



ABOUT
PepinNini Lithium Limited is a diversified ASX listed Exploration Company focused on exploring and developing a lithium brine resource and production project in Salta Province Argentina within the Lithium Triangle of South America. The Company also holds strategically located exploration tenements in the Musgrave Province of South Australia. The company also holds a copper-gold exploration project in Salta Province, Argentina

DIRECTORS
Rebecca Holland-Kennedy
 Managing Director
Sarah Clifton-Brown
 Finance Director
Philip Clifford
 Non-Executive Director
James Allchurch
 Non-Executive Director
Justin Nelson
 Company Secretary

CONTACT
 PepinNini Lithium Limited
 ABN 55 101 714 989

Level 1, 6/68 North Terrace
 Kent Town SA 5067
 TEL:+61 (0)8 8218 5000
 FAX:+61 (0)8 8212 5717
 EMAIL: admin@pepinnini.com.au

FURTHER INFORMATION
Ms Rebecca Holland-Kennedy
 Managing Director
 TEL: +61 (0)8 8218 5000



Evaporation Simulation Studies Indicate Unique Brine Chemistry Creates Enriched Brine Evaporate of 2.24% Lithium

The Directors of PepinNini Lithium Ltd (PNN, PepinNini, the Company) are pleased to report the results of a study of the brine from its Rincon, Pular and Incahuasi projects in which brine evaporation pathways were computer simulated to determine the concentrated brine composition which would be the result of the traditional evaporation and concentration methodology currently utilised by other lithium carbonate producers in the South American Lithium Triangle.



Figure 1 – Pular, Rincon and Incahuasi Projects

The study indicated and actual sample results confirm that Incahuasi brine has the highest calcium concentration and Rincon brine has the highest sulphate concentration. A mix of Incahuasi and Rincon brines was simulated resulting in precipitation of calcium sulphate (Ca₂SO₄) or gypsum. The simulation indicates that contaminants reduced in this way would create an enriched brine of 2.24% Lithium or 22,400ppm Lithium with a very low Magnesium:Lithium Ratio of 1.02:1.

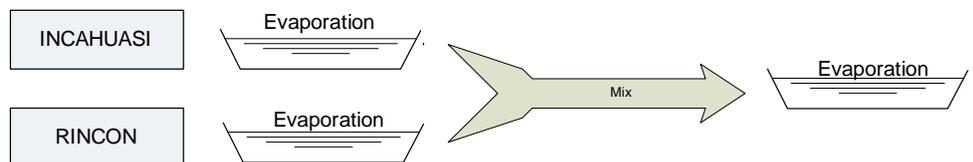


Figure 1 – Concentrated Brine mix pathway

Table 1 - Final Brine Composition – Rincon Incahuasi Blend

	H ₂ O Water %	Li Lithium %	Na Sodium %	K Potassium %	Ca Calcium %	Mg Magnesium %	Cl Chloride %	SO ₄ Sulphate %	BO ₂ Borate %
Final Brine	52.09	2.24	0.09	0.21	8.87	2.28	33.79	0.05	0.34

The study was prepared using brine sample results from the Company's drilling programs from which lithium carbonate resources

were estimated in accordance with the JORC Code (2012 Edition) (ASX:27 June 2018, 23 January 2019) and shallow pit brine samples from Incahuasi Salar were taken by previous explorer Latin American Minerals Inc(TSX-V:LAT13 Nov 2008 - Canadian National Instrument 43-101)⁽¹⁾ and Lithea Inc reported by Ekeko August 2011⁽²⁾.

The study commenced with evaporation pathway testing by computer simulation for each salar project using the Company's brine sample results and environmental data from the geographic area. Next, three Cases of different brine proportion mixes were undertaken. Case 1 brine blend of the most compatible brines from Rincon and Incahuasi Salares was simulated resulting in a dramatic increase in the Lithium recovery due to the respective brine chemistry. Brine from the Pular project was not considered to have a suitable chemistry for blending. The comparison results are tabulated below:

Table 2 – Brine Composition Case 1 and Individual Salar Comparison Results

Brine	Li Lithium %	Na Sodium %	K Potassium %	Ca Calcium %	Mg Magnesium %	Cl Chloride %	SO ₄ Sulphate %	BO ₂ Borate %	Mg:Li
Rincon	0.82	1.94	3.81	<0.01	2.44	3.78	29.79	3.16	8:1
Incahuasi	0.60	<0.10	2.17	12.00	2.80	30.00	-	1.10	5:1
Blend – Case 1	2.24	0.09	0.21	8.87	2.28	33.79	0.05	0.34	1.02:1

The study was carried out by International Expert Engineers Ad-Infinitem who have contributed amongst others to the Feasibility Study by Galaxy for the Sal de Vida project, Salar del Hombre Muerto(ASX:GXY 15 May 2018) and Scoping Study for Salt Lake Potash(ASX:SO4, 28 August 2016).

Figure 2 – Examples of Evaporation Ponds and Harvesting of Concentrate



The Company now intends to validate the simulated evaporation and blending pathway under laboratory conditions using a wind tunnel to evaporate the brine blend from the projects.

References:

(1)TSX-V:LAT 13 Nov 2008 – Latin American Minerals Inc. acquires Lithium project in Argentina following positive initial sampling program - Sampling and Analytical Protocols: Sampling and analytical protocols were implemented and supervised by or under the direction of Dr. Waldo Perez, the Corporation's internal Qualified Person as defined by National Instrument 43-101. All of the lithogeochemical samples were collected by geologists taking into account the nature of the material being sampled. The crust sample was collected with a hammer from surface, weighted between 2 to 4 kilograms and was collected in a plastic bag, tagged with a pre-numbered ticket and tightly closed with plastic tape. The brines samples were collected in a brand new plastic bottle filled atop containing 1 litre of brine and tightly closed. All samples were tagged with a prenumbered ticket and stored in a secured location at the base camp for no more than 10 days. The brines were stored in a dark room. The samples were shipped by courier to Alex Stewart Assayers Argentina S.A. ("ASAA") laboratories in Mendoza (Argentina). ASAA is an ISO 9001-2000-certified laboratory with headquarters in England. The crust samples were grinded to #200 mesh, then split and dissolved in hot water. A total of 500 ml of sample have been separated for ICP analysis. The brine samples were filtered and read directly by ICP analysis. All samples were assayed for 13 elements by ICP. Accuracy and precision of results is tested through the systematic inclusion of blanks and duplicates.

(2)Technical Report Salar de Incahuasi, Salta Argentina, Dr Ricardo N Alonso MAusIMM, Walter R Rojas, August 2011 – Lithea Inc.

Included as Appendices are the JORC Table 1 for the JORC resource stated 27 June 2018 for the Rincon Project which includes the brine sampling and for completeness the Technical Reports from Ad-Infinitum reporting the simulation process and results.

Competent Person's Statement

This announcement on the Salta Lithium project has been prepared with information compiled by Marcela Casini, MAusIMM. Marcela Casini is the Exploration Manager-Argentina of PepinNini Lithium Limited and has sufficient experience which is relevant to the style of mineralisation and type of deposit under consideration 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". Marcela Casini consents to the inclusion in the report of the matters based on her information in the form and context in which it appears.

Appendix 1 - JORC Table 1

Section 1 Sampling Techniques and Data

(Criteria in this section apply to all succeeding sections.)

Criteria	JORC Code explanation	Commentary
<p><i>Sampling techniques</i></p>	<ul style="list-style-type: none"> <i>Nature and quality of sampling (eg cut channels, random chips, or specific specialised industry standard measurement tools appropriate to the minerals under investigation, such as down hole gamma sondes, or handheld XRF instruments, etc). These examples should not be taken as limiting the broad meaning of sampling.</i> <i>Include reference to measures taken to ensure sample representability and the appropriate calibration of any measurement tools or systems used.</i> <i>Aspects of the determination of mineralisation that are Material to the Public Report.</i> <i>In cases where "industry standard" work has been done this would be relatively simple (eg "reverse circulation drilling was used to obtain 1 m samples from which 3 kg was pulverised to produce a 30 g charge for fire assay"). In other cases more explanation may be required, such as where there is coarse gold that has inherent sampling problems. Unusual commodities or mineralisation types (eg submarine nodules) may warrant disclosure of detailed information.</i> 	<ul style="list-style-type: none"> Liquid samples were collected using borehole packers over 1.2 metres thickness at 6 metre intervals Borehole fluid density, temperature conductivity and Ph were recorded at time of sampling  <ul style="list-style-type: none"> During the packer test, several 250l drums are filled in order to remove drilling fluids contaminants . To collect a representative sample the borehole must be cleaned taking out the amount of brine that represents 200 to 250% of the borehole volume capacity at any given depth, at this point the field parameters including Density and conductivity are typically found to become constant with each consecutive drum. Core samples were collected from drill core drilled at HQ3 diameter for RBR(Rapid Brine Release) testing to determine porosity and specific yield - carried out by Geosystems Analysis Inc, Tucson, Arizona, USA - methodology outlined in attached poster The samples were collected every

Criteria	JORC Code explanation	Commentary
----------	-----------------------	------------



20 m intervals, if a lithological change occurs between the sample points the interval was reduced
 Core sampling for porosity testing

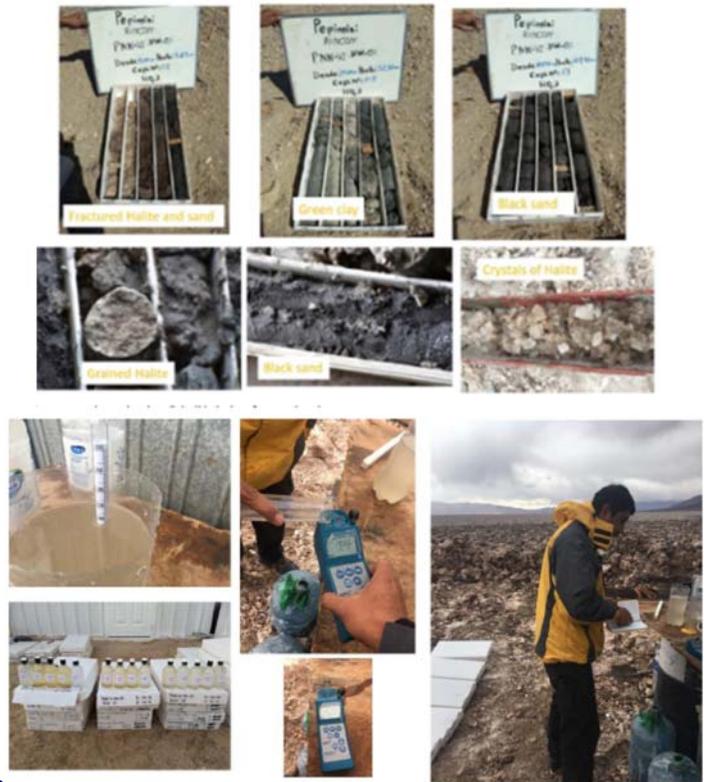
Drilling techniques

- Drill type (eg core, reverse circulation, open-hole hammer, rotary air blast, auger, Bangka, sonic, etc) and details (eg core diameter, triple or standard tube, depth of diamond tails, face-sampling bit or other type, whether core is oriented and if so, by what method, etc).



- Diamond core drilling – HQ3 diameter drilled vertically, triple tube

Criteria	JORC Code explanation	Commentary
		<ul style="list-style-type: none"> Boreholes were converted to piezometer wells for observation and re-sampling on completion of drilling 
<p><i>Drill sample recovery</i></p>	<ul style="list-style-type: none"> <i>Method of recording and assessing core and chip sample recoveries and results assessed.</i> <i>Measures taken to maximise sample recovery and ensure representative nature of the samples.</i> <i>Whether a relationship exists between sample recovery and grade and whether sample bias may have occurred due to preferential loss/gain of fine/coarse material.</i> 	<ul style="list-style-type: none"> The boreholes were drilled and cored to 80m and 130 m respectively. Drill core recoveries were recorded at time of drilling and recorded with lithological interpretation and sample intervals. Core recoveries ranged from 0-100% depending in lithology; sand and gravel lithologies generally had lower recovery than halite and clay lithologies. Under-consolidated sand intervals with lower recovery are typically associated with higher brine yield.
<p><i>Logging</i></p>	<ul style="list-style-type: none"> <i>Whether core and chip samples have been geologically and geotechnically logged to a level of detail to support appropriate Mineral Resource estimation, mining studies and metallurgical studies.</i> <i>Whether logging is qualitative or quantitative in nature. Core (or costean, channel, etc) photography.</i> <i>The total length and percentage of the relevant intersections logged.</i> 	<ul style="list-style-type: none"> Core is geologically logged by measurement and observation for lithology and photographed. core samples of 20 cm length were sent for RBR (Rapid Brine Release) testing to determine porosity and specific yield - carried out by Geosystems Analysis Inc, Tucson, Arizona, USA - Field parameters are measured for brine samples. These include density, temperature , conductivity and PH These are included in the bore hole

Criteria	JORC Code explanation	Commentary
		<p>descriptive log.</p>  <ul style="list-style-type: none"> • The boreholes were drilled and cored to 80m and 130 m respectively. • Borehole PNN-VI-DW-01 was geophysically logged, spontaneous potential, single point resistance, short and long normal resistivity
<p><i>Sub-sampling techniques and sample preparation</i></p>	<ul style="list-style-type: none"> • <i>If core, whether cut or sawn and whether quarter, half or all core taken.</i> • <i>If non-core, whether riffled, tube sampled, rotary split, etc and whether sampled wet or dry.</i> • <i>For all sample types, the nature, quality and appropriateness of the sample preparation technique.</i> 	<ul style="list-style-type: none"> • The boreholes must be cleaned by extracting brine before sampling can commence • Liquid samples were collected using the double packer. • Sample bottles are partly filled and rinsed with the brine to be sampled, emptied and then re-filled before the bottle top is installed and securely

Criteria	JORC Code explanation	Commentary
	<ul style="list-style-type: none"> Quality control procedures adopted for all sub-sampling stages to maximise representativity of samples. Measures taken to ensure that the sampling is representative of the in situ material collected, including for instance results for field duplicate/second-half sampling. Whether sample sizes are appropriate to the grain size of the material being sampled. 	<p>taped.</p> <ul style="list-style-type: none"> 30% of the samples are duplicates and blank, inserted as blinds in the string of samples. These samples are meant to control the quality assurance of the lab, According to the Competent Person requirements 
<p>Quality of assay data and laboratory tests</p>	<ul style="list-style-type: none"> The nature, quality and appropriateness of the assaying and laboratory procedures used and whether the technique is considered partial or total. For geophysical tools, spectrometers, handheld XRF instruments, etc, the parameters used in determining the analysis including instrument make and model, reading times, calibrations factors applied and their derivation, etc. Nature of quality control procedures adopted (eg standards, blanks, duplicates, external laboratory checks) and whether acceptable levels of accuracy (i.e. lack of bias) and precision have been established. 	<ul style="list-style-type: none"> A chain of custody was maintained for samples from drilling location to laboratory receipt.

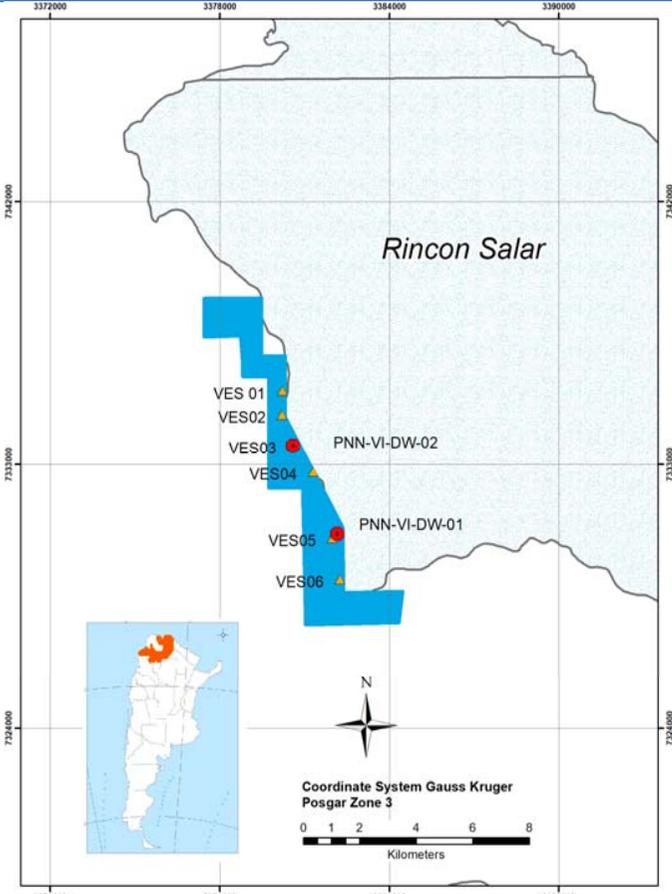
Criteria	JORC Code explanation	Commentary
Verification of sampling and assaying	<ul style="list-style-type: none"> The verification of significant intersections by either independent or alternative company personnel. The use of twinned holes. Documentation of primary data, data entry procedures, data verification, data storage (physical and electronic) protocols. Discuss any adjustment to assay data. 	<ul style="list-style-type: none"> A Competent person(CP) is used for oversight verification of sampling techniques, laboratory verification and reporting review 30 samples were taken from both Rincon bore holes of which 9 are control samples as per CP requirements
Location of data points	<ul style="list-style-type: none"> Accuracy and quality of surveys used to locate drill holes (collar and down-hole surveys), trenches, mine workings and other locations used in Mineral Resource estimation. Specification of the grid system used. Quality and adequacy of topographic control. 	<ul style="list-style-type: none"> Geographic positioning control for borehole location using both latitude and longitude and Gauss_Kruger POSGAR (WGS-84) Vertical Electrical Sounding(VES) using tetrapolar configuration, Schlumberger with wing extensions up to 1000 meters Handheld GPS device for traverse and point locations The grid system used is Argentina Gauss_Kruger POSGAR (WGS-84) Zone 3. Digital Elevation Model(DEM) from Google Earth appropriate for geophysical survey lines Interpretation software used RESIST 92 Ipiwin 2000
Data spacing and distribution	<ul style="list-style-type: none"> Data spacing for reporting of Exploration Results. Whether the data spacing and distribution is sufficient to establish the degree of geological and grade continuity appropriate for the Mineral Resource and Ore Reserve estimation procedure(s) and classifications applied. Whether sample compositing has been applied. 	<ul style="list-style-type: none"> Samples taken every 6 metres within the boreholes Up to 1.5km between geophysical stations Geographic positioning control appropriate for exploration survey lines
Orientation of data in relation to geological structure	<ul style="list-style-type: none"> Whether the orientation of sampling achieves unbiased sampling of possible structures and the extent to which this is known, considering the deposit type. If the relationship between the drilling orientation and the orientation of key mineralised structures is considered to have introduced a sampling bias, this should be assessed and reported if material. 	<ul style="list-style-type: none"> Boreholes drilled vertically to intersect salar horizontal layering
Sample security	<ul style="list-style-type: none"> The measures taken to ensure sample security. 	<ul style="list-style-type: none"> A chain of custody is established for samples from field to laboratory with each stage signed off and handed over to final receipt by laboratory Survey data collected, collated and interpreted by Mercoaguas - Servicios Hidrogeologicos Y Ambientales and securely distributed via electronic communications to Competent Person(CP) for confirmation and review.
Audits or reviews	<ul style="list-style-type: none"> The results of any audits or reviews of sampling techniques and data. 	<ul style="list-style-type: none"> Data collection, processing and analysis protocols aligned with industry best practice.

Section 2 Reporting of Exploration Results

(Criteria listed in the preceding section also apply to this section.)

Criteria	JORC Code explanation	Commentary
<i>Mineral tenement and land tenure status</i>	<ul style="list-style-type: none"> Type, reference name/number, location and ownership including agreements or material issues with third parties such as joint ventures, partnerships, overriding royalties, native title interests, historical sites, wilderness or national park and environmental settings. The security of the tenure held at the time of reporting along with any known impediments to obtaining a licence to operate in the area. 	<ul style="list-style-type: none"> Mina Villanovena 1 File Number 19565, Held 100% by PepinNini SA an Argentina entity wholly owned by PepinNini Lithium Ltd. Held under grant from Mining Court of Salta Province, Argentina Tenure (Mina) held in perpetuity and appropriately maintained.
<i>Exploration done by other parties</i>	<ul style="list-style-type: none"> Acknowledgment and appraisal of exploration by other parties. 	<ul style="list-style-type: none"> Exploration carried out by ADY - Energi Group Energi Group's Lithium Project - Salar del Rincón , Salta, Argentina - News Release 17 April 2017 www.enirgi.com Rincon Lithium Project Maiden JORC Mineral Resource - Argosy Minerals Ltd(ASX:AGY) 19 June 18
<i>Geology</i>	<ul style="list-style-type: none"> Deposit type, geological setting and style of mineralisation. 	<ul style="list-style-type: none"> PepinNini is primarily exploring for brine aquifers in salars (dried salt lakes) and the geological setting is suitable for lithium bearing brines in commercial quantities. Brine aquifers are indicated by high conductivity/low resistivity responses considered prospective for lithium brine
<i>Drill hole Information</i>	<ul style="list-style-type: none"> A summary of all information material to the understanding of the exploration results including a tabulation of the following information for all Material drill holes: <ul style="list-style-type: none"> easting and northing of the drill hole collar elevation or RL (Reduced Level – elevation above sea level in metres) of the drill hole collar dip and azimuth of the hole down hole length and interception depth hole length. If the exclusion of this information is justified on the basis that the information is not Material and this exclusion does not detract from the understanding of the report, the Competent Person should clearly explain why this is the case. 	<p>Borehole PNN-VI-DW-02</p> <ul style="list-style-type: none"> Borehole coordinates: GK Posgar Zone 3: 7333639.91E -3380585.57N Elevation:3730 masl Start drilling date: 16 Dec 2017 Finish drilling date: 23 Dec , 2017 Total Depth: 130 meters Drilling Methodology: Diamond Drilling Drilling Company: Hidrotec Rig: HT06LF90 <p>Borehole PNN-VI-DW-01</p>

Criteria	JORC Code explanation	Commentary
		<ul style="list-style-type: none"> • Borehole coordinates: GK Posgar Zone 3: N 3382155.2/E 7330630.6 Elevation:3,731 masl • Start drilling date: Dec 7, 2017 • Finish drilling date: Dec 9, 2017 • Total Depth: 80 meters • Drilling Methodology: Diamond Drilling • Drilling Company: Hidrotec • Rig: HT06LF90
<i>Data aggregation methods</i>	<ul style="list-style-type: none"> • <i>In reporting Exploration Results, weighting averaging techniques, maximum and/or minimum grade truncations (eg cutting of high grades) and cut-off grades are usually Material and should be stated.</i> • <i>Where aggregate intercepts incorporate short lengths of high grade results and longer lengths of low grade results, the procedure used for such aggregation should be stated and some typical examples of such aggregations should be shown in detail.</i> • <i>The assumptions used for any reporting of metal equivalent values should be clearly stated.</i> 	<ul style="list-style-type: none"> • No data aggregation used,
<i>Relationship between mineralisation widths and intercept lengths</i>	<ul style="list-style-type: none"> • <i>These relationships are particularly important in the reporting of Exploration Results.</i> • <i>If the geometry of the mineralisation with respect to the drill hole angle is known, its nature should be reported.</i> • <i>If it is not known and only the down hole lengths are reported, there should be a clear statement to this effect (eg 'down hole length, true width not known').</i> 	<ul style="list-style-type: none"> • Boreholes drilled vertically and core reported as true depths and intersection lengths, salar lithologies are horizontal
<i>Diagrams</i>	<ul style="list-style-type: none"> • <i>Appropriate maps and sections (with scales) and tabulations of intercepts should be included for any significant discovery being reported These should include, but not be limited to a plan view of drill hole collar locations and appropriate sectional views.</i> 	<ul style="list-style-type: none"> • Borehole location and geophysical data points plan

Criteria	JORC Code explanation	Commentary
		 <p>The map displays the Rincon Salar area with a grid of coordinates. Exploration points are marked as follows: VES 01, VES 02, VES 03, VES 04, VES 05, and VES 06 are indicated by yellow triangles along a blue-shaded area. PNN-VI-DW-01 and PNN-VI-DW-02 are indicated by red circles. An inset map shows the location within Argentina. A north arrow and a scale bar (0-8 km) are provided. The coordinate system is Gauss Kruger Posgar Zone 3.</p>
<p><i>Balanced reporting</i></p>	<ul style="list-style-type: none"> Where comprehensive reporting of all Exploration Results is not practicable, representative reporting of both low and high grades and/or widths should be practiced to avoid misleading reporting of Exploration Results. 	<ul style="list-style-type: none"> Results from boreholes PNN0VI-DW-01 and 02 reported
<p><i>Other substantive exploration data</i></p>	<ul style="list-style-type: none"> Other exploration data, if meaningful and material, should be reported including (but not limited to): geological observations; geophysical survey results; geochemical survey results; bulk samples – size and method of treatment; metallurgical test results; 	<ul style="list-style-type: none"> The grid system used is Argentina Gauss_Kruger POSGAR (WGS-84) zone 3.

Criteria	JORC Code explanation	Commentary
	<i>bulk density, groundwater, geotechnical and rock characteristics; potential deleterious or contaminating substances.</i>	
<i>Further work</i>	<ul style="list-style-type: none"> <i>The nature and scale of planned further work (eg tests for lateral extensions or depth extensions or large-scale step-out drilling).</i> <i>Diagrams clearly highlighting the areas of possible extensions, including the main geological interpretations and future drilling areas, provided this information is not commercially sensitive.</i> 	<ul style="list-style-type: none"> boreholes have been converted to a piezometer wells for standing level observation and future sampling and pumping tests will be carried out to provide additional information on the hydrogeologic properties of the aquifers and potential extractability of brines.

References

Houston, J, Butcher, A., Ehren, P., Evans, K., and Godfrey, L., 2011. **The evaluation of brine prospects and the requirement for modifications to filing standards.** Economic Geology, 106 (7). 1225-1239. 10.2113/econgeo.106.7.1225.

Johnson, A. I., 1967. Specific yield – **Compilation of specific yields for various materials:** U.S. Geological Survey Water Supply Paper 1662-D, 74 p.

Mercoaguas, 2017. **Prospeccion geoelectrica en la pertenencia Villanovena, Salar del Rincon, Departamento Los Andes, Provincia de Salta.** Technical report prepared for PepinNini Lithium Limited, August 2017, 33 pp.

_____, 2018a. **Reinterpretacion de SEV.** Technical report prepared for PepinNini Lithium Limited, 6 pp.

_____, 2018b. **Prospeccion geoelectrica en la pertenencia Villanovena, conos aluviales, Salar del Rincon, Departamento Los Andes, Provincia de Salta.** Technical report prepared for PepinNini Lithium Limited, May 2018, 26 pp.

Appendix 2 – Technical Memo 190610
Salars Evaporation Pathway
Ad-Infinitum

Technical Memo 190610

Prepared for:	PepinNini	PROTOCOLE
Prepared by:	Ad-Infinitem	190610
Subject:	Salares Evaporation Pathway	Revision
Date	Monday, June 10, 2019	0

Summary

This document addresses the evaporation pathway for Incahuasi, Rincón and Pular Salares from chemistry provided by PepinNini.

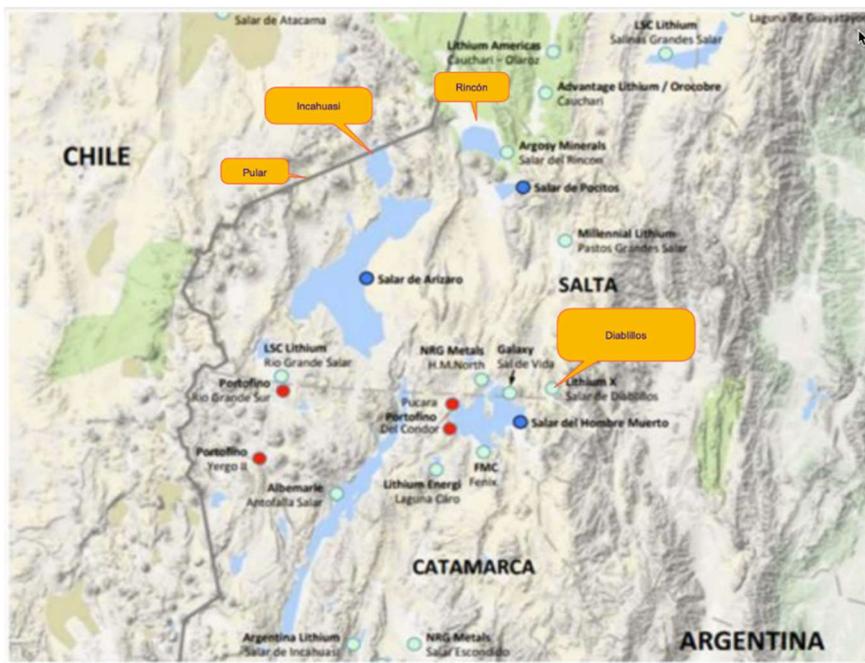
Review

Results present in this document represent the behaviour of the brine of each Salar if they are evaporated in a solar evaporation system with several stages at the average temperature of the site, these outcomes will be analyzed to determine possible alternatives to produce lithium carbonate in each Salar.

Considerations

Location

The salares to be evaluated are: Incahuasi, Rincón and Pular. The location of them is shown in the image below.



Input data

The simulation was carried out using the average annual average temperature of the sector and the chemical compositions of the brines.

Average annual temperature

The following table ¹ shows the data of the annual average temperature in the Rincon Salar.

¹ <http://www.rinconmining.com.ar/rincon/>

Technical Memo 190610

Temperature [°C]	Minimum	Maximum	Average
Annual	-11,4	26,7	7,65

The annual average temperature has been used in the simulation to determine the evaporation paths of the three Salares.

Chemical composition of the brine

In the following tables the initial chemical composition of the brine of each Salar which will be the initial point of the simulation.

INCAHUASI													
Unit:	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight						
Element	Barium	Boron	Calcium	Stronium	Iron	Lithium	Magnesium	Manganese	Sodium	Potassium	Sulphates	Chlorides	Water
Value		0,0078	1,0153	0,0328	0,0002	0,0150	0,7031	0,0002	6,4851	0,5481	0,0450	16,5393	74,61

RINCON													
Unit:	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight						
Element	Barium	Boron	Calcium	Stronium	Iron	Lithium	Magnesium	Manganese	Sodium	Potassium	Sulphates	Chlorides	Water
Value		0,0203	0,0374	0,0009	0,0003	0,0205	0,2286	0,0001	9,5526	0,4933	1,4271	15,5221	72,70

PULAR													
Unit:	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight	% Weight						
Element	Barium	Boron	Calcium	Stronium	Iron	Lithium	Magnesium	Manganese	Sodium	Potassium	Sulphates	Chlorides	Water
Value		0,0132	0,0591	0,0011	0,0005	0,0078	0,1453	0,0001	5,1001	0,4053	0,9299	8,2307	85,11

Strontium, Iron, and Manganese are excluded in the simulation since thermodynamics model has not these ions in its data base, however the interaction of these ions in Salar systems are very low or null.



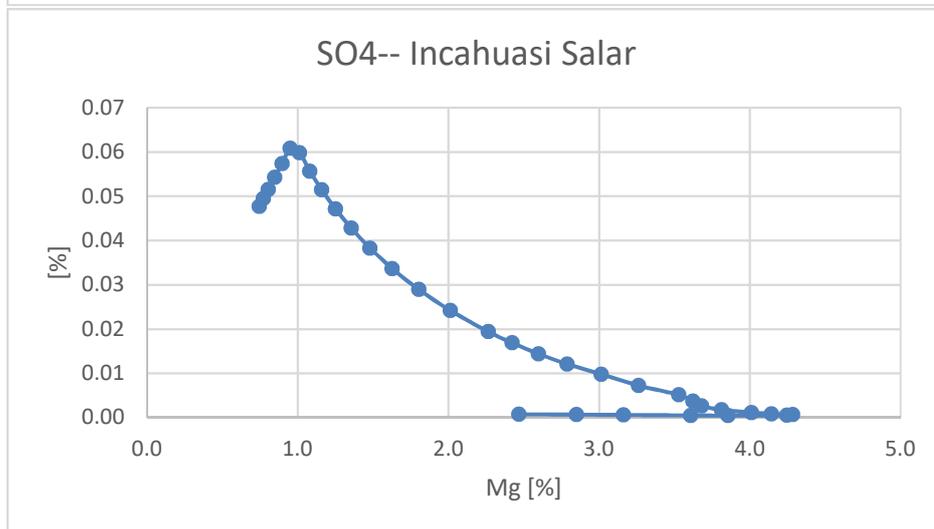
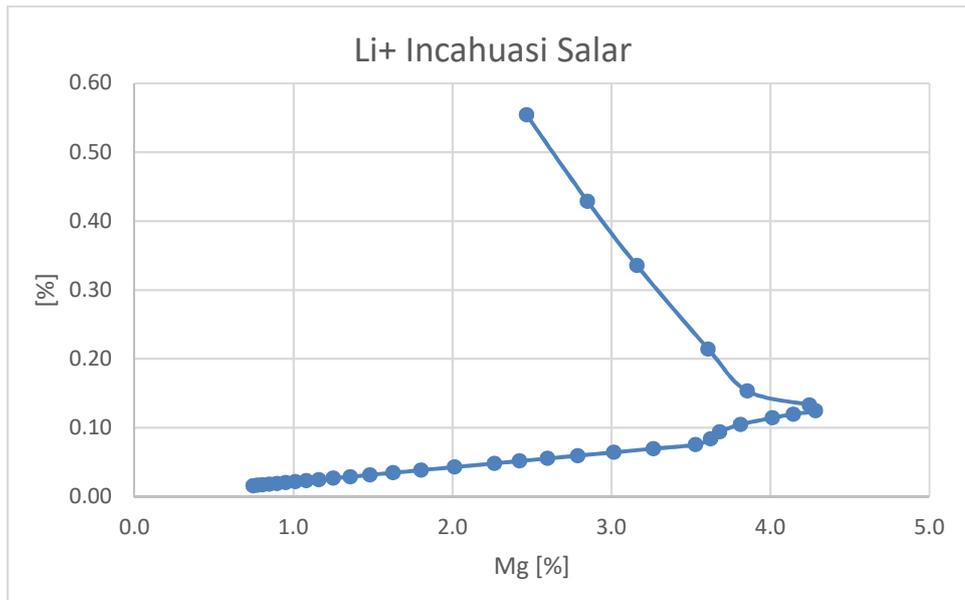
Technical Memo 190610

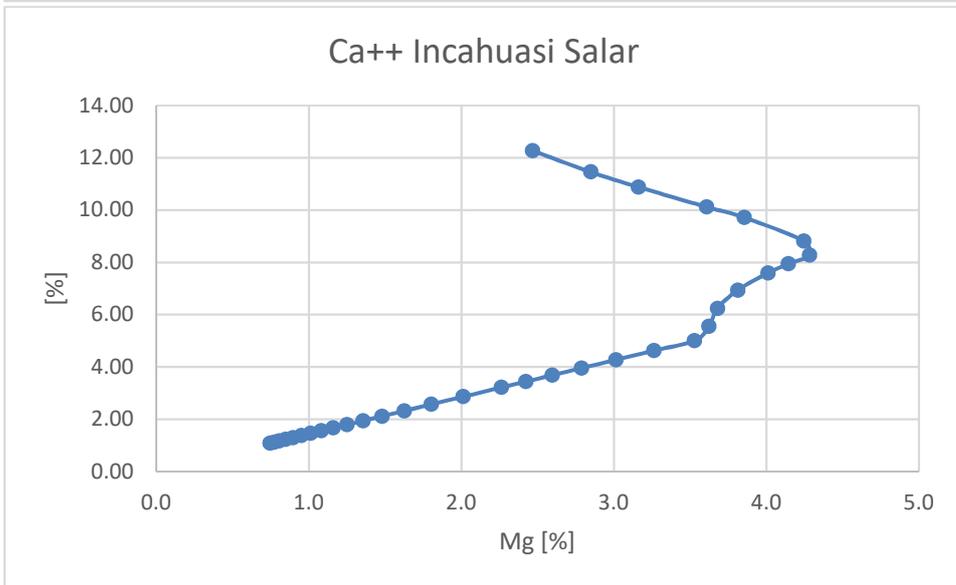
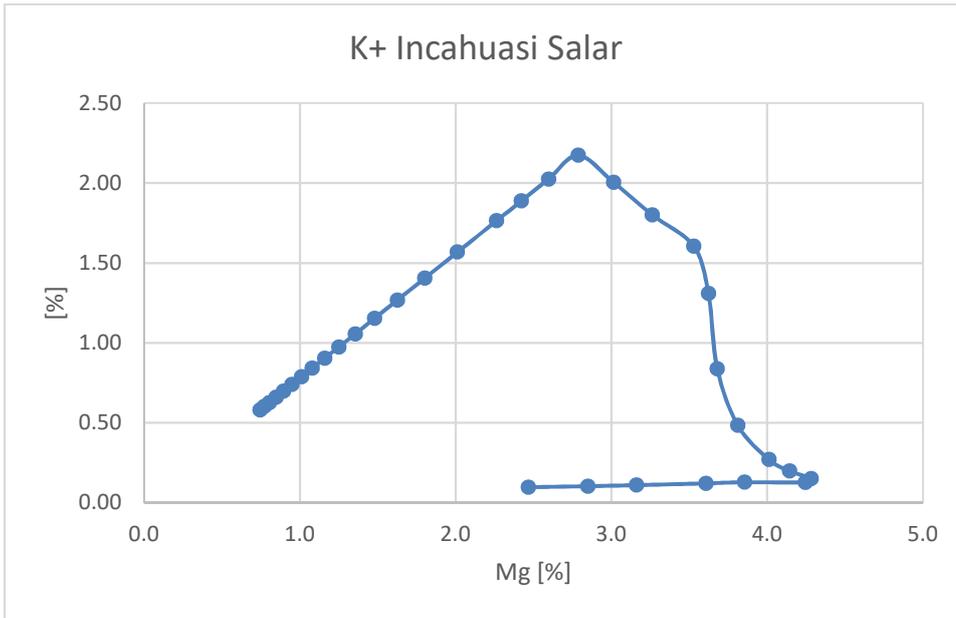
Simulation results

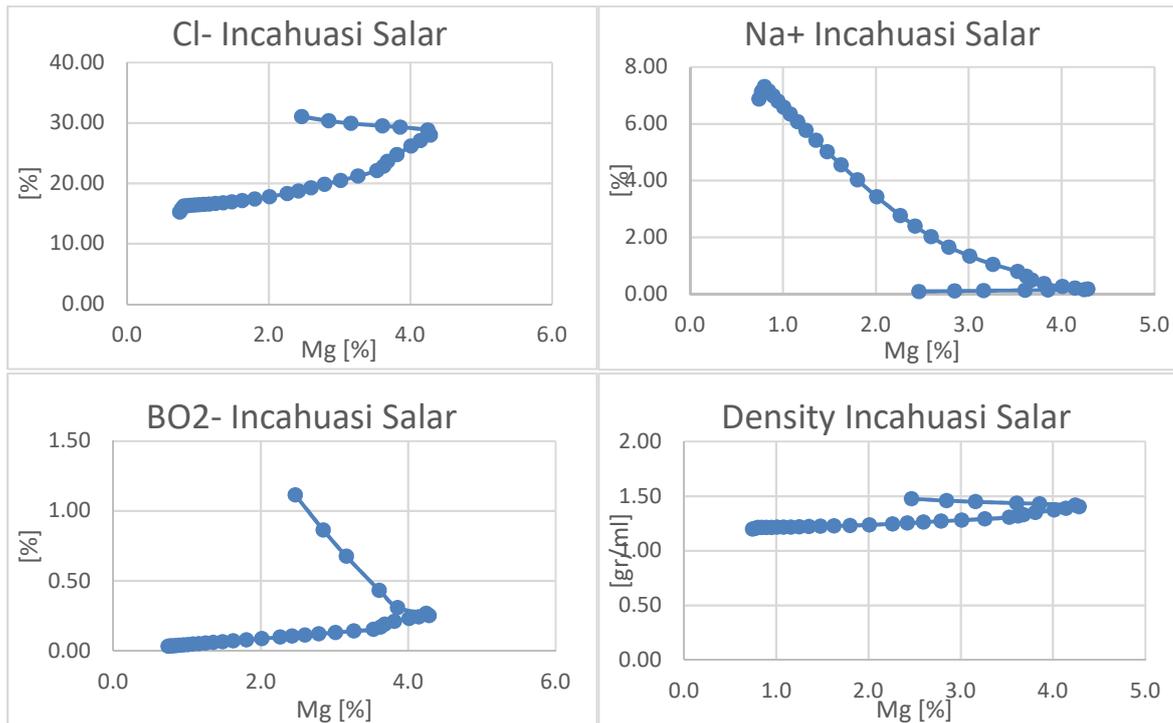
The brine evaporation behaviour of the Incahuasi, Rincón and Pular salares are presented in this section. The first group of charts describe the relation between several ions (Li^{+1} , Na^{+1} , K^{+1} , Ca^{+2} , Cl^{-1} , SO_4^{-2} and BO_2^{-2}) and magnesium during the evaporation process, as magnesium is the last ion to precipitate from brine. In addition, a detail of the different salts that have precipitated as a result of the brine evaporation.

Incahuasi Salar

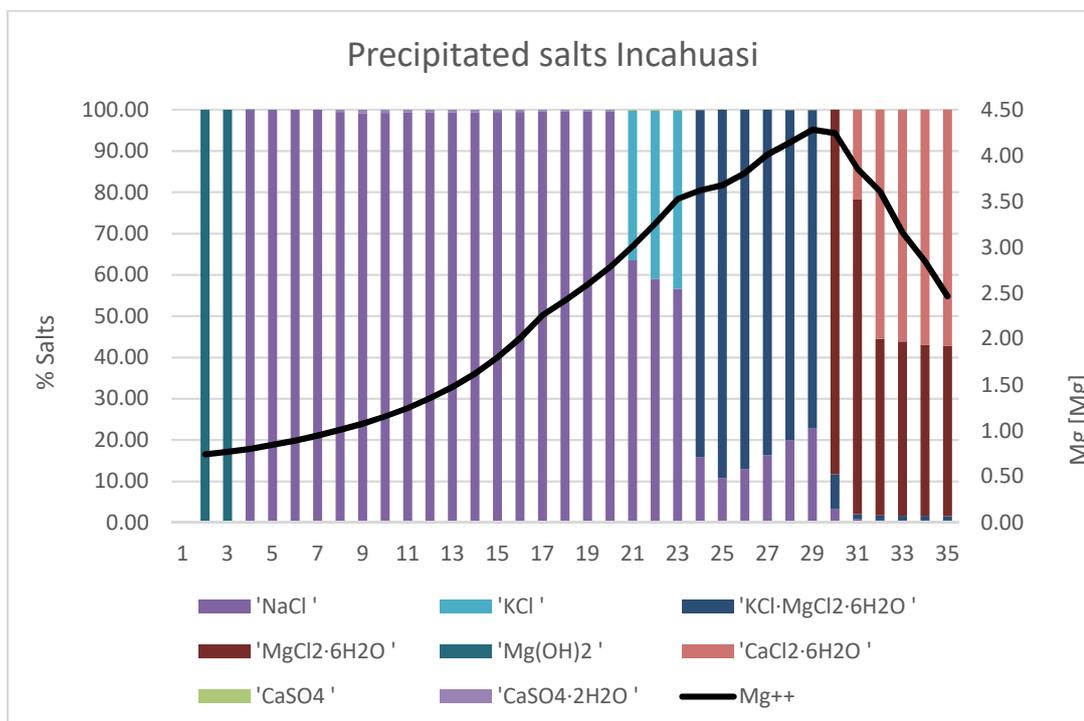
Brine Pathway







Salt Precipitation



Simulation Analysis

According to figures, it is possible to state the following observations:

- **Li⁺**: The maximum concentration achieved was 0,6 %w/w.



Technical Memo 190610

- **Na⁺¹**: The concentration decreased as a consequence of NaCl precipitation, and reach a value minor than 0,1 %w/w.
- **K⁺¹**: In the range (0,7-2,8) Mg %w/w the potassium concentration increased reaching a 2,17 %w/w maximum, afterwards the concentration decreases continuously due to the formation of KCl and carnallite.
- **Ca⁺²**: The concentration has an increasing trend, reaching a value of 12 % w/w.
- **Cl⁻¹**: the concentration increased, having values as high as 30% w/w
- **SO₄⁻²**: the brine content was completely depleted
- **BO₂⁻²**: the concentration increased reaching 1,1 % w/w.
- **Density**: The density value increased as a result of the evaporation process (1,5 g/mL as final value).

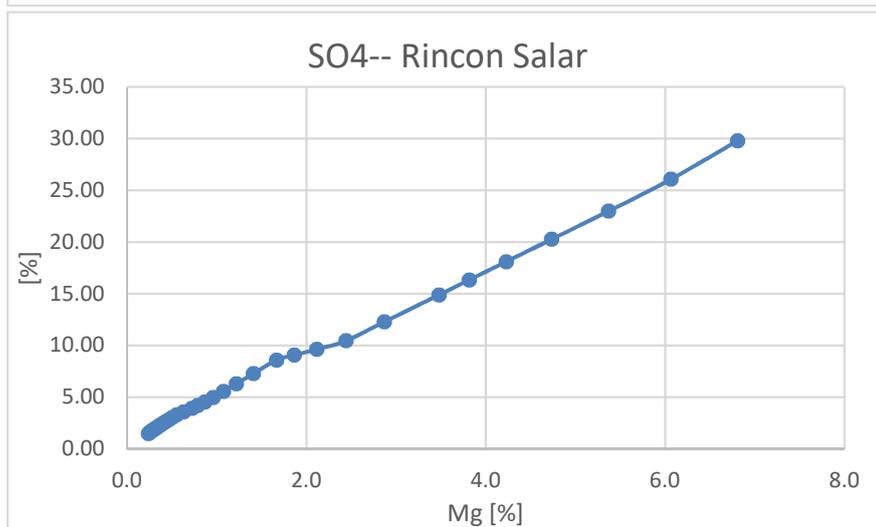
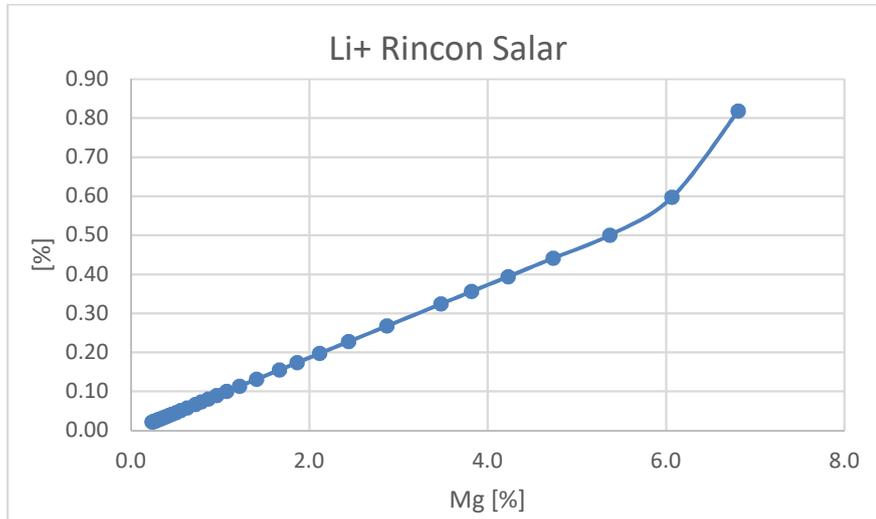
From salt precipitation graph can be seen the following salts precipitate during the brine evaporation process.

1. Mg(OH)₂
2. NaCl
3. KCl
4. KCl MgCl₂ 6H₂O (Carnallite)
5. MgCl₂ 6 H₂O (Bischofite)
6. CaCl₂ 6H₂O

Technical Memo 190610

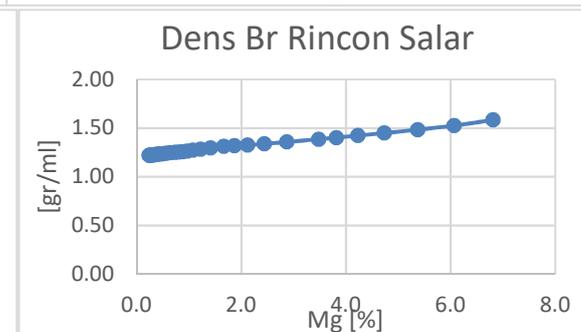
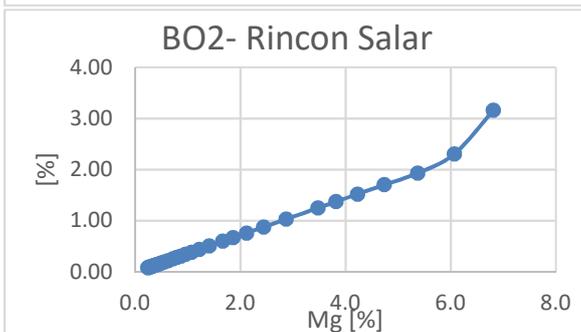
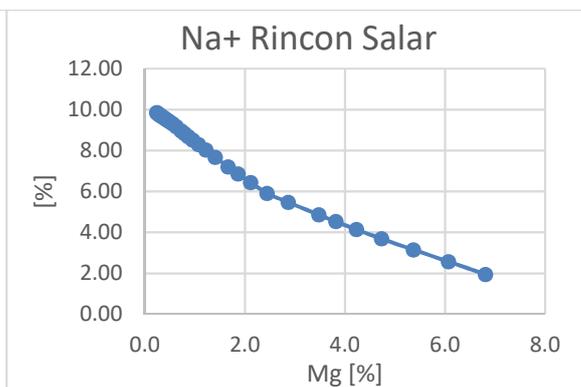
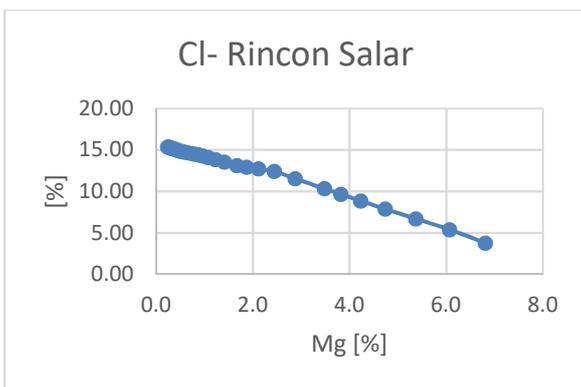
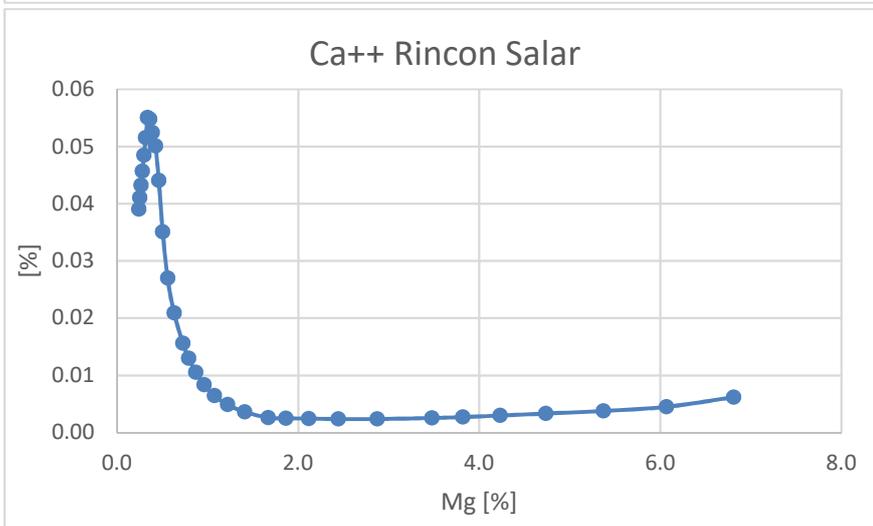
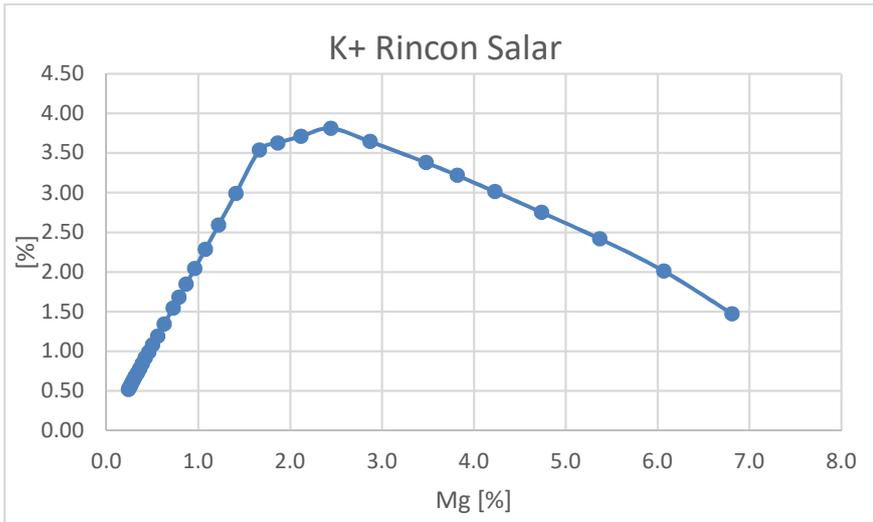
Rincón Salar

Brine Pathway

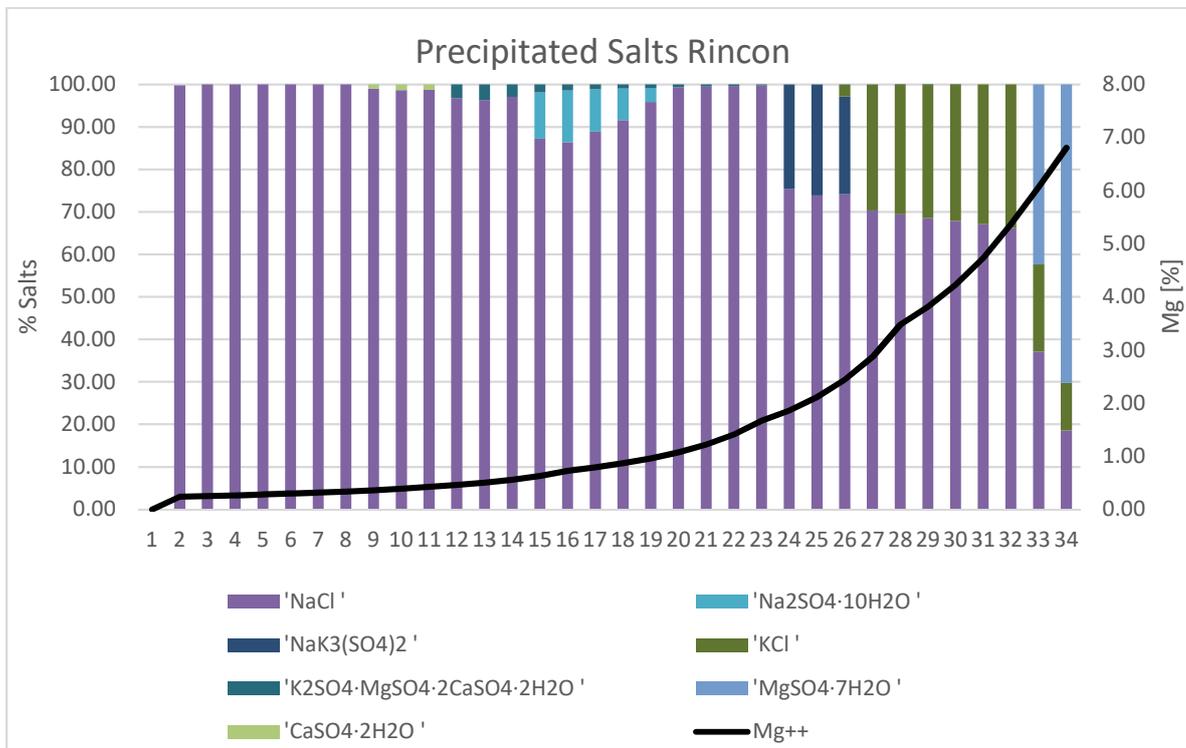




Technical Memo 190610



Salt Precipitation



Simulation Analysis

According to figures, it is possible to state the following observations:

- **Li⁺**: The maximum concentration achieved was 0,82 %w/w.
- **Na⁺**: The concentration decreased as a consequence of NaCl precipitation, and reach a value of 1,94 %w/w.
- **K⁺**: In the range (0,24-2.44) Mg %w/w the potassium concentration increased reaching a 3.81 %w/w maximum, afterwards the concentration decreases continuously due to the formation of KCl and carnallite.
- **Ca²⁺**: The concentration is low and decrease reaching a value minor than 0.01 % w/w
- **Cl⁻**: the concentration decreased, reaching a value of 3,78 %w/w
- **SO₄²⁻**: the concentration increase, reaching a value of 29,79 %w/w
- **BO₂²⁻**: the concentration increased reaching 3,16 % w/w.
- **Density**: The density value increased as a result of the evaporation process (1,58 g/mL as final value).

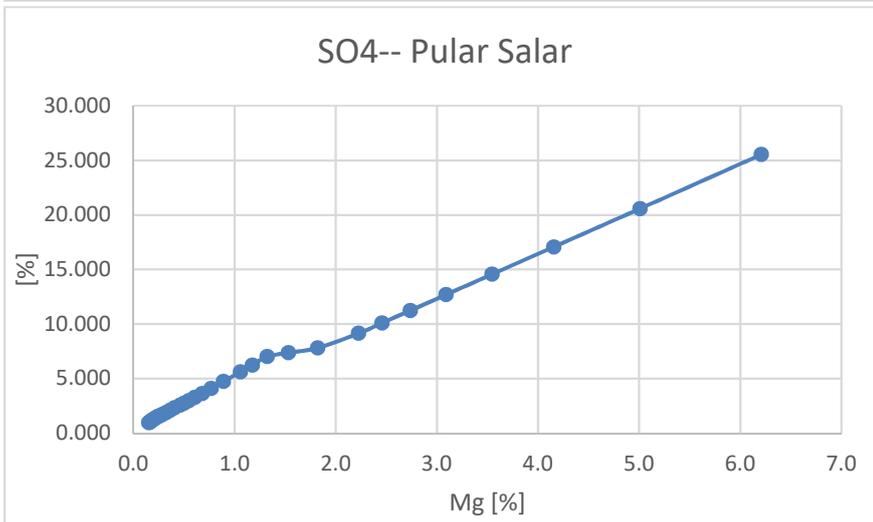
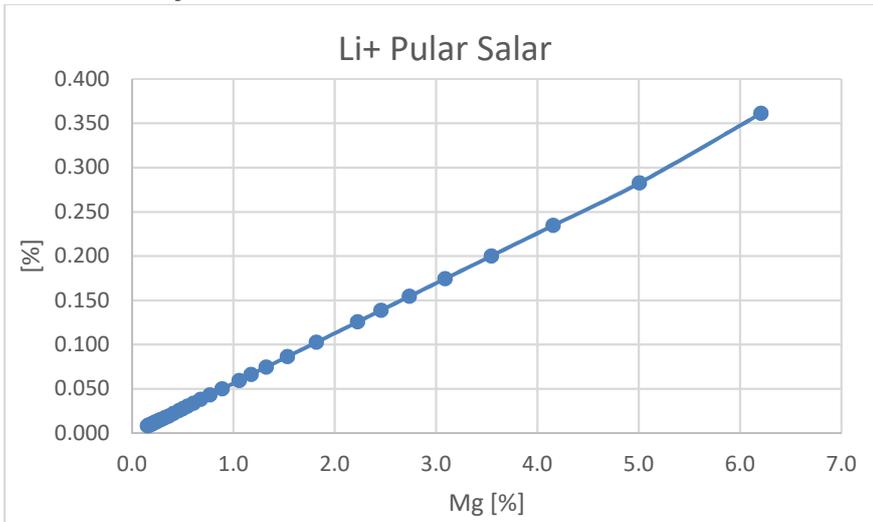
According to the simulation, it can be seen from Salt Precipitation figure the following salts precipitation during the brine evaporation process.

1. NaCl
2. K₂SO₄MgSO₄2CaSO₄ 2H₂O
3. Na₂SO₄ 2H₂O
4. NaK₃(SO₄)₂
5. KCl
6. MgSO₄ 7 H₂O

Technical Memo 190610

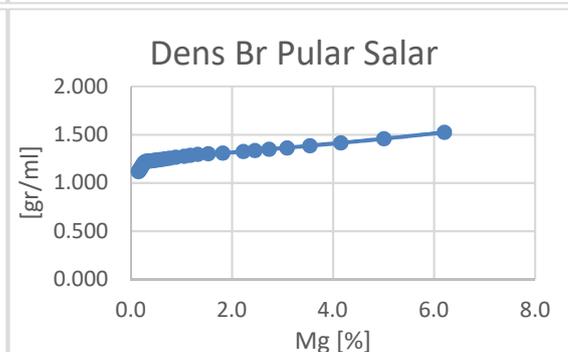
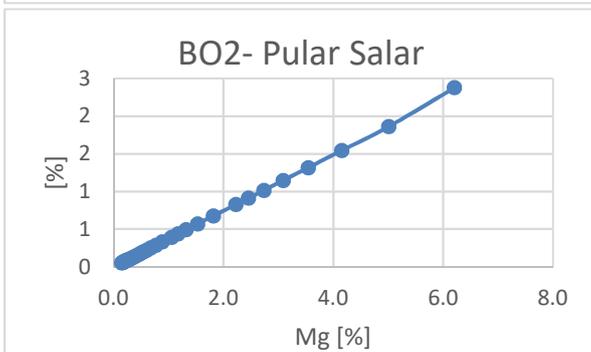
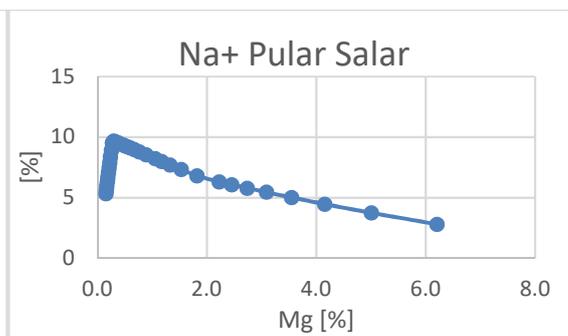
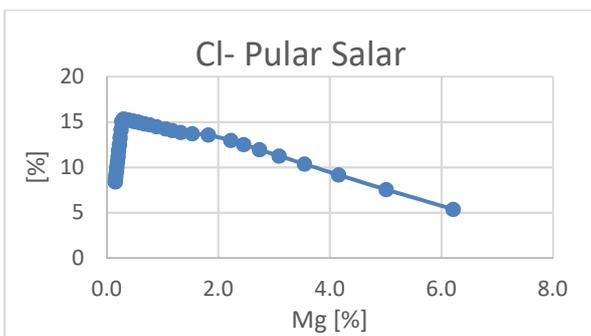
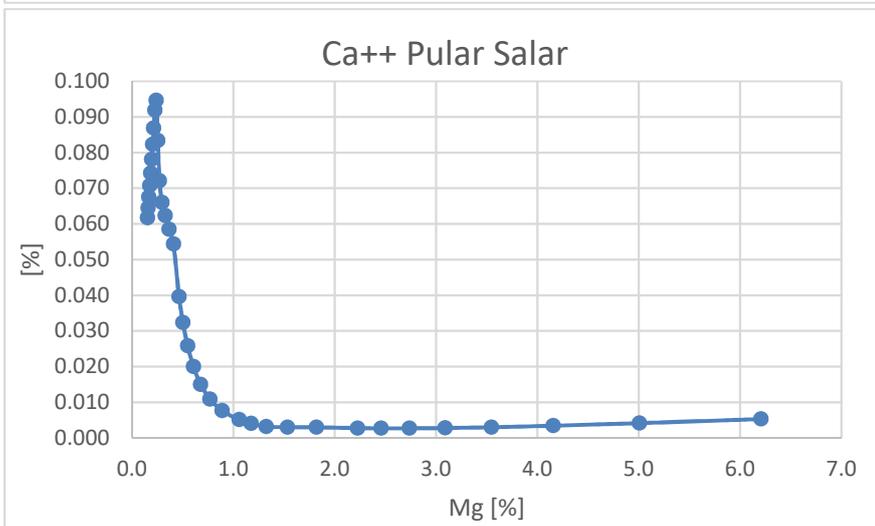
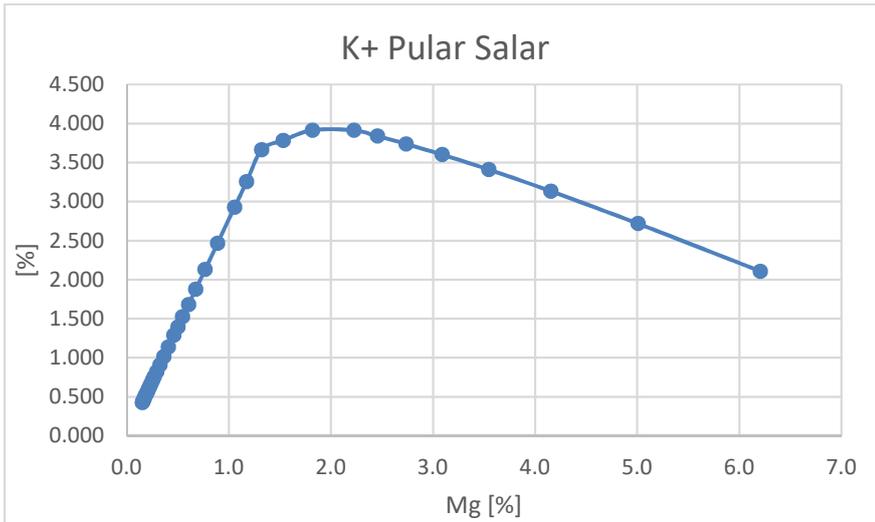
Pular Salar

Brine Pathway

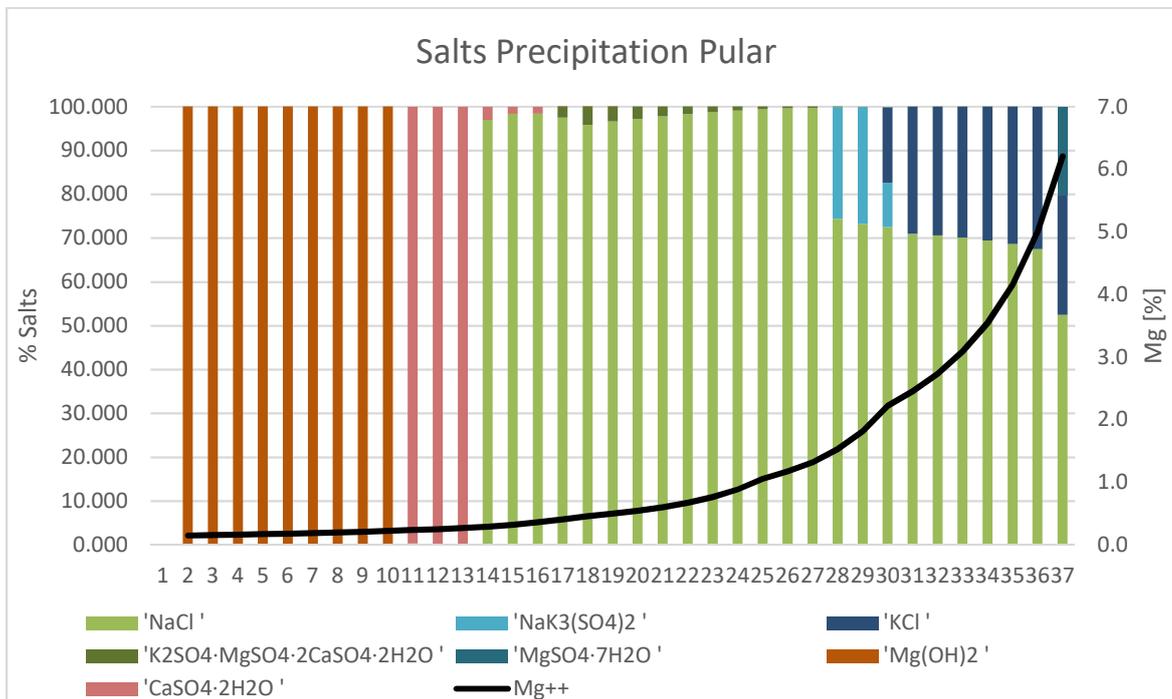




Technical Memo 190610



Salt Precipitation



Simulation Analysis

According to figures, it is possible to state the following observations:

- **Li⁺¹**: The maximum concentration achieved was 0.36 %w/w.
- **Na⁺¹**: The concentration increase reaching a 9,55 %w/w maximum, afterwards decreases as a consequence of NaCl precipitation, and reach a value of 2.1 %w/w.
- **K⁺¹**: In the range (0,15-1.5) Mg %w/w the potassium concentration increased reaching a 3.9 %w/w maximum, afterwards the concentration decreases continuously due to the formation of KCl
- **Ca⁺²**: The concentration is low and decrease reaching a value minor than 0.01 % w/w
- **Cl⁻¹**: the concentration decreased, reaching a value of 5,39 %w/w
- **SO₄⁻²**: the concentration increase, reaching a value of 25,53 %w/w
- **BO₂⁻²**: the concentration increased reaching 2,4 % w/w.
- **Density**: The density value increased as a result of the evaporation process (1,52 g/mL as final value).

According to the simulation can be seen the following salts precipitation during the brine evaporation process.

1. Mg(OH)₂
2. CaSO₄ 2 H₂O
3. K₂SO₄MgSO₄2CaSO₄ 2H₂O
4. NaCl
5. NaK₃(SO₄)₂
6. KCl
7. MgSO₄ 7 H₂O

Technical Memo 190610

Conclusions and recommendations

The following tables show a comparison of the initial brine and the final concentration obtained from simulation.

- Incahuasi Salar:

Incahuasi	% w/w								
	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Initial	76,28	0,02	6,63	0,56	0,72	1,04	14,68	0,05	0,03
Final (3,44% of initial mass)	52,31	0,55	0,10	0,10	2,47	12,28	31,06	0,00	1,11

The final concentration shows that there is a low concentration of lithium, compared with the other ions. The relation Mg/Li is 5/1, while the relation Ca/Li is 24/1.

- Rincon Salar:

Rincon	%w/w								
	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Initial	73,11	0,02	9,61	0,50	0,23	0,04	14,98	1,44	0,08
Final (3,07% of initial mass)	52,15	0,82	1,94	1,47	6,81	0,01	3,78	29,79	3,16

The final concentration shows a lithium concentration low compared with the other ions, however the highest lithium concentration compared with other Salares. The relation Mg/Li is 8/1 which could impact on plant yield. Also, a high sulphate concentration could generate a lithium loss due to lithium sulphate precipitation.

- Pular Salar:

Pular	%w/w								
	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Initial	85,21	0,01	5,11	0,41	0,15	0,06	8,08	0,93	0,05
Final (2,36% of initial mass)	55,16	0,36	2,81	2,11	6,21	0,01	5,39	25,53	2,38

The final lithium concentration is lowest compared with the other Salares. The ratio Mg/Li is 17/1, the highest of three Salares, and a high sulphate concentration similar to the result of Rincon Salar.

Two type of brines can be recognized from simulations:

1. High Calcium brine: Incahuasi Brine
2. High Sulphate brine: Rincon and Pular salares.

A potencial alternative in order to reduce the calcium and sulphate concentration of the brines could be mix Incahuasi and Rincon brines.

Adding some reagents to reduce magnesium, calcium and sulphate should be considered in the next stage of simulations.

The simulation shows that lithium concentration in Incahuasi and Rincon are potentially feasible to produce Lithium Carbonate, however the impact and effect on plant yield should be carried out.

Appendix 3 – Technical Memo 190710

Salars Evaporation Pathway

15 July 2019 - Ad-Infinitum

Prepared for:	PepinNini	PROTOCOLE
Prepared by:	Ad-Infinitem	190710
Subject:	Salares Evaporation Pathway	Final
Date	Monday 15 July 2019	0

1 BACKGROUND

As a result of the simulation of the evaporation pathways of Incahuasi and Rincon brines, it has been possible to recognize that Incahuasi brine has the highest calcium composition, and Rincon brine has the highest sulphate concentration.

Previously the well brine mixture was simulated, the results were presented in the previous report, now the case of the mixture of concentrated brines is studied.

2 OBJECTIVE

In order to obtain a suitable concentrated brine to produce lithium carbonate, a mix between Incahuasi and Rincon concentrated brines has been tested.

3 DESCRIPTION

Mix of concentrated brine: A mix of Incahuasi and Rincon brines has been simulated in order to take advantages of both brines to diminish the level of contaminants in the brine fed to lithium carbonate plant, precipitating Ca_2SO_4 . For this case, both brines have been evaporated individually, then after several stages of evaporation and a large part of the water have been evaporated, brines are mixed to then continue evaporating, the point uses in this cases is when the concentrated brine reaches 66% of weight in water. The following diagram shows the scheme of the simulation:

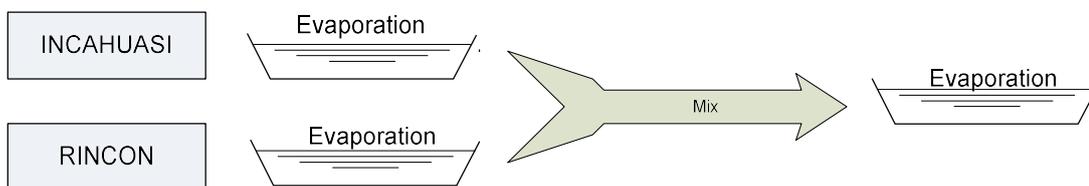


Diagram 1 Concentrated brine mix description

Three cases have been simulated in order to obtain a mix that maximized the process yield and brine concentration of lithium. The following cases have been considered:

Case 1: Mixing 40 %w/w of Incahuasi and 60 %w/w of Rincon concentrated brine, this relation has been selected in order to evaluate the effect of mayor proportion of rich sulphate brine (Rincon Brine).

Case 2: Mixing 50 %w/w of Incahuasi and 50 %w/w concentrated brine, this relation has been selected for evaluate an equitative mix of brines.

Case 3: Mixing 60 %w/w of Incahuasi and 40 %w/w of Rincon concentrated brine, this relation has been selected in order to evaluate the effect of mayor proportion of calcium rich brine (Incahuasi Brine).

4 INPUT DATA

The simulation has been carried out using the average annual average temperature of the Salares area and the chemical compositions of the brine of the concentrated brine when the composition of water reaches 66 % weight.

4.1 Average annual temperature

The following table ¹shows the data of the annual average temperature in the Rincon Salar.

Table 1. Annual average temperature in Rincon Salar

Temperature [°C]	Minimum	Maximum	Average
Annual	-11,4	26,7	7,65

The annual average temperature has been used in the simulation to determine the evaporation pathways of blends.

4.2 Chemical composition of the brine

In the following tables the brine composition after the mix of Incahuasi and Rincon concentrated Brine. This brine composition will be the initial point of the simulation.

Table 2. Brine Composition after brine mix in %w/w

Description	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Case 1	67,57	0,13	3,08	2,82	2,71	2,32	15,92	5,01	0,44
Case 2	68,32	0,13	2,36	2,48	3,00	2,70	17,16	3,45	0,40
Case 3	68,44	0,12	1,77	2,17	3,26	3,16	18,37	2,35	0,36

5 SIMULATION RESULTS

The brine evaporation behaviour of all the cases are presented below, in charts that shows the relation between ions and magnesium, during the evaporation process. In addition, there are graphs that shows the salts formed as a result of brine evaporation.

¹ <http://www.rinconmining.com.ar/rincon/>

5.1 Case 1: Mixing 40 %w/w of Incahuasi and 60 %w/w of Rincon concentrated brine

In the following table there is the final brine concentration after evaporation for Case 1. expressed in %w/w.

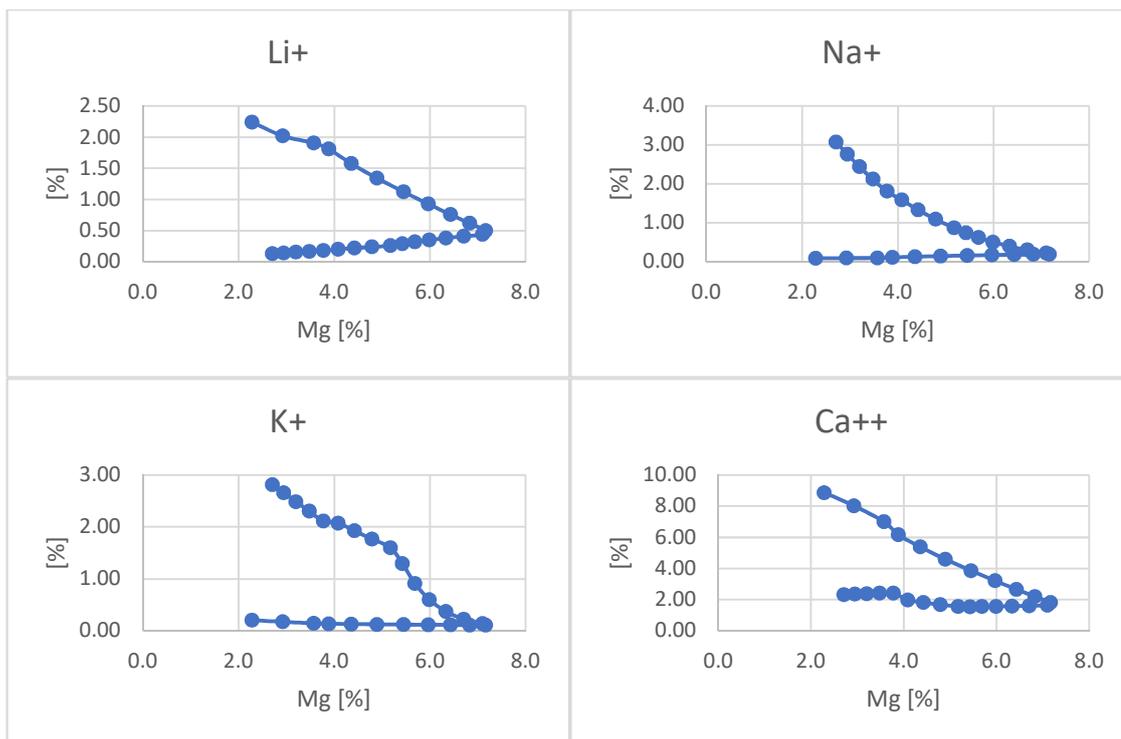
Table 3. Final Brine Composition Case 1

	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Final Brine	52,09	2,24	0,09	0,21	2,28	8,87	33,79	0,05	0,34

In this case, the lithium concentration reaches a value of 2,24 %w/w, and the impurities concentration is high, mainly calcium 8.9 %w/w.

5.1.1 Brine evaporation Pathway

The ions behaviour and salts precipitation during the brine evaporation, after the corresponding mix is shown in the next charts.



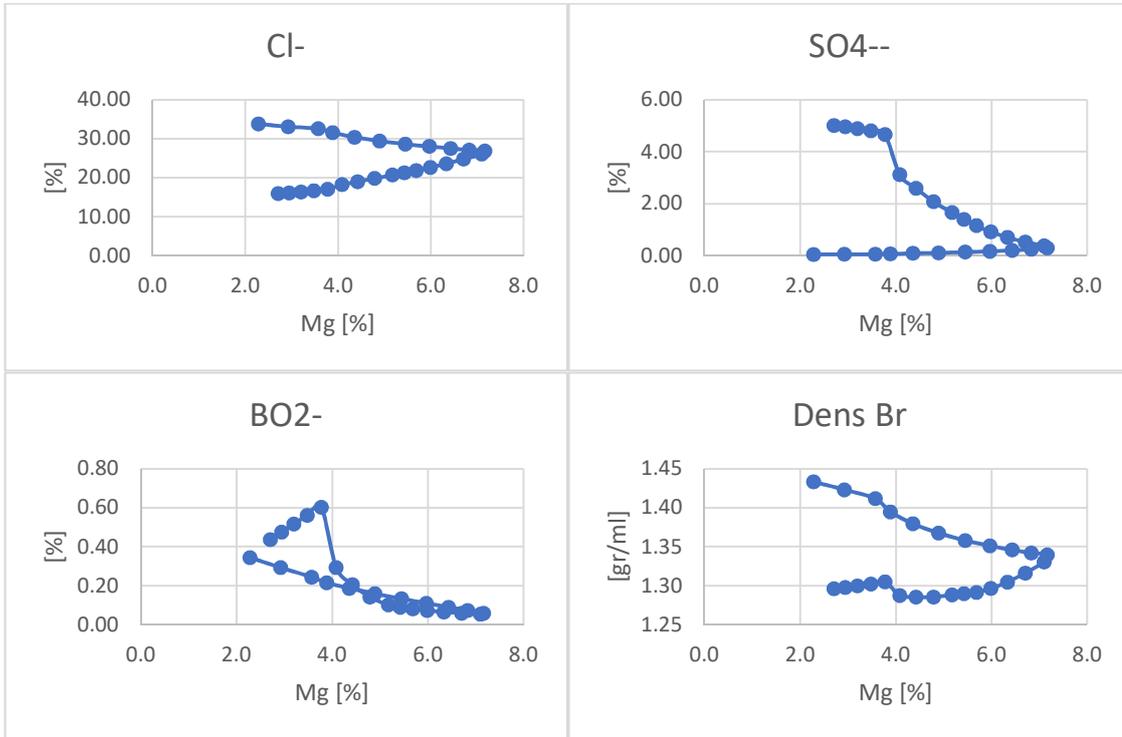


Figure 1. Ion behaviour during brine evaporation Case 1

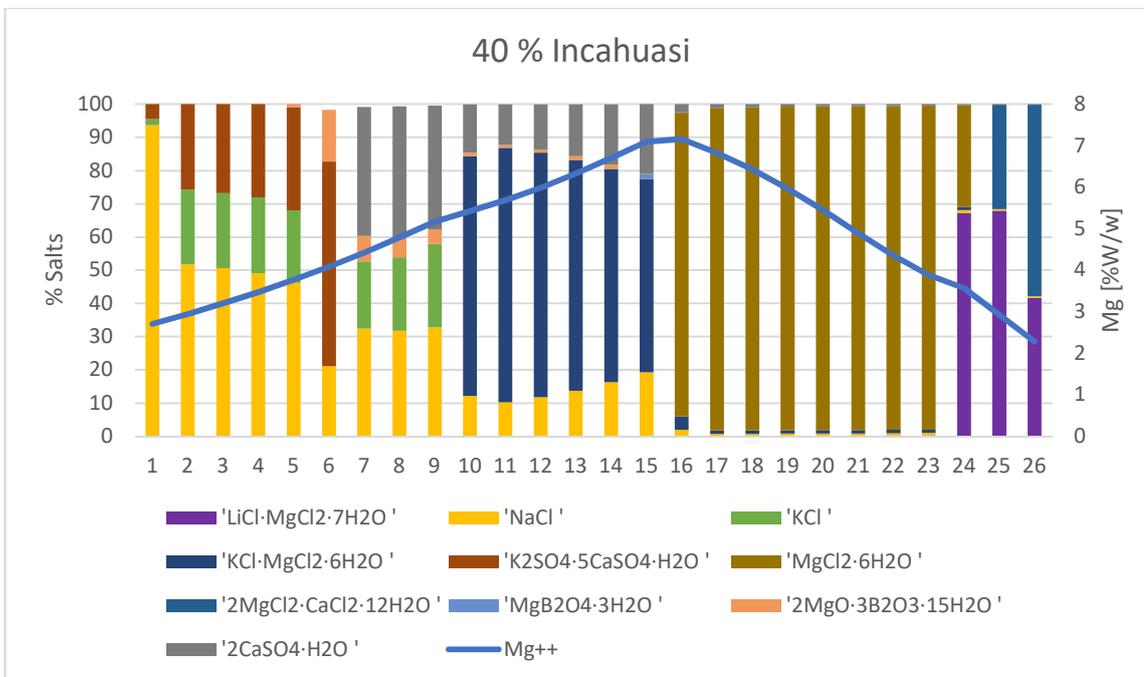


Figure 2. Salts precipitation during brine evaporation Case 1

5.1.2 Simulation Analysis

According to figures 1 and 2, it is possible to state the following observations:

- **Li⁺¹**: The maximum concentration achieved has been 2.25 %w/w. it has been identified lithium sulphate precipitation after 1.8 %w/w
- **Na⁺¹**: The concentration decreases because of NaCl precipitation, and it reaches a minor value of 0.1 %w/w.
- **K⁺¹**: The concentration decreases continuously due to the formation of KCl, K₂SO₄.5CaSO₄.H₂O, and carnallite (KClMgCl₂ 6H₂O)
- **Ca⁺²**: In the range (2.9 a 7.1) Mg %w/w the calcium concentration keep low due the precipitation of CaSO₄ H₂O and K₂SO₄.5CaSO₄.H₂O; after the concentration increase until 8.9 %w/w.
- **Cl⁻¹**: the concentration increase, having values as high as 33.8% w/w
- **SO₄⁻²**: the brine content has been completely depleted
- **BO₂⁻²**: the concentration increases and decreases until 0.34 %w/w.
- **Density**: The density value increases as a result of the evaporation process (1.43 g/mL as final value).

From salt precipitation graph can be seen the following salts precipitate during the brine evaporation process.

1. NaCl
2. K₂SO₄.5CaSO₄.H₂O
3. KCl
4. 2MgO.3B₂O₃.15H₂O
5. 2CaSO₄ H₂O
6. KClMgCl₂ 6H₂O
7. MgCl₂ 6H₂O
8. 2MgCl₂CaCl₂ 12H₂O
9. LiCl.MgCl₂ 7H₂O

5.2 Case 2: Mixing 50 %w/w of Incahuasi and 50 %w/w Rincon concentrated brine

In the following table there is the final Brine concentration after evaporation for the Case 2 expressed in %w/w

Table 4. Final Brine Composition Case 2

	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Final brine	52,61	1,05	0,09	0,11	2,69	10,75	31,66	0,09	0,91

In this case, the lithium concentration reaches a value of 1,05 % w/w, and the impurities concentration is higher, mainly calcium.

5.2.1 Brine Evaporation Pathway

The ions behaviour and salts precipitation during the brine evaporation, after the corresponding mix is shown in the next charts.

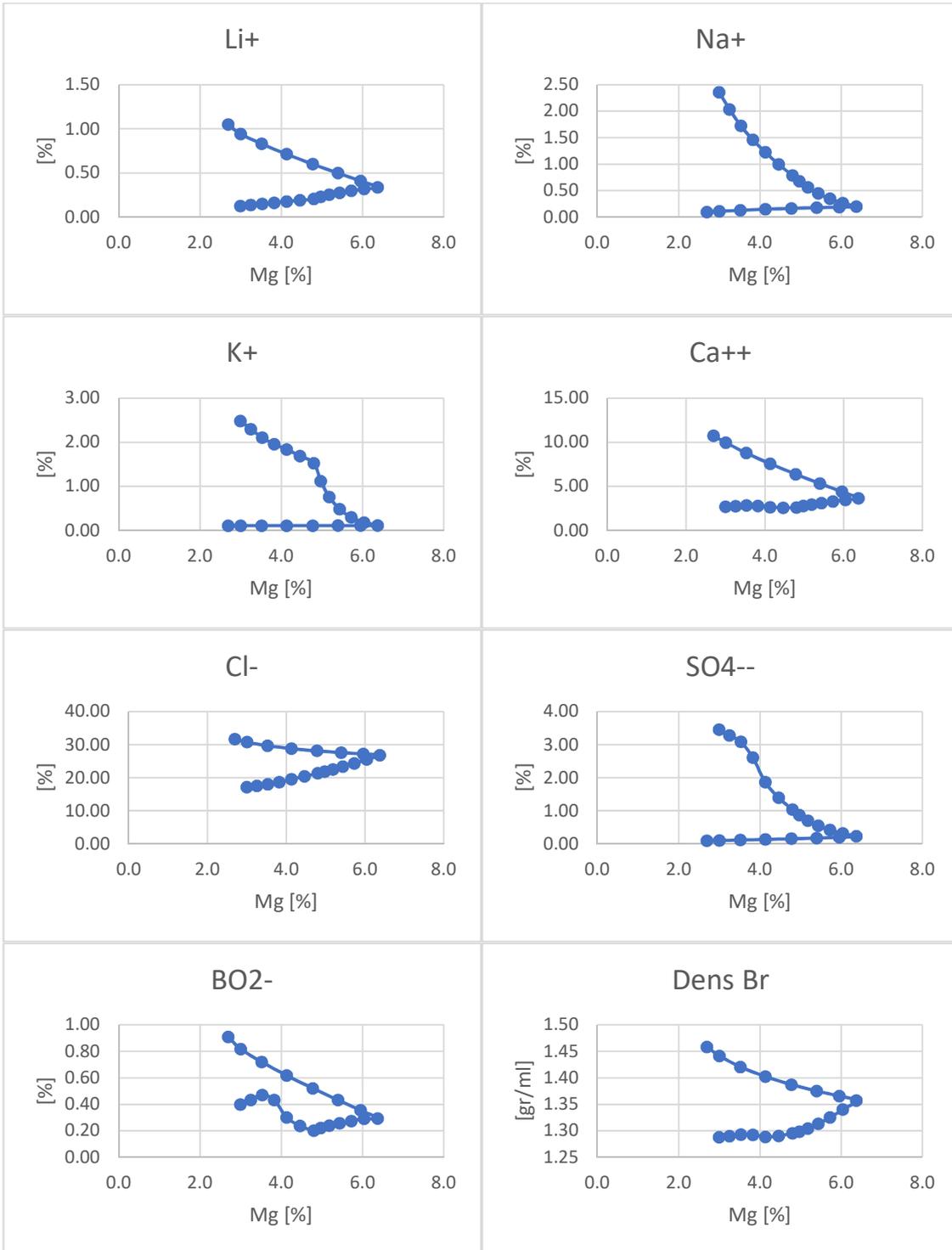


Figure 3. Ion behaviour during brine evaporation Case 2

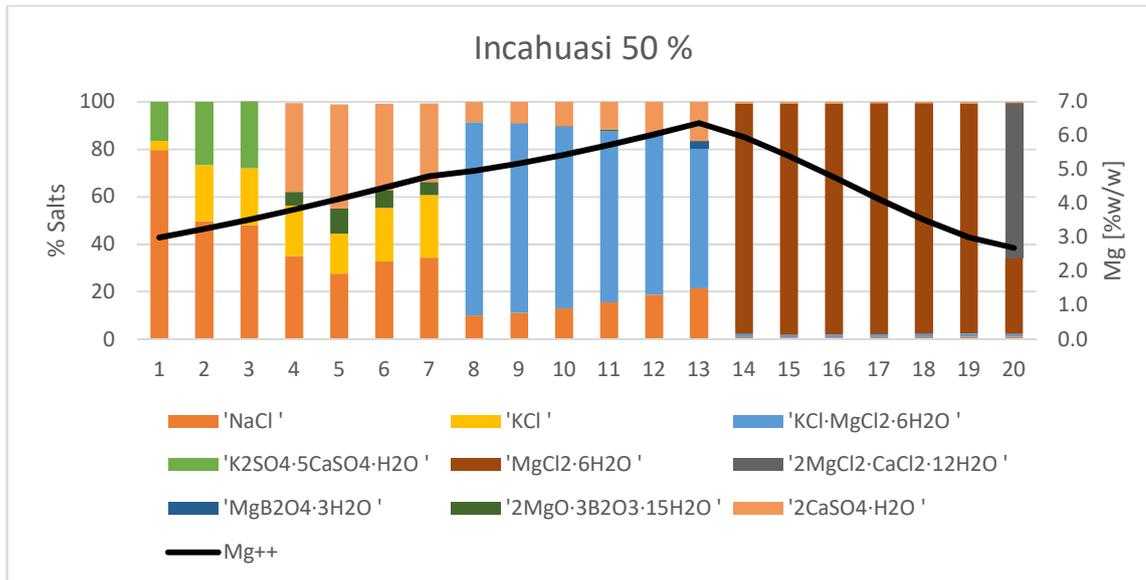


Figure 4. Salts precipitation during brine evaporation Case 2

5.2.2 Simulation Analysis

According to figures 3 and 4, it is possible to state the following observations:

- **Li⁺¹**: The maximum concentration achieved has been 1.05 %w/w.
- **Na⁺¹**: The concentration decreases because of NaCl precipitation, and it reaches a minor value of 0.1 %w/w.
- **K⁺¹**: The concentration decreases continuously due to the formation of KCl, K₂SO₄·5CaSO₄·H₂O and carnallite (KClMgCl₂ 6H₂O)
- **Ca⁺²**: In the range (2.9 a 6.4) Mg %w/w the calcium concentration keep low due the precipitation of 2CaSO₄ H₂O and K₂SO₄·5CaSO₄·H₂O; after the concentration increase until 10.8 %w/w.
- **Cl⁻¹**: the concentration increased, having values as high as 31.7% w/w
- **SO₄⁻²**: the brine content has been completely depleted
- **BO₂⁻²**: the concentration increases and decreases until 1.91 %w/w.
- **Density**: The density value increases as a result of the evaporation process (1.46 g/mL as final value).

From salt precipitation graph can be seen the following salts precipitate during the brine evaporation process

1. NaCl
2. KCl
3. K₂SO₄·5CaSO₄·H₂O
4. MgB₂O₄·3H₂O
5. 2MgO·3B₂O₃·15H₂O
6. 2CaSO₄ H₂O
7. KClMgCl₂ 6H₂O
8. MgCl₂ 6H₂O
9. 2MgCl₂CaCl₂ 12H₂O

5.3 Case 3: Mixing 60 %w/w of Incahuasi and 40 %w/w Rincon concentrated brine

In the following table there is the final brine concentration after evaporation for the Case 3 expressed in %w/w

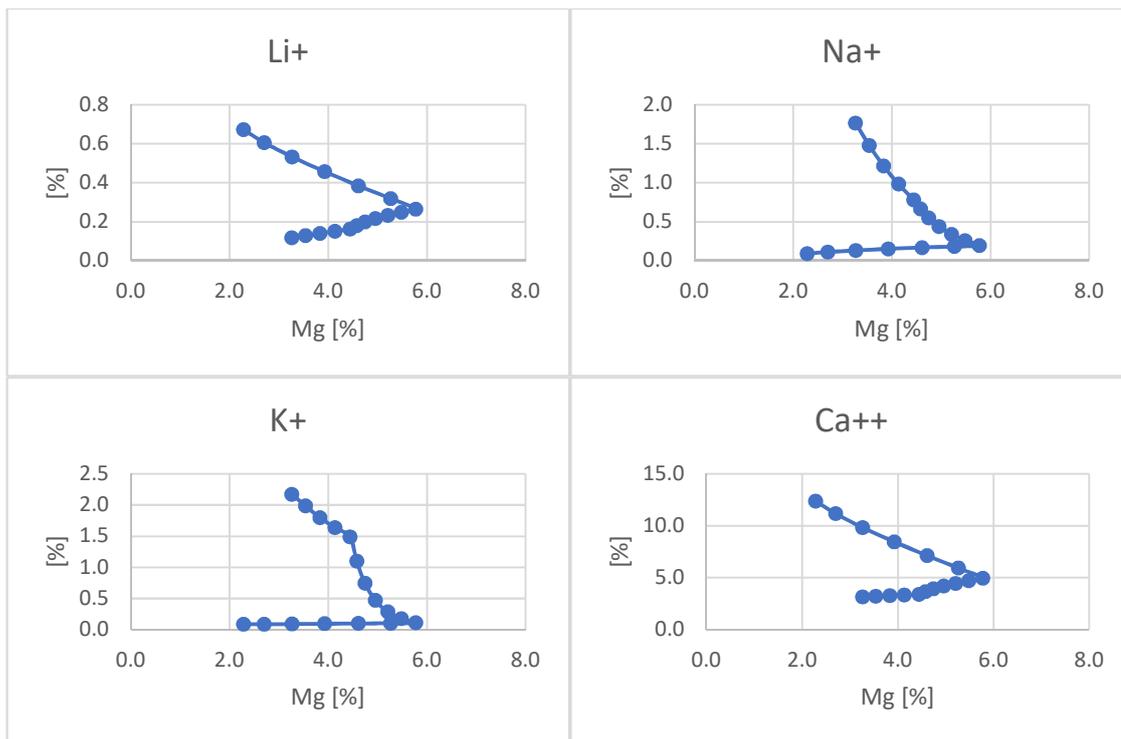
Table 5. Final Brine Composition Case 3

	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Final Brine	51.96	0.67	0.09	0.09	2.28	12.38	30.89	0.16	1.46

In this case, the lithium concentration reaches a value of 0.67%w/w, and the impurities concentration is high, mainly calcium.

5.3.1 Brine Evaporation Pathway

The ions behaviour and salts precipitation during the brine evaporation, after the corresponding mix is shown in the next charts.



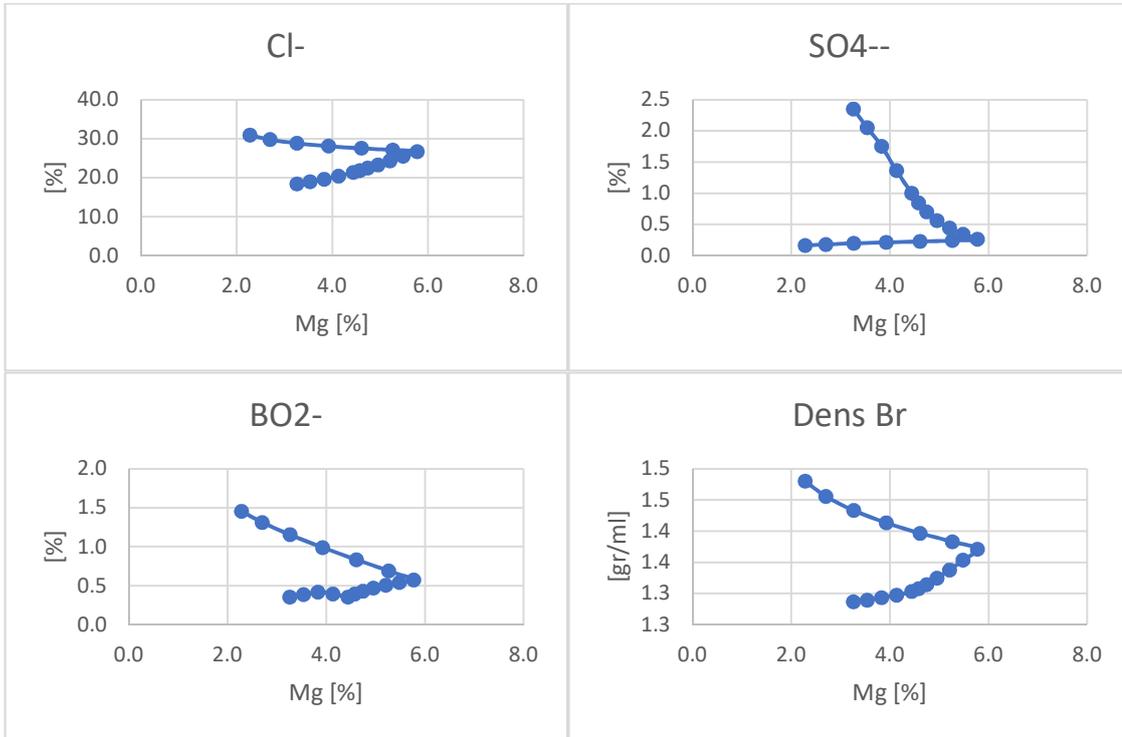


Figure 5. Ion behaviour during brine evaporation Case 3

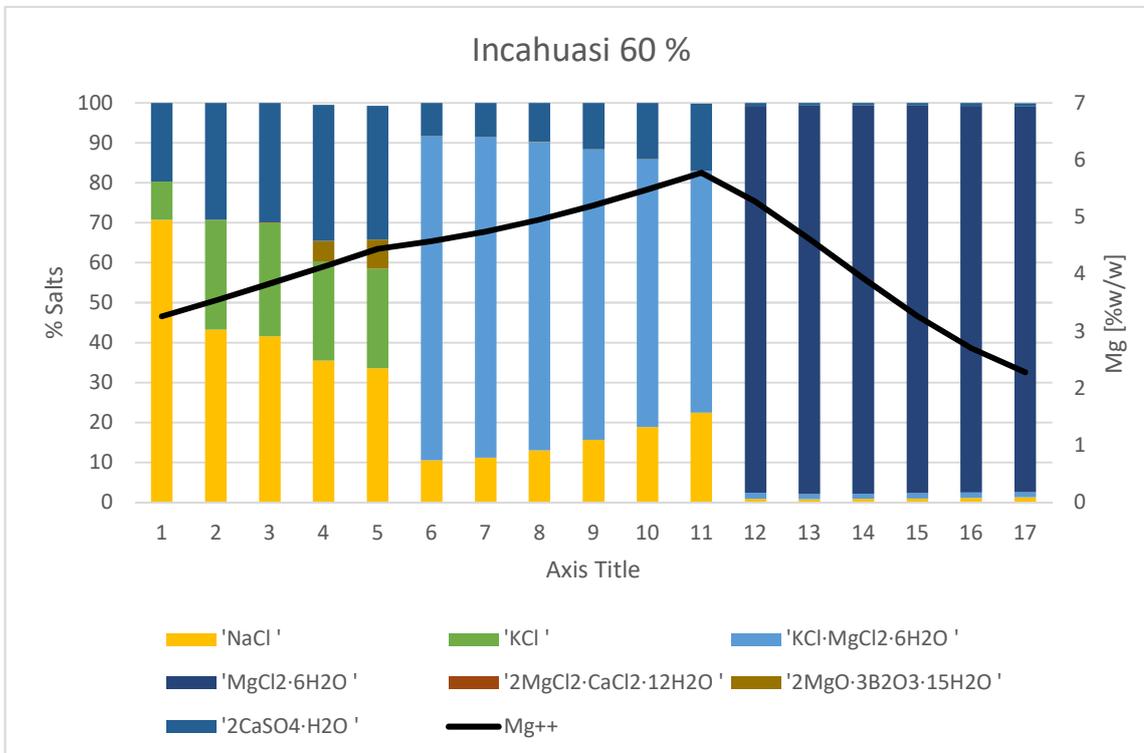


Figure 6. Salts precipitation during brine evaporation Case 3

5.3.2 Simulation Analysis

According to figures 3 and 4, it is possible to state the following observations:

- **Li⁺¹**: The maximum concentration achieved has been 0.67 %w/w.
- **Na⁺¹**: The concentration decreases because of NaCl precipitation, and reach a value minor than 0.1 %w/w.
- **K⁺¹**: The concentration decreases continuously due to the formation of KCl, and carnallite (KClMgCl₂·6H₂O)
- **Ca⁺²**: In the range (2.9 a 4.5) Mg %w/w the calcium concentration keep constant due the precipitation of 2CaSO₄·H₂O; after the concentration increase until 12.4 %w/w.
- **Cl⁻¹**: the concentration increased, having values as high as 30.8% w/w
- **SO₄⁻²**: the brine content was completely depleted
- **BO₂⁻²**: the concentration increases and decreases until 1.5 %w/w.
- **Density**: The density value increased as a result of the evaporation process (1.48 g/mL as final value).

From salt precipitation graph can be seen the following salts precipitate during the brine evaporation process

1. NaCl
2. 2CaSO₄·H₂O
3. KCl
4. 2MgO·3B₂O₃·15H₂O
5. KClMgCl₂·6H₂O
6. MgCl₂·6H₂O
7. 2MgCl₂·CaCl₂·12H₂O

6 COMPARISON AND CONCLUSION

The table 6 shows the final concentration reaches in the three cases of mix of brines simulated, thus case 1 presents the highest lithium concentration and lower concentration of impurities.

Table 6: Final brine concentration of three cases

	H2O	Li+	Na+	K+	Mg++	Ca++	Cl-	SO4--	BO2-
Case 1 Final Brine	52.09	2.24	0.09	0.21	2.28	8.87	33.79	0.05	0.34
Case 2 Final Brine	52.61	1.05	0.09	0.11	2.69	10.75	31.66	0.09	0.91
Case 3 Final Brine	51.96	0.67	0.09	0.09	2.28	12.38	30.89	0.16	1.46

A comparison of lithium concentration and ionic relations for the simulated cases, is shown in the next table

Table 7: Comparison of result in Cases 1, 2 and 3

Description	Final Lithium concentration [%w/w]	Mg/Li Ratio	Ca/Li Ratio	SO4/Li Ratio
Incahuasi evaporation	0,55	4,5	22,3	0
Rincón evaporation	0,82	8,3	0,01	36,33
Concentrated brine mix Case 1	2.24	1.02	3.96	0.02
Concentrated brine mix Case 2	1.05	2.57	10.23	0.09
Concentrated brine mix Case 3	0.67	3.4	18.48	0.24

From the table 7 can be observed that:

The evaporation of the mixed concentrated brines, particularly case 1 and 2, allows reaching higher lithium concentrations than those obtained in the evaporation of the brines separately.

Case 1, which has an Incahuasi 40% and Rincon 60% proportion, allows obtaining a brine with a higher concentration of lithium.

The lowest Mg/Li and Ca/Li ratio were obtained for Case 1, which impacts on process plant yield due to lower removal of contaminants.

During the evaporation path of brine of case 1, there is LiCl.MgCl₂ 7H₂O precipitation, when the brine reaches 1.9% Li (3.5% Mg), this impacts on lithium recovery, thus, to avoid that there are two alternatives proposed:

- Use lime slurry to precipitate Mg, but it must be considered that the brine at that point already has a high concentration of calcium (7% Ca), lime adds more calcium.
- Cut evaporation process in pond in before precipitation of $\text{LiCl} \cdot \text{MgCl}_2 \cdot 7\text{H}_2\text{O}$ and treat the brine in the process plant.

6.1 Recommendations

According to results presented in this document is recommended use Case 1, mix of 40 %w/w of Incahuasi and 60 %w/w of Rincon concentrated brine, to evaluate the potential production of lithium for PepinNini.

Evaporation path should be validated through a laboratory test, it is suggested using a wind tunnel to evaporate the mix of brines. Model should be adjusted or validated according with the result of this test.