

**Hydraulic Fracturing Wastewater Pilot
Summary of Test Results**

The following provides an overview of testing conducted on behalf of Lafarge Canada Inc. to evaluate the use of treated hydraulic fracturing wastewater as a coolant in the operation of their kiln.

Prior to using the wastewater, it was filtered to remove the naturally occurring radioactive materials (NORMS) and then filtered a second time through reverse osmosis to remove the salts.

Testing took place between May 20 and June 17, 2014. Two million litres of treated wastewater from Atlantic Industrial Services was used in the pilot project and evaporated in the kiln at 700°C. Nova Scotia Environment received the reports on September 26, 2014. Staff reviewed the results and prepared the following table.

Analysis of water batch testing, air emission and clinker testing showed no statistically significant difference between the operational water drawn from Shortts Lake and the AIS wastewater before, during and after evaporation.

All results are below limits for Canadian Drinking Water Quality (CDWQ), Fresh Water Aquatic Life Guidelines (FWAL), Base Level Industrial Emission Requirements (BLIERs), United Kingdom Water Risk Assessment Protocol (WRAP) and Canadian Council of Ministers of Environment (CCME) soil guidelines.

N/R = Not regulated

Water batch testing (Before evaporation)	Emissions using Operational water Shortts Lake (ppb)	Emissions using AIS treated wastewater (ppb)		
			CDWQ (ppb)	FWAL (ppb)
Aluminum	0.112	0.345	N/R	N/R
Antimony	Not detected (ND)	0.000759	0.006	N/R
Arsenic	0.000901	ND	0.01	0.012
Barium	0.0464	0.0291	1.0	N/R
Beryllium	ND	ND	N/R	N/R
Cadmium	ND	ND	0.005	1.0

Chromium	0.00196	0.00178	0.05	1
Cobalt	ND	ND	N/R	N/R
Copper	0.00788	ND	N/R	N/R
Iron	0.309	0.198	N/R	300
Lead	0.00241	0.00636	0.01	Calculated
Manganese	0.0376	0.0101	N/R	N/R
Mercury	ND	ND	0.001	0.026
Molybdenum	0.00198	0.00249	N/R	73
Nickel	0.00180	0.00284	N/R	N/R
Phosphorus	ND	ND	N/R	N/R
Selenium	ND	ND	0.01	1
Sulphur	35.6	4.51	N/R	N/R
Titanium	0.00507	0.00419	N/R	N/R
Vanadium	0.000968	0.00100	N/R	N/R
Air emission testing (During evaporation)	Operational water Shortts Lake	AIS treated wastewater	Results	
			Approval	BLIERS
Particulate (mg/D _{Sm} 3)	55.3	69.7		
Particulate (mg/D _{Sm} 3 co 11% O ₂)	46.2	57.8	90	75
Particulate emission rate (g/s)	1.40	1.72	N/R	
Radionuclides Concentration				
Alpha (Bq/D _{Sm} 3)	10.5	13.1		
Beta	0.8	1.1		
Gamma	ND	ND		

Radium 236	0.005	0.011	
Radionuclides emission rate			
Alpha (Bq/sec)	264	323	
Beta	20.4	26.6	
Gamma	ND	ND	
Radium 236	0.11	0.26	
Cooling water spray rate (l/s)	1.57	1.52	
Metals emission summary (ug/s)			
Aluminum	15012	18350	
Antimony	ND	ND	
Arsenic	16.5	22.8	
Barium	314	371	
Beryllium	ND	ND	
Cadmium	8.09	7.84	
Chromium	114	208	
Cobalt	6.61	8.70	
Copper	53.0	43.7	
Iron	12640	11892	
Lead	785	843	
Manganese	641	592	
Mercury	61.6	77.6	
Molybdenum	9.9	15.3	
Nickel	167	235	
Phosphorus	ND	ND	

Selenium	116	239	
Sulphur	10155546	8514449	
Titanium	315	361	
Vanadium	72.1	98	
Clinker testing (After evaporation)	Operational water Shortts Lake (ppm)	AIS treated wastewater (ppm)	Results
			UK WRAP
Antimony	<2	<2	325
Arsenic	13	13	128
Barium	253	236	36000
Beryllium	<2	<2	9.1
Boron	<100	<100	310
Cadmium	<1	<1	4
Chromium	48.7	56.2	220
Cobalt	4.3	4.6	115
Copper	17.7	15.6	474
Lead	20.3	17.6	976
Mercury	<0.050	<0.050	1.3
Molybdenum	11.3	12.8	81
Nickel	39.3	43.8	583
Phosphorus	<500	<500	2818
Selenium	<10	<10	162
Silver	<1	<1	0.126
Tin	<20	<20	1847
Vanadium	90	89	1339

Zinc	22.7	22	918
Thallium	<1	<1	2.5
Uranium	6	6	23 (CCME soil)