Locked Cycle Leaching Test and Yellowcake Precipitation

In 2013, the Saskatchewan Research Council ("SRC") in Saskatoon, SK, Canada commenced locked cycle alkaline leach testing on drill core samples from Kivalliq's Lac 50 Trend uranium deposits. These tests were designed to simulate continuous leaching operations, optimize processing conditions to remove impurities and determine dosage of reagents required. A final yellowcake product was also produced to confirm low impurity levels demonstrated by preliminary testing disclosed in Kivalliq's news release of February 28, 2013.

The locked cycle alkaline leaching tests show that after an initial charge of sodium carbonate and sodium bicarbonate these reagents can be recycled. Any additional leach reagent needed can be produced onsite by capturing the carbon dioxide extracted from exhaust gases of diesel generators typical in mining operations. After initial start up, sodium hydroxide and lime are the only alkaline reagents that the alkaline leaching process will consume.

An 8.7 kilogram composite sample derived from 49 drill core pulp rejects from 12 Lac 50 and J4 Zone drill holes was submitted to SRC for locked cycle leach tests. A total of 21 cycles were conducted at 70^{o}C, 50% pulp density, 300 kPa of oxygen gas for up to 48 hours. Fresh alkaline solution, containing 50 g/L sodium carbonate and 20 g/L sodium bicarbonate, was only used in the first cycle to start the process. The other 20 cycles were performed in the recycled alkaline solutions after sodium diuranate precipitation and carbonation. Lime, as a calcium hydroxide solution, was used to precipitate and remove sulfate and other impurities. To reduce consumption of sodium hydroxide, lime was also used to remove excess sodium bicarbonate from the leach solution. The sodium hydroxide consumption rate was determined to be 16.9 kg/tonne while the consumption rate for lime was 7.6 kg/tonne. After sodium diuranate precipitation, excessive sodium hydroxide in the recycled barren solution was carbonated to produce sodium carbonate and sodium bicarbonate by introducing carbon dioxide gas.

The process conditions of leaching, impurity removal, sodium diuranate precipitation, and carbonation achieved high uranium leaching recovery (>95% in 48 hours), effective lime precipitation impurity removal with low uranium loss (<0.1%), high uranium recovery in the sodium diuranate precipitate (99.6%), and consistent solution regeneration for recycling.

Low Impurity Yellowcake Production

Sodium diuranate produced from each leach cycle was combined, dissolved in sulphuric acid, and precipitated as a single representative ammonium diuranate yellowcake final product. The final uranium peroxide yellowcake product was analyzed at SRC for uranium and impurities. The results compared with Impurity Maximum Concentration Limits from ASTM C976-13 Standard Specification for Uranium Concentrate are shown in Table 1. The yellowcake produced contains 70.0% uranium and low impurity levels. Boron and magnesium are marginally higher than penalty levels but significantly below reject levels. All impurities assayed meet ASTM C976-13 standards. The conditions for uranium peroxide yellowcake production are not yet optimized and will be the focus of future testing.

TABLE 1. Impurity Analysis of Kivalliq Yellowcake Product ASTM C976-13a

Specifications Component	ASTM C967-13 (Mass%, Uranium Basis)		Kivalliqre(Mass%, Uranium Basis) Yellowcake Product
	Limit without Penalty	Limit without Rejection	
Uranium (U)	N/A	65% min.	70%
Arsenic (As)	0.05%	0.1%	0.0016%
Boron (B)	0.005%	0.1%	0.008%
Calcium (Ca)	0.05%	1%	<0.01%
Carbonate (CO_3)	0.2%	0.5%	0.04%
Chromium (Cr)	N/A	N/A	<0.0001%
Fluoride (F)	0.01%	0.1%	<0.01%
Halides (Br, Cl, I)	0.05%	0.1%	<0.002%
Iron (Fe)	0.15%	1%	<0.01%
Lead (Pb)	N/A	N/A	<0.0001%
Magnesium (Mg)	0.02%	0.5%	0.05%
Moisture (H_2O)	2%	5%	0.2%
Molybdenum (Mo)	0.1%	0.3%	0.003%
Phosphorus (PO_4)	0.1%	0.7%	<0.01%
Potassium (K)	0.2%	3%	<0.01%
Selenium (Se)	N/A	N/A	<0.001%
Silica (SiO_2)	0.5%	2.5%	0.07%
Silver (Ag)	N/A	N/A	<0.001%
Sodium (Na)	1%	7.5%	<0.01%
Sulfur (S)	1%	4%	0.16%
Thorium	0.1%	2.5%	<0.0001%
Titanium	0.01%	0.05%	0.009%
^{234}U	56 µg/gU	62 µg/gU	55.2 µg/gU
Vanadium (V)	0.06%	0.3%	0.003%
Zirconium (Zr)	0.01%	0.1%	<0.001%

Metallurgical Results Demonstrate High Uranium Recoveries and Rapid Leach Kinetics (September 11, 2013)

In 2012, the Saskatchewan Research Council ("SRC") commenced a metallurgical testing program on core from Kivalliq's Lac 50 Trend. The program objectives were to maximize uranium extraction through the removal of sulphides using flotation and optimizing the alkaline leaching processes. Results from the 2012 metallurgical program were very encouraging with high U_3O_8 recovery rates and the production of a low impurity final yellowcake product. (see Kivalliq news release of February 28, 2013)

In 2013, metallurgical testing was expanded to include a composite sample from the newly discovered J4 deposit. The goal was to compare alkaline leach parameters of the J4 Zone to previous test work, while continuing to develop optimal grinding, sulphide flotation and leach conditions. A 26.0 kilogram composite derived from 44 split drill core pulp rejects was submitted to the SRC Mineral Processing Group for metallurgical analysis. Pulp samples used in the composite were selected from 17 holes drilled along 650 metres of strike length at J4 Zone. A head grade sample taken from the composite and analyzed by total digestion ICP at SRC is shown in Table 1.

TABLE 1. J4 Zone Composite Sample ICP Total Digestion Assay (ppm)

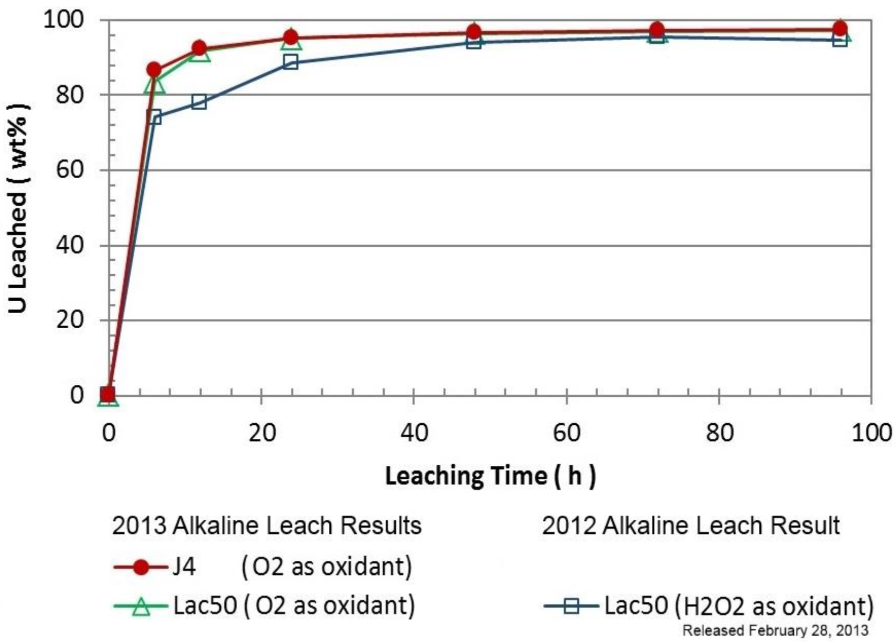
U	Ag	Pb	Cu	Zn	Mo	Zr	Total S	Sulphide
7040	43.5	3885	6075	3030	3090	608	21200	13700

Sulphide flotation on J4 Zone composite material tested variable grind sizes in water and alkaline solution respectively. An optimum sulphide recovery of 99.2% was achieved in alkaline solution at a grind size of 100% passing 140 mesh (106 µm).

Alkaline leaching of J4 Zone flotation tails achieved rapid uranium extraction of 86.7% in 6 hours, 92.3% in 12 hours, 95.2% in 24 hours, 96.7% in 48 hours, 97.2% in 72 hours, and 97.5% in 96 hours under the following conditions: 100% passing 140 mesh grind, 70°C, 50% solids slurry, 50 g/L Na_2CO_3 and 20 g/L $NaHCO_3$ solution chemistry and oxygen at 300 kilopascals as oxidant.

Using the same optimized conditions, an additional test was conducted on a sample from the 2012 Lac 50 composite (but at 100% passing 200 mesh grind as per 2012 composite preparation). When compared to the 2012 result leach kinetics improved with uranium extractions of 83.6% in 6 hours, 91.7% in 12 hours, 95.1% in 24 hours, 96.4% in 48 hours, 97.0% in 72 hours, and 97.3% in 96 hours. Figure 1 compares alkaline leach kinetics from 2013 to that of 2012.

FIGURE 1. Optimized Leach Kinetics for J4 Zone composite and 2012 Lac 50 composite samples



Positive Metallurgical Results from Lac 50 Trend; Low Impurity Yellowcake Produced (February 28, 2013)

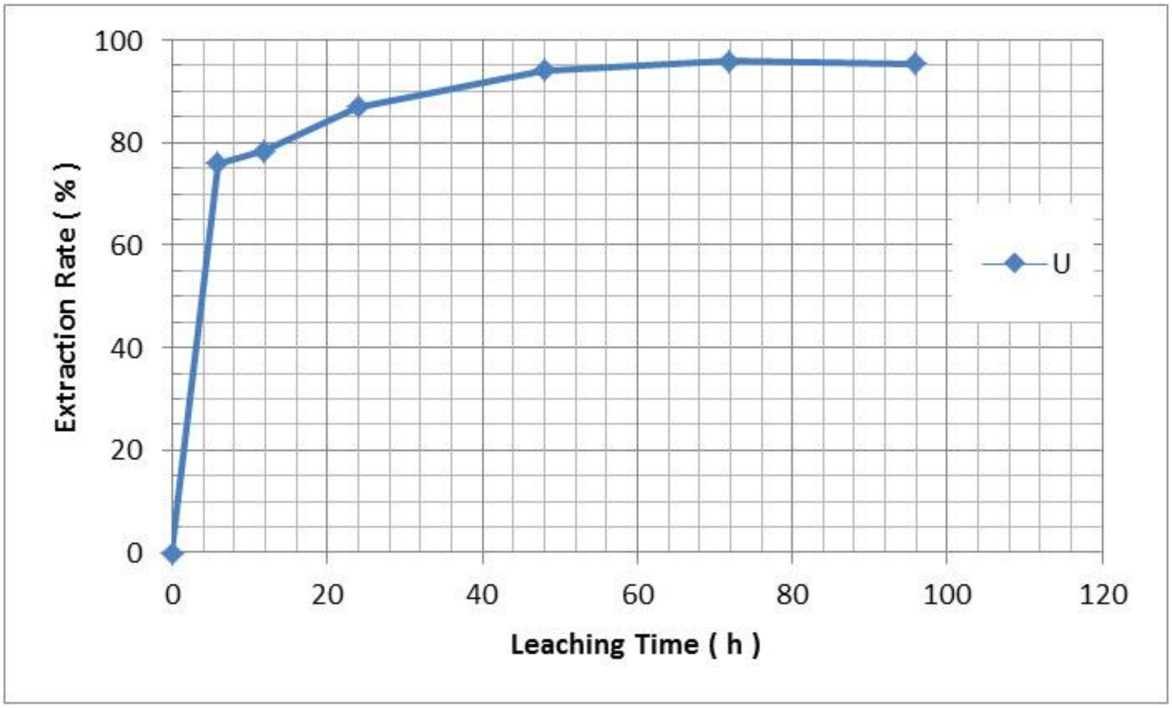
Commencing in June 2012, the Saskatchewan Research Council ("SRC") metallurgical testing program on core from Kivalliq's Lac 50 Trend was designed to investigate uranium alkaline leaching optimization and perform a preliminary evaluation of the purity levels of the final yellowcake product. Objectives of the tests were to:

- Maximize uranium extraction through optimizing the alkaline leaching process
- Maximize the recovery of sulphides through flotation
- Compare preliminary yellowcake product impurity levels to ASTM C967-13 uranium ore concentrate specifications

A 60 kilogram ("kg") composite was derived from split drill core pulp rejects submitted to SRC for analysis. Samples were selected from 51 holes drilled along 3.2 kilometres of strike length at the Lac 50 Trend Main Zone, Western Extension and Eastern Extension. Previous work indicated carbonate content above 13% and therefore alkaline leaching was considered the most effective extraction process for the Lac 50 Trend uranium deposits. Results from alkaline leaching tests to date are highly encouraging.

Optimized results(shown in Figure 1) indicate that a – 74 µm (-200mesh) feed at 70^{o}C, atmospheric pressure, 50% pulp density, sufficient oxidation, and a reagent addition rate of 70 kg/tonne (50 kg Na_2CO_3 and 20 kg $NaHCO_3$), extracts 94.1% of uranium in 48 hours and extracts 95.9% of uranium in 72 hours.

FIGURE 1. Optimized Leach Kinetics of Uranium



Alkaline leaching is a selective process that can result in a pregnant leaching solution with relatively low impurity levels. The use of an alkaline leach circuit at the Lac 50 Trend could have additional benefits:

- Simple purification processes to produce yellowcake
- Environmentally sensitive recirculated processing solution circuit resulting in reduced reagent use and uncomplicated effluent treatment
- Simplified tailings handling with the possibility to utilize tailings for backfill during mining

A preliminary yellowcake precipitation was performed with the leach solution from the composite. Uranium in the pregnant solution was readily precipitated as sodium diuranate. The optimized uranium value attained was 71.9% for a final yellowcake product. In addition to U, the final yellowcake sample was analysed for several major impurities, the results for which are shown compared with Impurity Maximum Concentration Limits from ASTM C967-13 *Standard Specifications for Uranium Ore Concentrate* in Table 1.

TABLE 1. Impurity of the Preliminary Kivalliq Yellowcake Product

Specifications	**ASTM C967-13 (Mass%, Uranium Basis)**		**Kivalliq (Mass%, Uranium Basis)**
Component	**Limit without Penalty**	**Limit without Rejection**	**YC Product**

Uranium (U)	N/A	65% min.	71.9%
Arsenic (As)	0.05%	0.1%	0.0009%
Barium (Ba)	N/A	N/A	0.0001%
Boron (B)	0.005%	0.1%	N/A
Cadmium (Cd)	N/A	N/A	0.00006%
Calcium (Ca)	0.05%	1%	0.02%
Carbonate (CO_3)	0.2%	0.5%	0.069%
Chromium (Cr)	N/A	N/A	0.018%
Fluoride (F)	0.01%	0.1%	N/A
Halides (Br, Cl, I)	0.05%	0.1%	N/A
Iron (Fe)	0.15%	1%	<0.01%
Lead (Pb)	N/A	N/A	0.007%
Magnesium (Mg)	0.02%	0.5%	N/A
Mercury (Hg)	N/A	N/A	N/A
Moisture (H_2O)	2%	5%	N/A
Molybdenum (Mo)	0.1%	0.3%	0.0004%
Phosphorus (PO_4)	0.1%	0.7%	0.03%
Potassium (K)	0.2%	3%	<0.002%
Selenium (Se)	N/A	N/A	<0.0001
Silica (SiO_2)	0.5%	2.5%	N/A
Silver (Ag)	N/A	N/A	0.0003%
Sodium (Na)	1%	7.5%	<0.01%
Sulfur (S)	1%	4%	0.125%
Thorium	0.1%	2.5%	0.00006%
Titanium	0.01%	0.05%	<0.002%
^{234}U	56 µg/gU	62 µg/gU	N/A
Vanadium (V)	0.06	0.3%	<0.0001%
Zirconium (Zr)	0.01%	0.1%	N/A

Assayed impurities are below the Maximum Concentration Limit Without Penalty standard specifications for uranium ore concentrate. Low impurity levels achieved in preliminary yellowcake tests are very encouraging at this early stage of testing.

The SRC metallurgical program was designed to build on first phase metallurgical testing initiated in 2010 by SGS Mineral Services (“SGS”). SRC aggregated a master composite sample weighing approximately 60 kg, by blending and homogenizing 166 quarter split and half split pulp reject samples from drill core submitted to SRC Geoanalytical Lab for analysis as part of Kivalliq's 2010 and 2011 diamond drilling programs. A head grade sample from the 2012 composite analyzed by SRC's ICP 1 total digestion method assayed 0.737%U, 0.217%Mo, 0.667%Cu, 0.221%Zn, 0.231%Pb, and 26.7 g/tonne Ag.

The SRC facility operates in accordance with ISO/IEC 17025:2005 (CAN-P-4E), General Requirements for the Competence of Mineral Testing and Calibration laboratories and is accredited by the Standards Council of Canada. The samples are analyzed by SRC's ICP-OES multi-element ICP1 method. ICP1 results for are reported in parts per million (ppm). 1 ppm = 1g/tonne, 10,000 ppm = 1%. ICP results U>1,000 parts per million (ppm) are analyzed using SRC's ISO/IEC 17025:2005-accredited U_3O_8 Assay method. Jeff Ward, P.Geo, President of Kivalliq and a Qualified Person for the Company, has reviewed and approved the information contained in this release.

Metallurgical Tests from NI-43-101 Tech Report (March 1, 2012)

During 2010, Kivalliq engaged SGS to carry out preliminary metallurgical testing to examine uranium recovery from a composite of pulp rejects from 2009 half split drill core submitted to SRC for uranium and trace element analytical work during the 2009 drilling program (Brown and Todd, 2011). The test work included sample preparation, head analyses and agitated leach tests. Detailed metallurgical test procedures, analyses and a list of the sample rejects from the 2009 drill core that was used in the composite metallurgical sample and metallurgical test procedures are provided in the March 1 2011 Technical Report on the Angilak Property (Dufresne and Sim, 2011).

The uranium extraction results were considered excellent, with 98% dissolution for acid leach tests and up to 94.7% dissolution for alkaline leach tests. Both acid and alkaline leaching were evaluated due to the high carbonate content in the preliminary composite samples. Uranium leach extraction kinetics were all considered good with the acid leach tests reaching maximum extraction of uranium at 6 to 10 hours and the alkaline atmospheric tests requiring up to 24 hours.

Metallurgical Testing from NI-43-101 Tech Report (March 1, 2011)

During 2010, Kivalliq engaged SGS to carry out preliminary metallurgical testing to examine uranium recovery from a 73 kg composite of pulp rejects from 2009 half split drill core submitted to SRC for uranium and trace element analytical work during the 2009 drilling program (Brown and Todd, 2011). The test work included sample preparation, head analyses and agitated leach tests.

The reject samples received by SGS were combined, blended and then crushed to -10 mesh (-2 mm) and split into metallurgical test charges. A head sample was representatively split and subjected to a detailed chemical analysis. The head grade was determined to be 0.77% U_3O_8, with minimal thorium, 3% sulphur (S) and more than 10% carbonate reported as CO_2 The levels of rare earth elements (REE's) and other potentially deleterious elements such as arsenic (As) and selenium (Se) were found to be low.

A total of six leach extractions using a variety of leach conditions and sample grinding were completed and are listed in Table 1. In general, the uranium extraction results were considered high, with 98% dissolution for both acid leach tests (Test 1 and Test 3) and up to 94.7% dissolution for alkaline leach tests (Test 4, Test 6, Test 7 & POX 1). Acid consumption during the first two tests at 359 and 489 kg/t respectively, was relatively high. This was attributed to the high carbonate gangue content of the composite and therefore both acid and alkaline leaching were evaluated. Uranium leach extraction kinetics were all good with the acid leach tests reaching maximum extraction at 6 to 10 hours and the alkaline atmospheric tests requiring up to 24 hours.

TABLE 1: Uranium leach test conditions and extractions (from Brown and Todd, 2011).

Test ID	Grind Size, P80 µm	Leach Medium	Temp., ºC	Retention Time, hrs	% U Extraction	Leach Type
Test 1	90	5 g/L H_2SO_4	50	24	98.0	acid
Test 3	90	40-50 g/L H_2SO_4	50	24	98.0	acid
Test 4	90	50g/LNa_2CO_3,20g/L$NaHCO_3$	80	48	94.7	alkaline
POX 1	90	50g/LNa_2CO_3,20g/L$NaHCO_3$	120	8	91.7	alkaline
Test 6	43	50g/LNa_2CO_3,20g/L$NaHCO_3$	80	48	70.3	alkaline
Test 7	90	50g/LNa_2CO_3,20g/L$NaHCO_3$	80	24	93.0	alkaline