	414	90	3.4
2000	8.7	4.6	9.8	1270	0	0

Product: Magnesium Chloride

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Young Production
0	8.1	7.9	8.3	320	100	17
250	8.8	7.9	9.9	489	40	3.2
500	8.8	7.8	9.9	617	50	1.3
4000	8.7	7.8	8.9	1798	80	0.1
1000	8.9	7.8	9.7	761	60	5.2

Product: Calcium Chloride

Concentration (mg/L)	Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Young Production
0	8.1	7.9	8.3	320	100	17
250	8.8	7.2	9.6	498	80	9.2
500	8.8	7.2	9.5	619	90	8.4
1500	8.9	6.4	9	1140	90	9.3
6000	8.7	5.9	7.6	2710	70	0

Product: Glycerol

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Young Production
0	8.1	7.9	8.3	320	100	17
5	8.8	7.2	9.8	313	100	0
100	8.8	6.2	9.8	415	100	0.9
1000	8.9	5.8	9.5	829	90	0.1
3000	8.7	5.9	9.5	1329	100	0

Fathead Minnows

Product: Inhibitor A1 with Sodium Chloride

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (ms/cm)	Percent Survival	Mean Weight (mg)
0	6.8	5.3	8.3	320	97.5	0.73
500	7.8	5.0	10.6	528	85.0	0.64
3000	7.9	5.1	10.6	1465	97.5	0.77
6000	7.7	4.8	10.5	2620	92.5	0.87
12000	7.7	5.0	10.4	4780	90.0	0.85

Product: Potassium Acetate

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Weight (mg)
0	6.8	5.3	8.3	320	97.5	0.7253
50	7.8	4.8	10.7	344	87.5	0.5941
200	7.7	4.3	11.0	419	67.5	0.4551
500	7.2	3.5	10.9	559	87.5	0.4802
2000	7.0	3.2	10.8	1306	15.0	0.3375

Product: Magnesium Chloride

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Weight (mg)
0	6.8	5.3	8.3	320	98	0.7253
30	7.7	4.7	10.6	304	83	0.7212
100	7.6	4.7	10.4	375	90	0.8234
300	7.9	5.2	10.5	500	93	0.8586
1000	7.6	4.8	10.3	932	98	0.7742

Product: Calcium Chloride

Concentration (mg/L)	Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Weight (mg)
0	6.8	5.3	8.3	320	97.5	0.753
1000	7.0	4.2	9.7	796	95	0.7206
3000	6.1	2.9	9.3	1890	70	0.4125
6000	6.1	2.8	9.3	3560	62.5	0.4079
12000	4.3	1.7	6.9	7420	0	0

Product: Glycerol

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Percent Survival	Mean Weight (mg)
0	6.8	5.3	8.3	320	97.5	0.7253
10	7.3	4.3	10.3	316	72.5	0.6221
50	7.4	3.9	10.8	312	77.5	0.6598
100	7.2	3.0	11.3	320	87.5	0.6514
500	6.9	2.9	10.8	361	90	0.5968

Product: Inhibitor A1 with Sodium Chloride *Selenastrum capricornutum*

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Mean # Cells x 10 ⁴
0	10.0	8.3	11.7	541	495.6
200	9.8	8	11.5	1284	698.1
6000	9.3	7	11.6	2820	492.5
15000	8.3	4.3	12.2	6010	233.6
30000	6.4	3.6	9.2	11140	17.1

Product: Potassium Acetate

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Mean # Cells x 10 ⁴
0	10.0	8.3	11.7	541	495.6
1000	5.7	2.8	8.5	1484	6.4
2000	5.2	1.9	8.5	9610	0
4000	5.5	2.4	8.5	40000	0.25
12000	7.9	7.3	8.4	69000	0.25

Product: Magnesium Chloride

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Mean # Cells x 10 ⁴
0	10.0	8.3	11.7	541	495.6
1000	9.0	6.4	11.6	1162	417.5
2000	8.9	6.6	11.2	1706	428.1
8000	9.3	7.6	11	5130	188.1
20000	7.6	7	8.1	11020	3.1

Product: Calcium Chloride

Concentration (mg/L)	Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Mean # Cells x 10 ⁴
0	10.0	8.3	11.7	541	495.6
2000	8.8	6.4	11.2	1135	560
20000	8.2	4.3	12	1747	533.8
100000	6.8	2.4	11.2	3050	450
200000	4.2	2.5	5.9	7670	0.4

Product: Glycerol

Concentration (mg/L)	Average Dissolved Oxygen (mg/L)	Ending Dissolved Oxygen (mg/L)	Beginning Dissolved Oxygen (mg/L)	Specific Conductance (us/cm)	Mean # Cells x 10 ⁴
0	10.0	8.3	11.7	541	495.6
50	8.7	8	9.3	530	392.0
1000	6.3	3.9	8.6	637	14.3
5000	6.0	3.4	8.6	1046	8.9
10000	5.4	3.0	7.7	1527	3.5