SALT LAKE POTASH LTD

14 September 2017

# EXPERT TESTWORK CONFIRMS SOP PROCESS WITH EXCELLENT RECOVERIES

*Salt Lake Potash Limited (**the Company** or **SLP**) is pleased to report excellent results from SOP process development testwork performed by globally recognised potash process leaders, Saskatchewan Research Council (**SRC**).*

*The comprehensive testwork program validates and refines the parameters used in the process plant flowsheet for the Company's Goldfields Salt Lake Project (**GSLP**). Importantly, the testwork was conducted on a 60kg representative sample of kainite harvest salt produced on site at Lake Wells.*

*Highlights from the SRC process testwork include:*

### *High Potassium Recovery Indicated*

- *Bench scale testing on the complete plant process confirms an **overall process plant potassium recovery of over 92%** is achievable, validating parameters of GSLP mass balance models to date.*
- *SOP produced exceeds the industry high-grade benchmarks of 52% $K_2O$ and 54% $SO_4$.*

### *Flexible Process Options*

- *The feed salt can be easily upgraded through removal of coarse halite, **reducing the mass feed to flotation by up to 25%**.*
- *Both reverse and direct flotation show excellent recovery (up to 97%), providing optionality in process selection depending on brine handling requirements.*
- *Both mechanical cell and column flotation were tested successfully.*

### *Potential for Additional Co-products*

- *The SRC work has opened an opportunity to make a valuable **$MgSO_4$ co-product with limited additional process input**.*

### *Further Development Work Accelerated*

- *SRC has been engaged to perform selected further optimisation tests followed by a continuous locked cycle operation, to produce significant quantities of schoenite flotation product and SOP to be produced for further testing and marketing.*

Commenting on the testwork, SLP's CEO, Matt Syme, said *"We are very pleased with the results received from SRC, the world's leading potash laboratory, which reiterate the excellent attributes of the Project. The testwork results validate the flowsheet for the GSLP and provide us with a number of important options to further optimize the production process and therefore the Project."*

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## The GSLP SOP Production Process

The proposed process for production of SOP at the GSLP sees brine extracted from Lake Wells concentrated in a series of solar ponds to induce the sequential precipitation of salts, firstly eliminating waste halite and then producing potassium-containing salts (Harvest Salts) in the harvest ponds.

The Harvest Salts are then treated in a processing plant to convert these salts into SOP, while minimising deportment of sodium chloride (a contaminant) to the product. The SOP production process consists of attrition, reverse flotation to remove chlorides, conversion of the mixed sulphate salts to schoenite, and crystallisation of the schoenite to SOP, before drying and packaging.

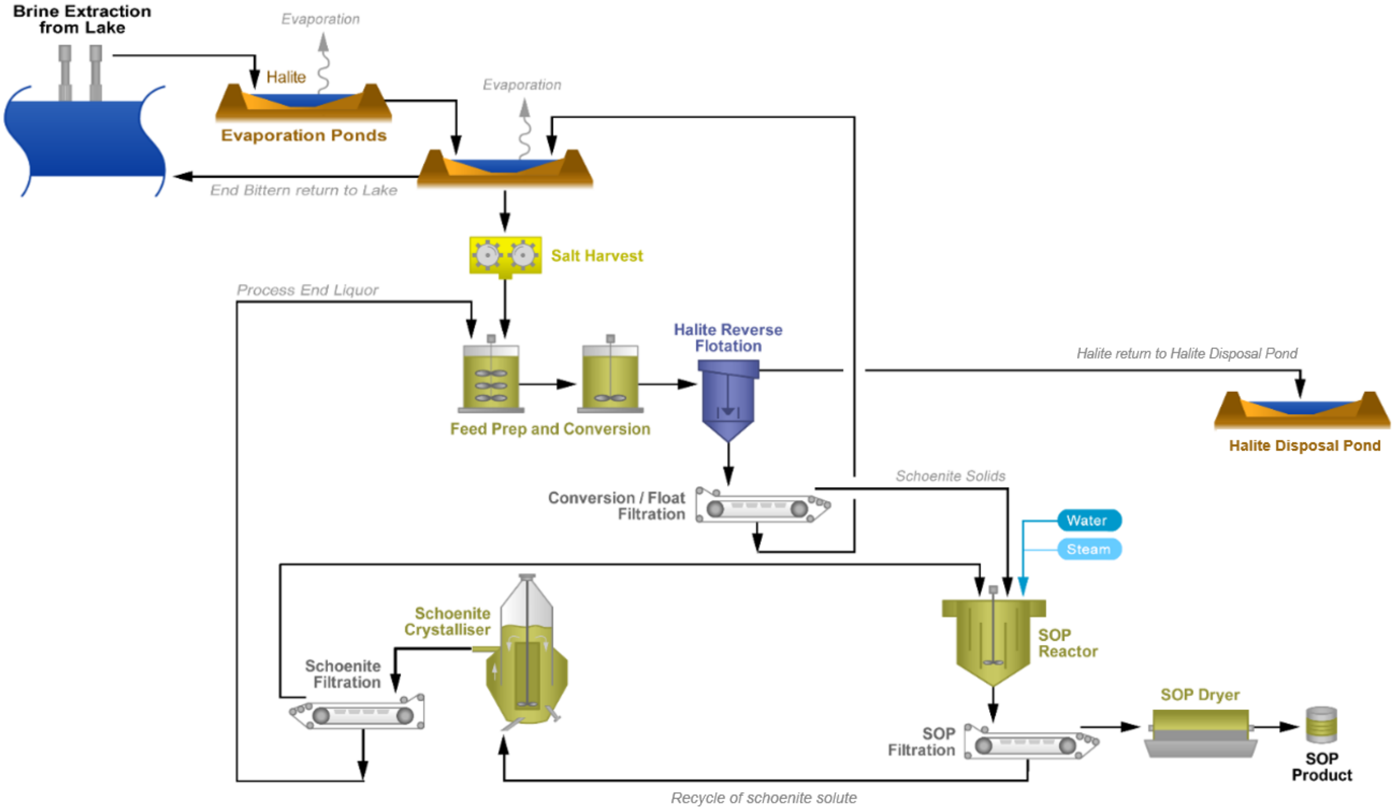


**Figure 1: Simplified Lake Wells (GSLP) SOP Conceptual Flowsheet**

## SRC Process Development Work

The testwork was performed by the Saskatchewan Research Council (**SRC**) in Saskatchewan, Canada. SRC is a recognized global leader in potash process metallurgical testing. SRC's Minerals team has the facilities and expertise to design and perform potash processing and metallurgical testing work for the potash industry worldwide.

The objective of the SRC testwork was to validate and refine the process parameters used in the production model and process flowsheet at the Company's Goldfields Salt Lake Project (**GSLP**). These process parameters were designed by the Company's metallurgical consultants based on experience overseas and results for GSLP lab testwork in the USA and Australia.

The testwork program was designed to improve the Company's understanding of the processing plant component of the operation using actual Harvest Salts produced from Lake Wells brines under site conditions. These Harvest Salts differ from salts produced in laboratory evaporation trials and provide a much more representative basis from which to develop an economic process route.

The key sections of the testwork were the following:


The testwork program was designed and managed by the Company and international brine-processing expert Mr Carlos Perucca of Carlos Perucca Processing Consulting Ltd (**CPPC**).

## Harvest Salt Sample Preparation

The Company selected a single harvest (~60kg) of harvest salt from the Site Evaporation Trial (**SET)** at Lake Wells which produces Harvest Salts from Lake Wells' brine under actual site conditions. The Harvest Salts are within the range of salt composition (chemical and physical characteristics) expected in a commercial scale operation (Figure 2).


**Figure 2: Harvest Salts delivered to SRC**

## Feed Assay and Characterisation

The received harvest salt had excess brine removed before being homogenised and sampled for chemical assay and mineralogical analysis by SRC. The remaining salt was screened at 2mm with oversize crushed to 100% passing 2mm. This formed the feedstock for the process development work. ICP analysis of the homogenised feed sample is shown in Table 1.

| Sample | CaO, % | $K_2O$, % | MgO, % | Na2O, % | S, % | Insol, % |
|---|---|---|---|---|---|---|
| Feed Salt | 0.02 | 10.1 | 12.4 | 16.4 | 9.88 | 0.1 |
| Repeat | 0.02 | 10.4 | 12.5 | 16.8 | 9.92 | 0.1 |

**Table 1: Harvest Salt ICP Assay**

XRD analysis of the harvest salt showed the species present as predominantly Kainite (>50%) with lower proportions of Halite and various hydrations of magnesium sulphate, correlating well with the chemical analysis. Figure 3, below, shows the XRD results and interpretation.

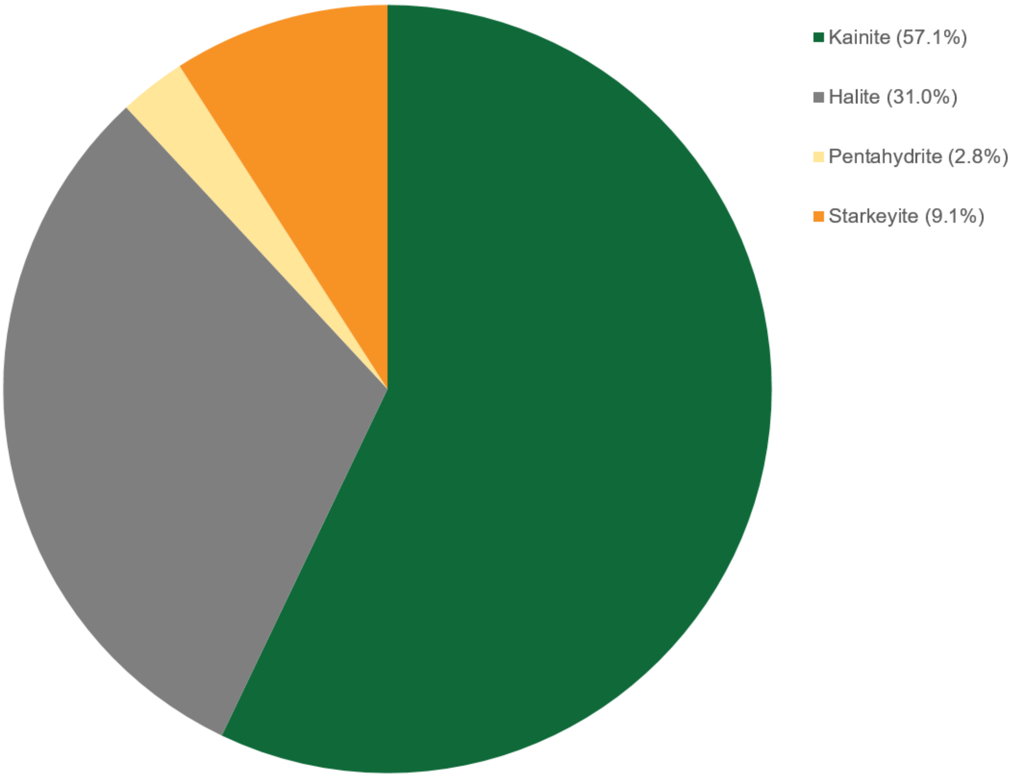


**Figure 3: Harvest Salt XRD results**

The harvest salts were also analysed by Scanning Electronic Microscope (SEM) to ascertain the level of crystal agglomeration in the as-harvested salt. Figure 4, below, shows the high proportion of agglomeration in the <1mm fraction of the sample.

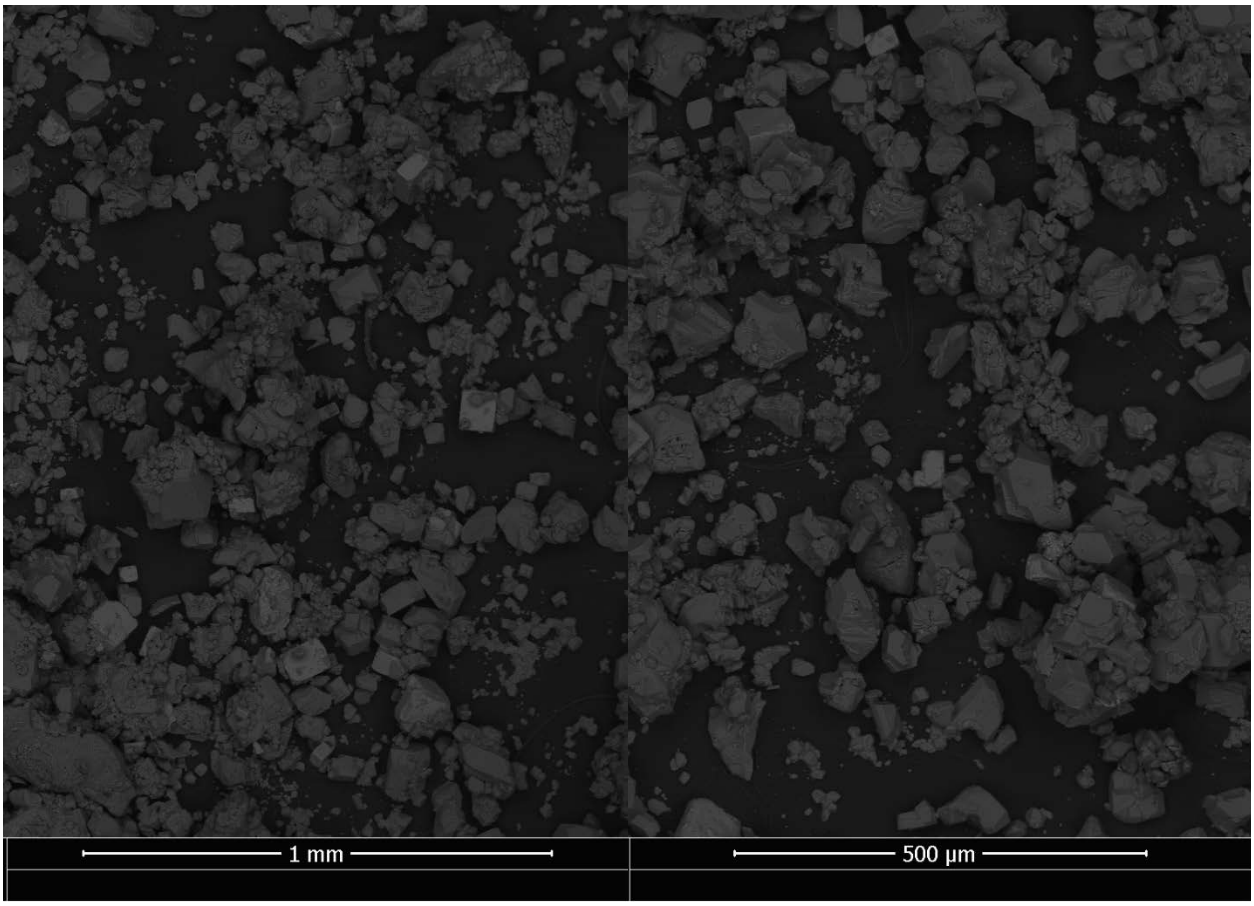


**Figure 4: SEM of the feed salt**

## Product Salt Liberation and Kainite Destruction

In order to achieve an effective and selective flotation result it is necessary to liberate the product salts from waste halite.

A short residence time in an attrition cell was partially effective in liberating the product salts. Figure 6 shows an SEM image of attritioned salt showing an improvement in the number of discrete crystals observed however, some agglomeration is still present.

**Figure 5: Attrition Scrubber**

As a potential alternative approach the feed salt was also subjected directly to kainite decomposition (converting kainite to schoenite) which comprised a 2 hour residence time at ~45% solids in a sulphate saturated brine (simulated process recycle brine). SEM of the resulting salt showed excellent salt liberation (Figure 7).

Overall potassium recovery from the destruction reaction was greater than 100%, up to 146% under optimised conditions, with excess potassium in the brine reporting as schoenite in the solid phase. XRD of the decomposition product showed >96% conversion of kainite to schoenite was achievable in a two hour residence time.

Once the salts were liberated, size by grade analysis on the destruction product showed the majority of the potassium containing salts reported to the fine (<425 µm) fraction. A selective screening of the product allows around 23% of the mass of the flotation feed to be discarded while retaining 98.5% of the potassium.

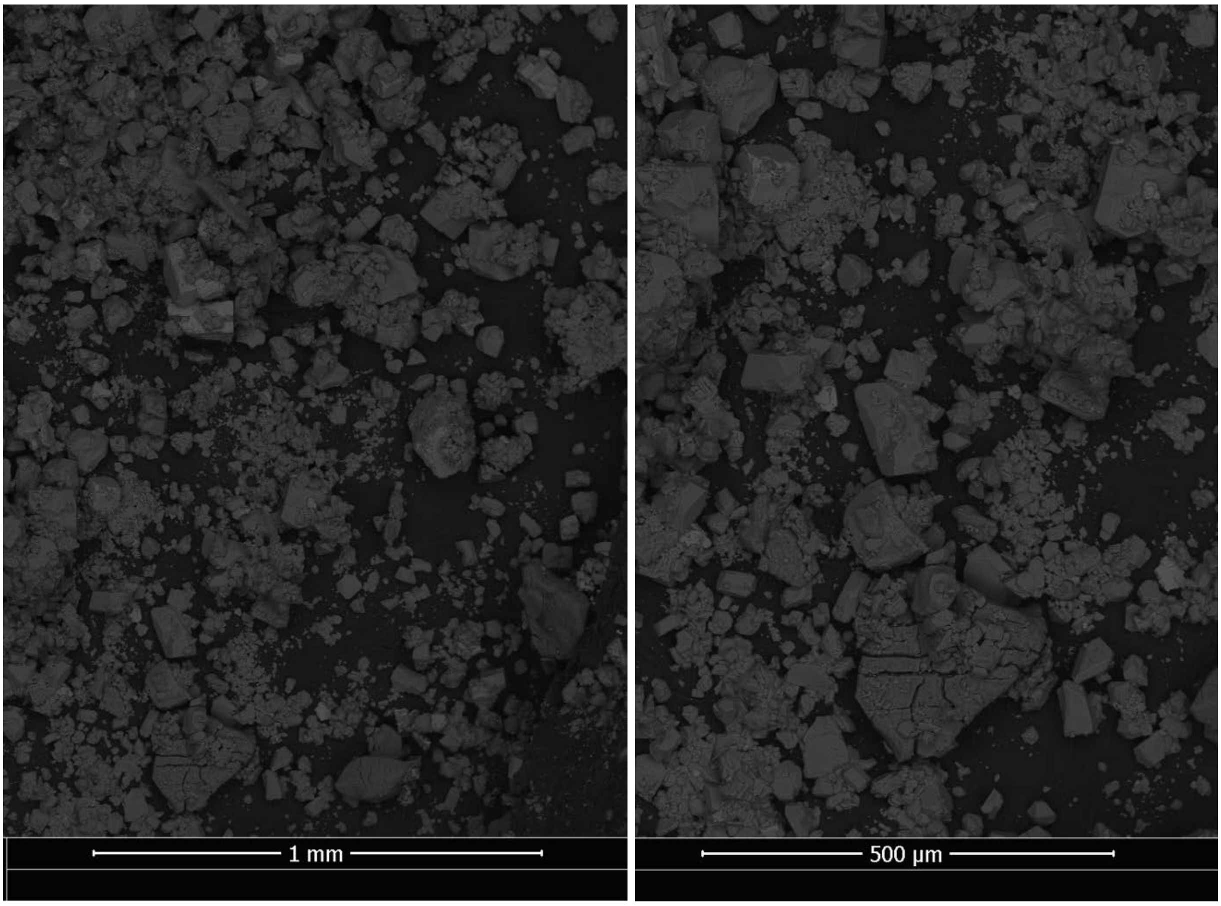


**Figure 6: SEM Images of the Attrition-Scrubbed Sample (6 minutes)**

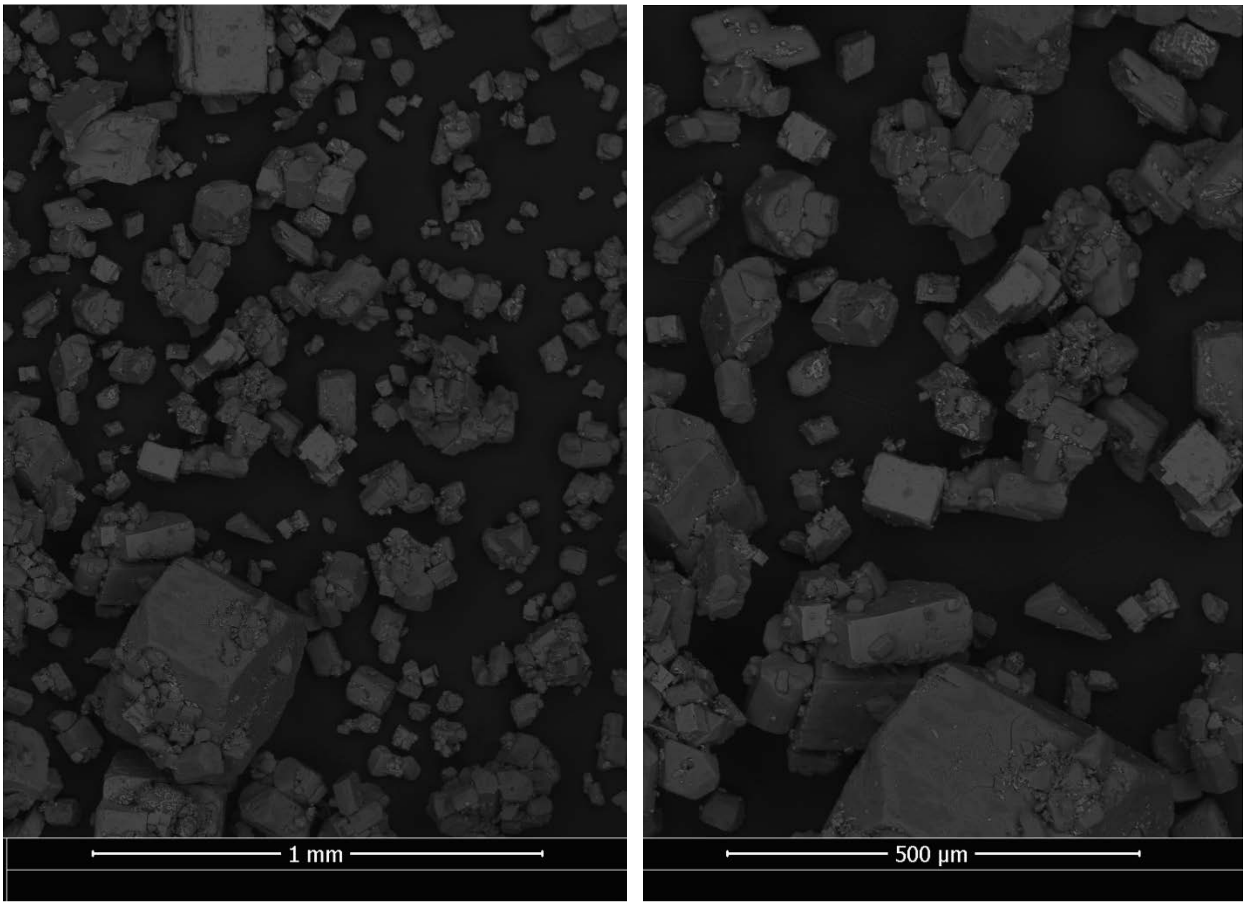


**Figure 7: SEM Images of the Decomposed Sample**

## Flotation

Harvest Salts produced from Lake Wells contain approximately 50% kainite. This allows both direct flotation (of schoenite) and reverse flotation (of waste halite) as a potential production model. Both methods were tested on the decomposition product, with an aim to produce a concentrated schoenite product with less than 5% NaCl out of the flotation circuit. This then allows an SOP product of commercial quality in the conversion circuit.

Direct flotation in both mechanical cells and column flotation (Figure 8) were tested, successfully recovering up to 93.3% of the potassium to the flotation product.

Column reverse flotation tests demonstrated excellent selectivity, indicating potassium recovery of 97.1% was achievable with excellent halite rejection. The reverse flotation product contained only 0.6% Na and as such has the potential to product high purity SOP product.

**Figure 8: Flotation Column**

The balance of the mass in the reverse flotation product is schoenite and magnesium sulphate, providing an opportunity to apply a second, direct flotation to the reverse flotation product and make both a low sodium schoenite feed to crystallisation and a magnesium sulphate co-product. Magnesium sulphate has a ready market in Asia as a crop nutrient but also provides potential operation flexibility in the GSLP project to maximise SOP production by providing a transportable sulphate source.

## SOP Conversion

Tests of SOP conversion of schoenite flotation product at various solid-liquid ratios were carried out with the optimum ratio between 1.3 and 1.5 tonnes of water per tonne of feed salt. Figure 9, below shows the XRD analysis of SOP conversion products at the various solid-liquid ratios tested.

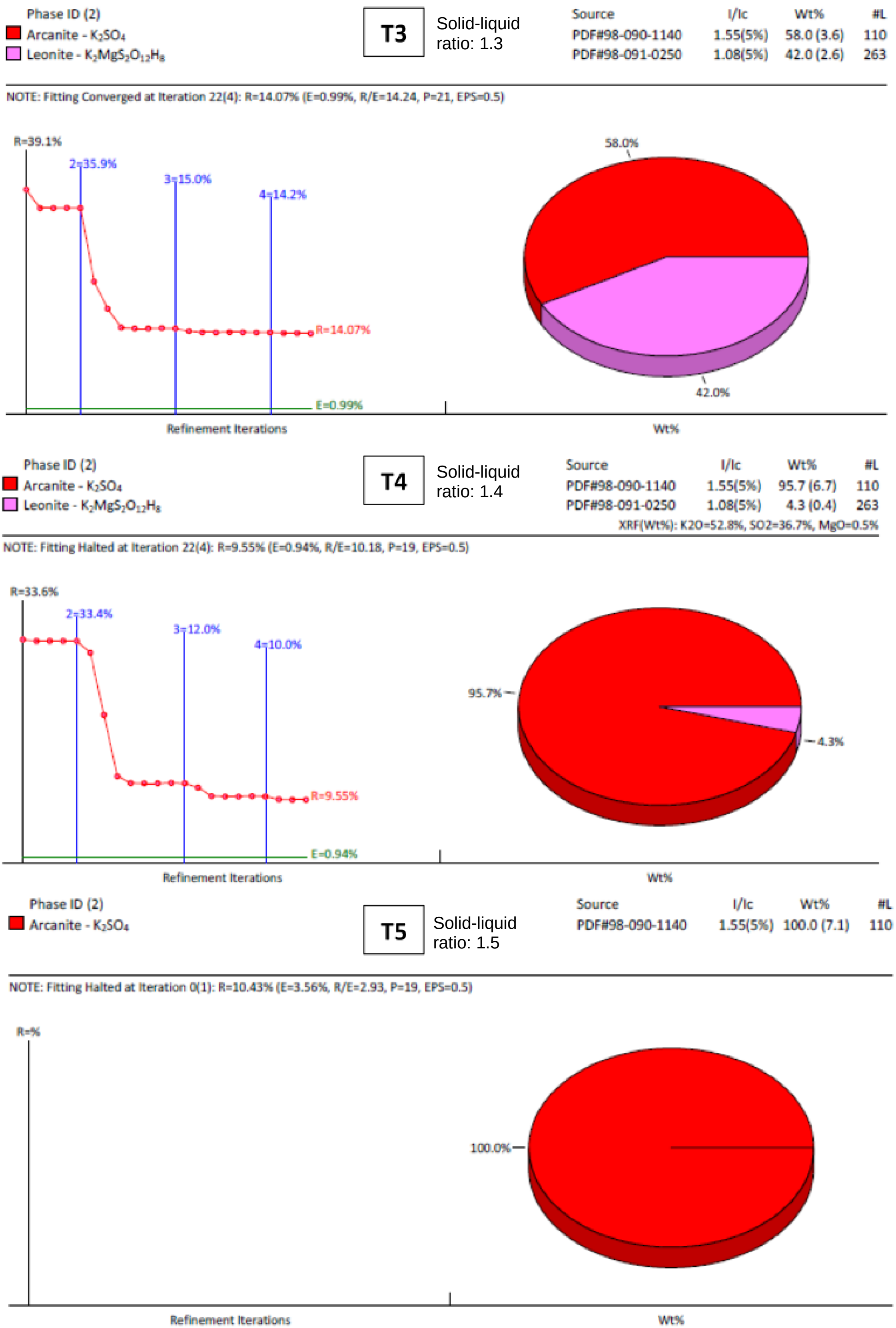


**Figure 9: SOP Compositions at Various Solids/liquids Ratios**

Optimisation of reaction time at a solid-water ratio of 1/1.5 showed a minimum retention time of 1.5 hours was required to reach the Company's target SOP purity of >98% (see Figure 10).

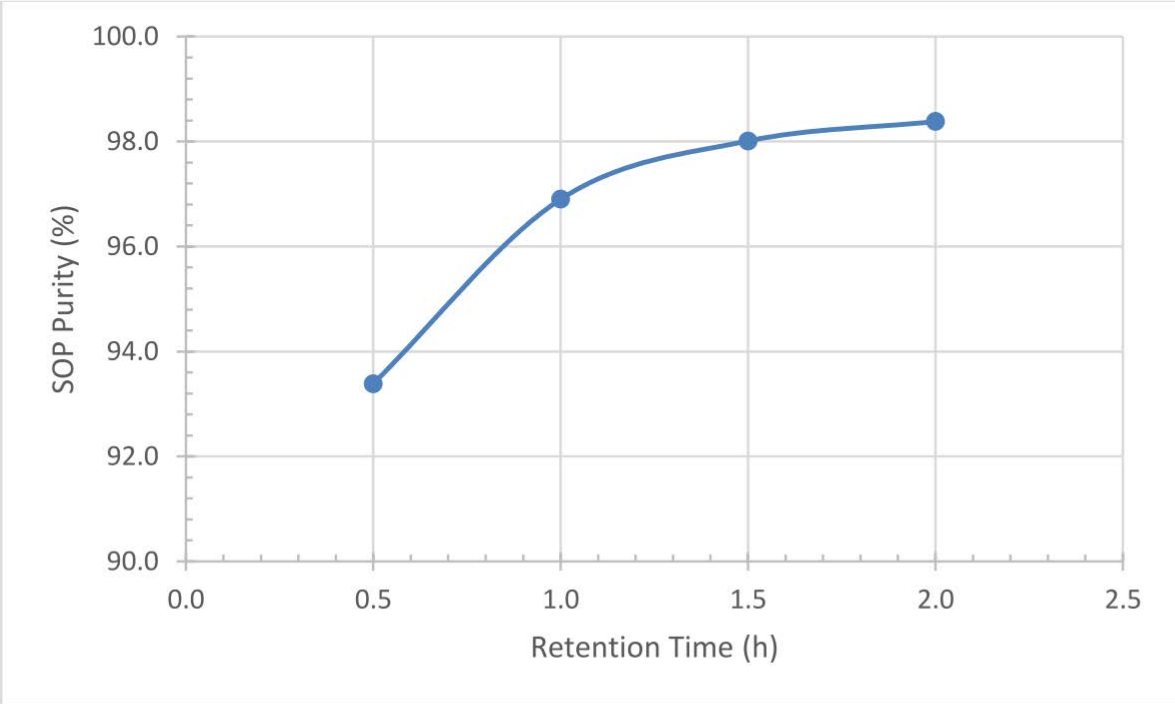


**Figure 10: SOP purity as a Function of Reactor Retention Time**

The product quality produced from flotation product at varying retention times is detailed in Table 2, below. At 1.5 hour retention time the product purity surpasses SLP's internal quality target of 98% (>53% K2O) with a very low sodium content.

| Retention Time, h | Assay, % | | | | | |
|---|---|---|---|---|---|---|
| | CaO, wt% | K2O, % | MgO, % | Na2O, % | S, % | SO4, % |
| 0.5 | 0.05 | 50.5 | 1.84 | 0.26 | 18.7 | 56.1 |
| 1.0 | 0.06 | 52.4 | 0.42 | 0.21 | 18.5 | 55.5 |
| 1.5 | 0.05 | 53.0 | 0.41 | 0.19 | 18.5 | 55.5 |
| 2.0 | 0.05 | 53.2 | 0.44 | 0.21 | 18.8 | 56.4 |

**Table 2: SOP Product Purity at Varying Retention Time**

The results above compare very favourably to the specifications of products marketed as SOP for agricultural use worldwide where average potassium assays range from 50% to 52% as K2O and sulphate assays range from 52% to 54% as SO4.

## Overall Potassium Recovery

The conceptual overall flowsheet developed by SRC can be seen in Figure 11, below.

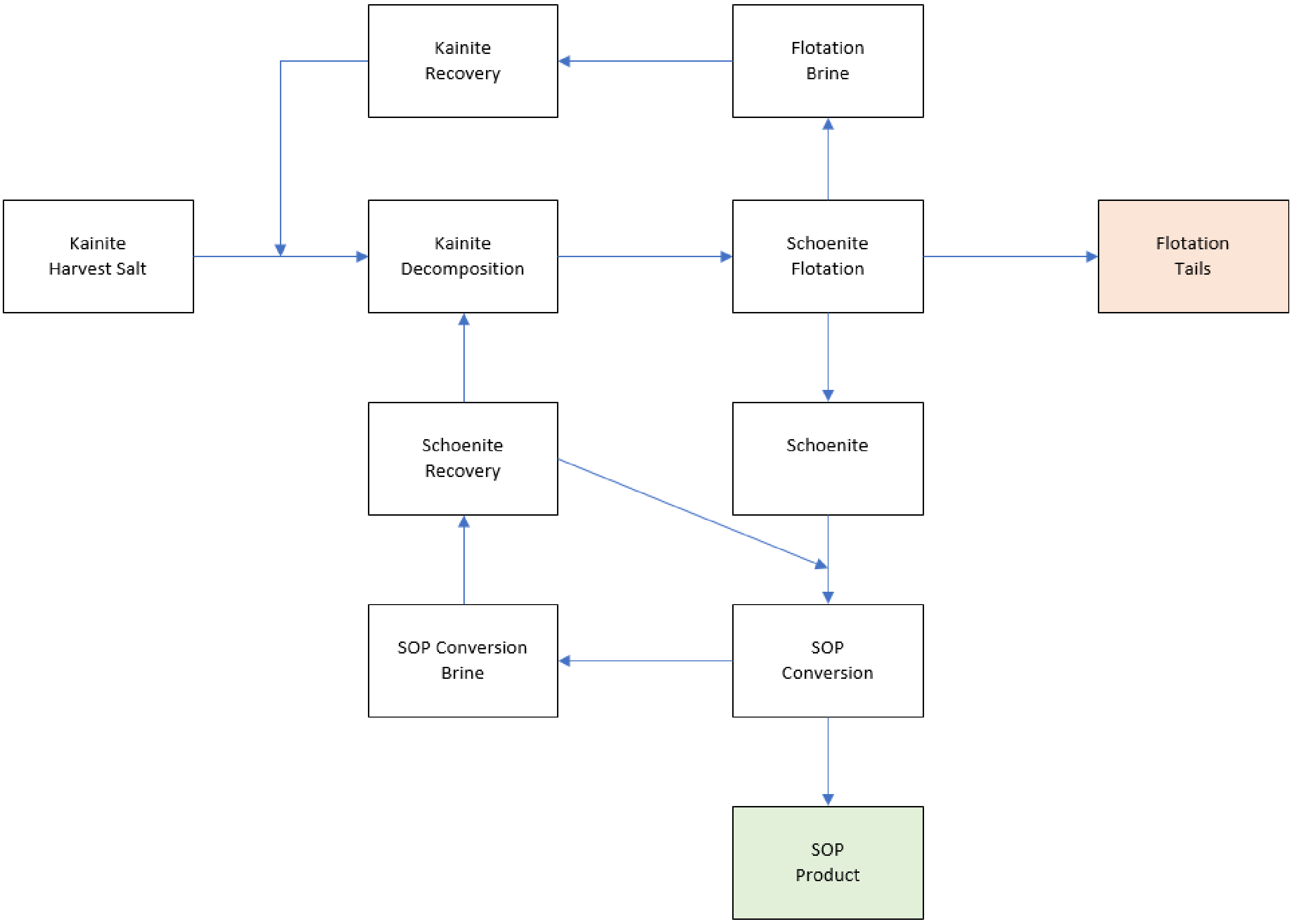


**Figure 11: Conceptual SOP Process and Potassium Distribution**

Single pass SOP conversion from schoenite, including recovery of schoenite from the conversion brine was determined as 39.7% in the SRC lab, with the remaining schoenite recycling to the kainite decomposition reactors to recover potassium.

Tests were carried out on recovery of residual potassium from excess flotation brine as kainite, with a 98.2% recovery of potassium from this stream achievable, which is recycled to the plant feed.

This results in an overall potassium recovery of up to 92%, depending on the flotation option and brine handling methods employed in the process development. This compares favourably with performance parameters included in the mass balance models which the Company has generated for its feasibility studies. Future mass balance models will be refined to reflect the SRC results.

**International salt processing expert Carlos Perucca of CPPC commented on the SRC results "*I am extremely pleased with the results of the SRC testwork and the implied potential for an efficient SOP production process at the Goldfields Salt Lake Project. In my experience the potential recovery indicated by this work is at the high end of recoveries of other SOP operations worldwide.*"**

## Next Steps and Process Validation

The work completed by SRC has highlighted several opportunities for further refinement and development of the GSLP SOP process.

SRC has been engaged to carry out further optimisation tests to validate and duplicate the results achieved to date, followed by a locked-cycle continuous production test to test brine recycle assumptions and obtain product purity information on a continuous basis.

The locked-cycle test will also provide a significant quantity of flotation product to allow crystalliser vendor testing and design work, and also SOP product for product testing and commercial purposes.

## Conclusions

The work completed at SRC to date has shown:

- Minimal comminution is required to liberate salts for flotation;
- Kainite destruction achieves high conversion to schoenite in 2 hours at ambient conditions;
- Both direct and reverse flotation provide viable flow sheet options for further investigation;
- Potassium recovery in flotation is high with up to 97.1% achieved in reverse flotation;
- Both reverse and direct flotation options present the opportunity to make a second saleable $MgSO_4$ product with minimal additional processing;
- SOP conversion produces high purity (>98%) SOP with a 1.5 hour residence time; and
- Global potassium recovery for the process plant may be as high as 92% depending on the flotation option and brine recycle philosophy selected.

Further work is underway to further refine parameters to feed into Pre-Feasibility Study level studies on both the commercial operation and the pilot plant.

***Competent Persons Statement***

*The information in this report that relates to Process Testwork Results is based on, and fairly represents, information compiled by Mr Bryn Jones, BAppSc (Chem), MEng (Mining) who is a Fellow of the AusIMM, a 'Recognised Professional Organisation' (RPO) included in a list promulgated by the ASX from time to time. Mr Jones is a Director of Salt Potash Limited. Mr Jones has sufficient experience, which is relevant to the style of mineralisation and type of deposit under consideration and to the activity which he is undertaking, to qualify as a Competent Person as defined in the 2012 Edition of the 'Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves'. Mr Jones consents to the inclusion in the report of the matters based on his information in the form and context in which it appears.*