CLEANING LABORATORY EVALUATION SUMMARY

SCL #:	2016
DateRun:	11/17/2016
Experimenters:	Jason Marshall, Vanessa Harripersaud
ClientType:	Chemical Company
ProjectNumber:	Project #1
Substrates:	Liquid
PartType:	Coupon
Contaminants:	None
Cleaning Methods:	
Analytical Methods:	pH, ORP - Oxidation-reduction potential readings , Dissovled Oxygen
Purpose:	To evaluate ozone levels over time for CleanCore Aqueous Ozone solution (ozonated water) Times = 0, 2 & 4 hrs and compare different methods of measuring aqueous ozone.

Experimental Procedure:

The CleanCore Aqueous Ozone kiosk machine was turned on and run to generate ozonated water. Ozonated water was collected into the supplied CleanCore spray bottle.

Prior to running any cleaning trials, the system was used to compare the analytical devices to determine how comparable values would be from each system. The comparison of ORP (mV) readings between Clean Core Aqueous Ozone On-Demand Ati Q45H In-Line Meter and HANNAH HI 98121 Hand-held Meter was done by measuring ORP values after the system was operating at a steady state. Values were recorded and compared.

Properties of tap water and the ozonated water (directly from the spray hose and the CleanCore Spray Bottle) were measured and recorded throughout the procedure, as necessary, including temperature, ORP values (mV), dissolved ozone levels (ppm), pH and water hardness.

Instrumentation used for measurements:
on-machine: dissolved ozone meter - ATi Q45H (ozone in ppm and temp in °F); ORP meter - Black Stone BL982411 ORP Controller (ORP in mV)
handheld instruments: Hanna HI 98121 meter (ORP & temp in °C); Chemetrics Meter with vacu-vials (dissolved ozone in ppm)

At the appropriate time interval, based on the age of the ozonated solution in the CleanCore Spray Bottle (t= 0 hr, t=2 hr, t=4 hr), the cleaning solution from the CleanCore Spray Bottle was analyzed for ozone level and ORP values.

Water hardness was measured to be around 150 ppm in all trials.

Chemistries Evaluated: CleanCore Aqueous Ozone Solution (at t=0 hr, t=2 hr, t=4 hr) generated by CleanCore Aqueous Ozone Kiosk model machine, stored in CleanCore Spray Bottle;

Results:

The initial data for the two ORP units were tabulated and a correlation equation was established. The resulting equation was found to have an R^2 value of 0.9978 indicating a very good fit of the equation to the data collected.

Table of ORP values in mV Date: Oct 5 2016

In-Line	Hand Held		
ATi Q45H	HANNAH-HI9812	Temp °F	Temp °C
283	243	59.3	15.2
278	242	59.3	15.2
265	233	58.6	14.8
266	234	58.6	14.8
267	233	58.6	14.8
290	233	59.1	15.1
306	237	59.2	15.1
345	245	59.3	15.2
389	265	59.4	15.2
419	282	59.4	15.2
453	302	59.5	15.3
483	316	59.5	15.3
509	337	59.6	15.3
530	361	59.7	15.4
553	380	59.8	15.5
582	404	60.0	15.5

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602	422	60.2	15.7
617	440	60.3	15.7
635	470	60.7	15.9

In each of the four cleaning trials (bathroom -B, DCC 17 -D, glass -G and Hucker's soil –H), the ORP readings taken from the CleanCore spray bottle dropped down to an average of 357 mV (tap water average 242 mV), after two hours the average were nearly identical to tap water (264 to 231 mV) and at four hours the difference was even smaller (238-225 mV)

Date: 9 Nov 2016					
Reading from CleanCore	HANNA Handheld				
In-Line Instruments	Meter	Temp wall meter	Temp hand held		
Dissolved Oxygen					
(ppm)	ORP (mV)	ORP (mV)	Calculated	Deg F (C)	Deg F (C)
1.164	917	908	860	62.8 (17.1)	61.9 (16.6)
1.111	919	897	864	62.5 (16.9)	61.9 (16.6)
1.111	919	912	864	62.4 (16.9)	61.7 (16.5)
1.177	919	908	864	62.3 (16.8)	61.7 (16.5)
Date: 10 Nov 2016					
Reading from CleanCore	HANNA Handheld				
In-Line Instruments	Meter	Temp wall meter	Temp hand held		
Dissolved Oxygen					
(ppm)	ORP (mV)	ORP (mV)	Calculated	Deg F (C)	Deg F (C)
1.063	941	909	908	69.4 (20.8)	70.0 (21.1)
1.214	943	907	912	69.4 (20.8)	70.0 (21.1)
0.992	942	910	910	69.4 (20.8)	70.2 (21.2)
1.051	942	900	910	69.4 (20.8)	70.2 (21.2)
Date: 15 Nov 2016					
Reading from CleanCore	HANNA Handheld				
In-Line Instruments	Meter	Temp wall meter	Temp hand held		
Dissolved Oxygen					
(ppm)	ORP (mV)	ORP (mV)	Calculated	Deg F (C)	Deg F (C)
0.996	933	880	892	67.1 (19.5)	66.4 (19.1)
1.003	934	871	894	66.9 (19.4)	66.2 (19.0)
1.006	934	920	894	66.8 (19.3)	66.2 (19.0)

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1.007	935	883	896	66.7 (19.3)	66.0 (18.9)

For the dissolved ozone in parts per million, the initial value from the unit ranged from 1.01 – 1.24 ppm. When measured from the CleanCore spray bottle at time zero, the ppm levels were 0.19-0.46 ppm for the four trials. After two hours the ppm levels were ranged from 0.03-0.1, at or equal to tap water levels. It appears that the use of the supplied spray bottle reduces the ozone level in solution under these laboratory conditions.

ORP - mV	t=0 hrs	t=2 hrs	t=4 hrs	Deg F	Deg C
Hannah meter					
Bathroom (spray)	254	224	223	71.8	22.1
Hannah meter DCC 17					
(spray)	365	342	233	72.0	22.2
Hannah meter Glass					
(spray)	402	248	274	70.8	21.6
Hannah meter Huckers					
(spray)	409	244	223	75.1	23.9
Hannah meter Tap water					
Bathroom run	205	211	205	72.5	22.5
Hannah meter Tap water					
DCC 17 run	262	238	242	71.7	22.1
Hannah meter Tap water					
Glass run	214	242	242	69.8	21.0
Hannah meter Tap water					
Hucker run	287	236	212	73.5	23.1
Unit meter Bath	930			73.9	23.3
Unit meter DCC	930			70.2	21.2
Unit meter Glass	930			68.1	20.1
Unit meter Huckers	930			74.3	23.5

A similar trend was shown for the Vacu Vial (VV) measurements.

Dissolved Ozone - PPM	t=0 hrs	t=2 hrs	t=4 hrs	Deg F	Deg C
VV - Bathroom (spray)	0.21	0.05	0.01	71.8	22.1
VV - DCC 17 (spray)	0.19	0.03	0.02	72.0	22.2
VV - Glass (spray)	0.23	0.1	0	70.8	21.6
VV - Huckers (spray)	0.46	0.04	0.01	75.1	23.9
VV - Tap water B	0.04			72.5	22.5
VV - Tap water D	0.04			71.7	22.1
VV - Tap water G	0.02			69.8	21.0
VV - Tap water H	0.03			73.5	23.1
meter B	1.044 - 1.23			73.9	23.3
meter D	1.103 - 1.149			70.2	21.2
meter G	1.141 - 1.236			68.1	20.1
meter H				74.3	23.5

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	1.010 - 1.200				
VV - Fill hose B	0.85			71.8	22.1
VV - Fill hose D	0.76			72.0	22.2
VV - Fill hose G	0.89			70.8	21.6
VV - Fill hose H	1.06			75.1	23.9

Summary:

Substrates:	Liquid				
Contaminants:	None				
Company Name:	**Product Name:**	**Conc.:**	**Efficiency:**	**Effective:**	**Observations:**
CleanCore	CleanCore queous Ozone Solution	100	0.00	☐	
Water	Water	100	0.00	☐	

Conclusion:

Each of the analytical tools used to measure ozone levels in the supplied unit showed that the level of ozone in solution drastically dropped when sprayed through the supplied CleanCore bottle and over the four hour testing period.

When comparing the ORP meters from the wall unit and hand held device showed that even though both systems had different mV values, the hand held unit could be used in the field as an assessment tool supplying relative ORP values as compared to the wall system. For the Vacu-Vial comparison, values were consistently lower than the wall system values as well. However, the vials could still be used to provide in-field measurement in the same way as the hand held ORP unit.

Both surrogate measurement systems demonstrated the downward trend of ozone levels overtime. Both showed that the use of the spray unit degraded ozone levels significantly.