

Method of Producing a Naturally Purified Salt Product From Inorganic Salt Mixtures

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Cargill Salt

Process Methodology

Component	Weight Percent
MgSO₄	20 – 30 %
MgCl₂	0 – 7 %
KCl	4.0 - 9.0 %
NaCl	28 – 45 %
Na₂SO₄	0 – 6 %
Water	< 34 %
Wt % Insoluble Material	1.0 - 8.0 %



Magnesium Chloride Brine Recycled
From Step-6 Mixed with concentrated Magnesium Chloride Brine



Step-6
Selected
MgSO₄
Extraction
115°F



Step-7

Chloride
Brine



Step-8
Drying/Co

Re-
Purge S

Step-7
Crystallization
Temperature Range
- 75°F



Step-5
Crude
Crystallization
- 70°F
(from Salt)

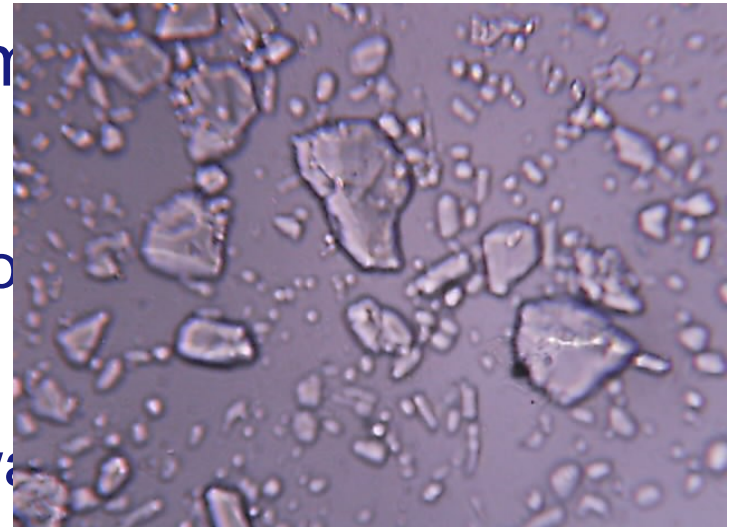
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Recycle to Extraction
& Purge

Key Process Variables



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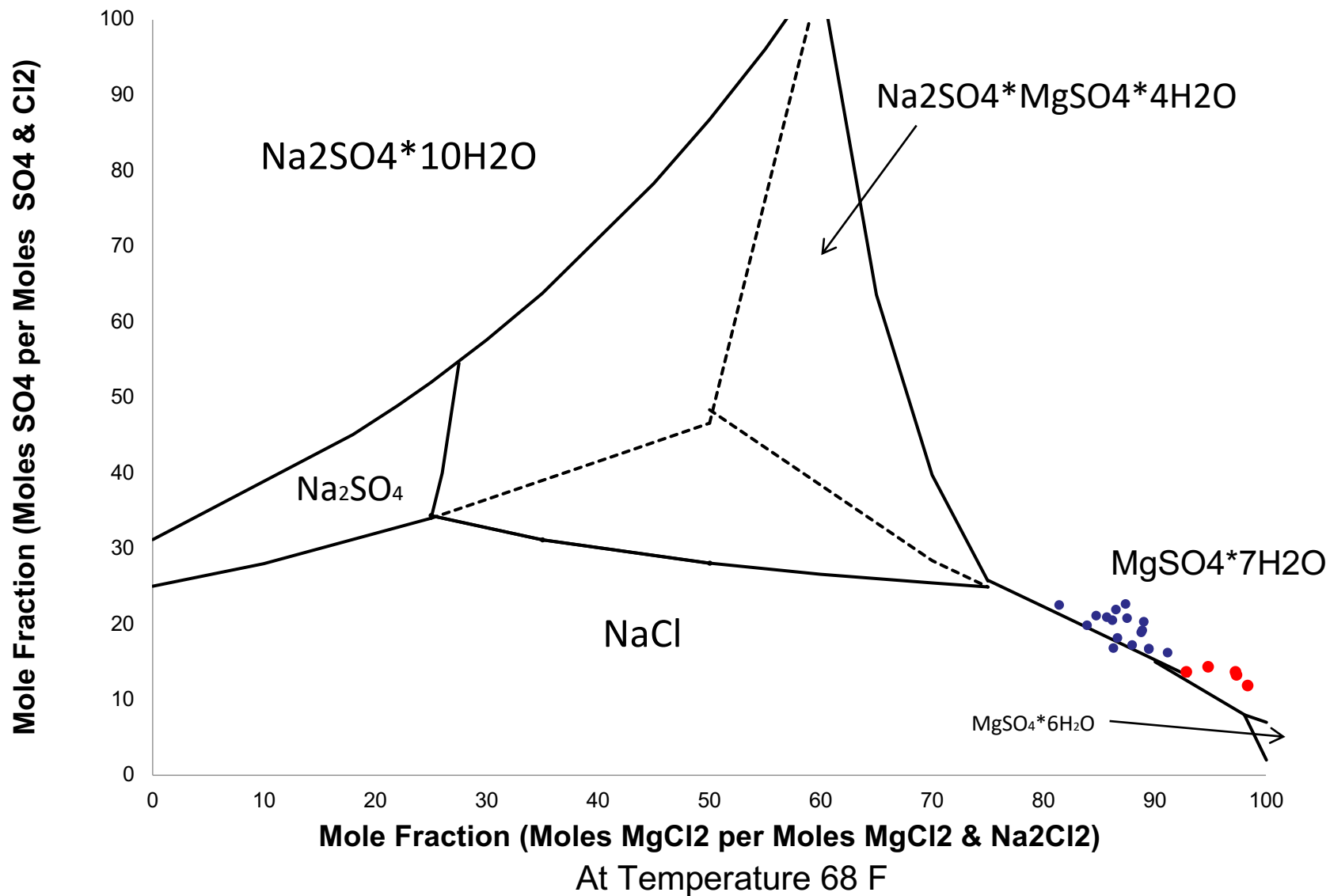
- Diluting Crystallization Feed Brine
 - Brine recycled from secondary stage
 - Water Addition

WORLD SALT SYMPOSIUM

June 19-21, 2018



Park City UT, USA



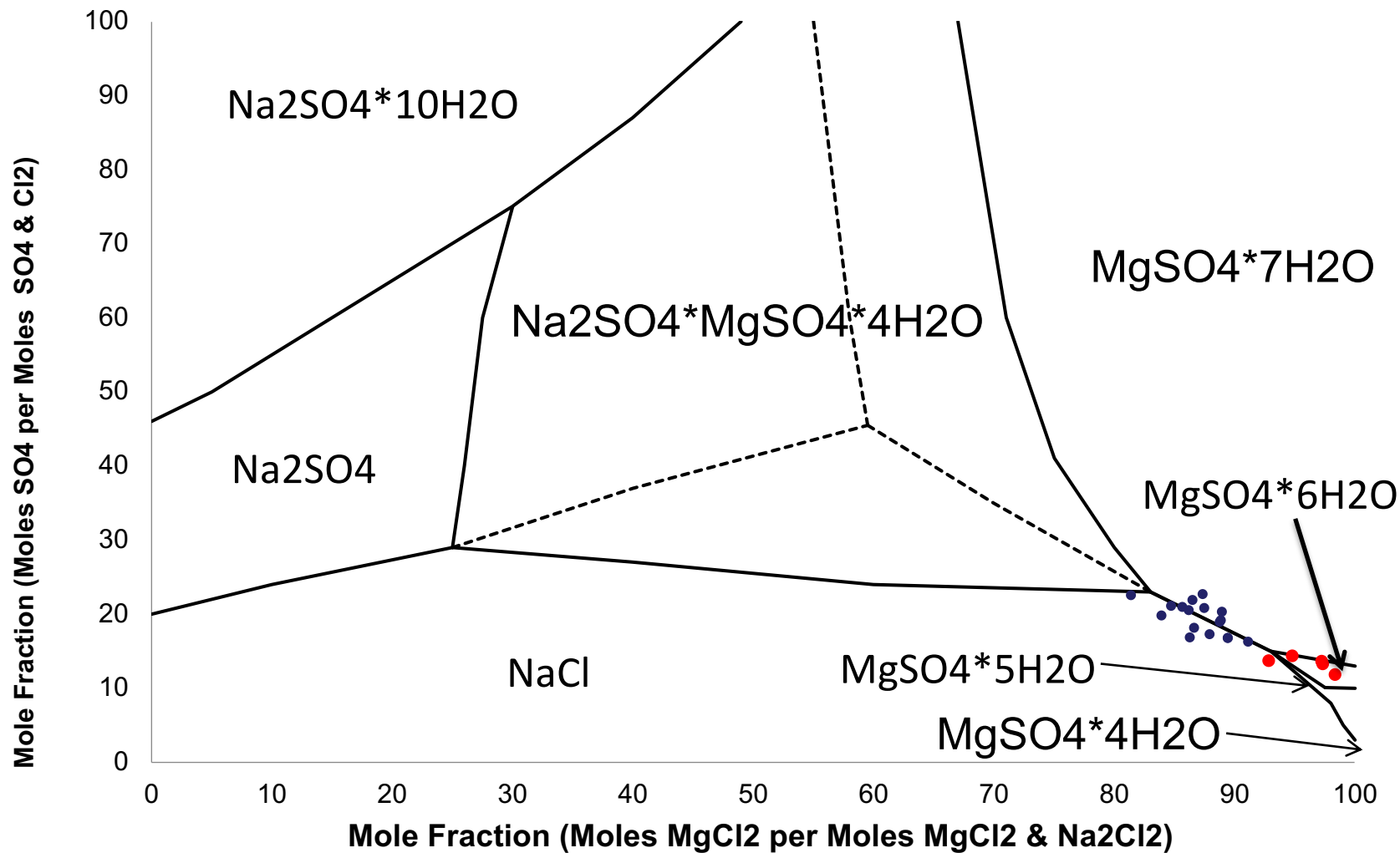
Source J. D'ANS Solubility of the Systems of Ocean-Salt Deposits

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Park City UT, USA



At Temperature 77 F

Source J. D'ANS Solubility of the Systems of Ocean-Salt Deposits

Conclusions Summary

- Proven Method to Produce USP Epsom Salt From a Mixed Inorganic Salt Feed
- Handles Wide Range of Feed Material
- Efficiently Separates other inorganic salts in the mixture
- Traditional Process Equipment
- Temperature Range
- Utilizes Natural Process Components
- US Patent 5,281,242

Questions





APPENDIX

DATA

Pilot Week	Average Weight Percent Feed Solids Discharged with Fines	Average Weight Percent of KCl of Feed Discharged with Fines Stream	Average Weight Percent KCl in Fine Stream	Average Weight Percent of Extraction Brine Entrained in Fine Stream	Average Residence Time (min)	Average Mixing Ratio	Weight Percent of KCl & NaCl from Feed recovered	Purity of Recovered NaCl + KCl on Anhydrous Basis	Weight Percent of MgSO ₄ in Feed Dissolved in Extraction
5/11/2009	21%	57%	22%	6%	31	2.4	66%	94%	64%
4/13/2009	14%	40%	25%	5%	24	2.5	67%	82%	77%
3/30/2009	14%	59%	18%	8%	25	2.1	78%	81%	63%

Week of Operation 2009	Single or Double Batch	Percent of Feed solids Retained as Course Product (NaCl Solids)	Percent of Feed NaCl & KCl Recovered	Purity of Recovered Course (NaCl & KCl) Anhydrous	Weight percent magnesium sulfate from feed extracted	Weight percent magnesium Sulfate from Feed Discharged with Course Solids	Weight percent Feed Solids Discharged as waste solids (Fine Solids)	Extraction Residence Time	Average Temperature Of Extraction	Weight Percent of Extraction Brine Entrained With Fine Solids	Mixing Ratio
2-Feb	Double	39%	63%	91%	76%	13%	21%	71	121	NA	1.3
9-Feb	Double	38%	70%	94%	93%	8%	25%	125	120	NA	1.3
9-Feb	Single	41%	56%	83%	73%	29%	32%	222	120	NA	1.1
23-Feb	single	44%	78%	86%	24%	19%	31%	29	121	NA	1.2
30-Mar	single	37%	78%	81%	63%	21%	14%	25	120	6%	2.1
13-Apr	single	34%	67%	82%	77%	18%	14%	24	122	5%	2.5
11-May	single	33%	66%	95%	62%	7%	21%	31	122	8%	2.4

Particle Size Data

Pilot Crude

Ave Pilot May 2009

20 mesh	1.1
30 mesh	17.0
40 mesh	33.5
50 mesh	29.0
70 mesh	15.0
100 mesh	4.0
PAN	0.4

Pilot Crude

Ave Pilot April 2009

20 mesh	4.2
30 mesh	21.6
40 mesh	31.1
50 mesh	21.0
70 mesh	11.6
100 mesh	6.4
PAN	4.1

Purity May Pilot Data

CZ Discharge Solids	Washed / Unwashed	MgSO ₄	MgCl ₂	KCl	NaCl	Water	Wt % Solids (Wet Cake) (Cake created by filtering solids from brine)
5/11/09 1:40 PM	Unwashed	44%	6%	0.2%	-3%	53%	20%
5/11/09 6:12 PM	Unwashed	45%	2%	0.1%	0%	53%	8%
5/11/09 11:00 PM	Unwashed	41%	4%	0.2%	0%	55%	19%
5/12/09 2:00 AM	Unwashed	38%	5%	0.0%	2%	55%	NA
5/12/09 4:00 AM	Unwashed	44%	3%	0.2%	1%	53%	25%
5/12/09 10:12 AM	Unwashed	40%	5%	0.2%	-2%	57%	30%
5/12/09 5:25 PM	Unwashed	43%	4%	0.2%	-2%	54%	30%
5/12/09 9:00 PM	Unwashed	43%	3%	0.2%	0%	53%	30%
5/13/09 12:30 AM	Unwashed	44%	2%	0.2%	1%	53%	27%
5/13/09 4:30 AM	Unwashed	43%	4%	0.2%	-1%	54%	26%
5/13/09 8:30 AM	Unwashed	42%	5%	0.1%	-4%	57%	22%
5/13/09 12:00 PM	Unwashed	45%	1%	0.2%	2%	52%	27%
5/13/09 4:45 PM	Unwashed	40%	4%	0.2%	-1%	56%	30%
5/13/09 8:30 PM	Unwashed	46%	2%	0.1%	0%	52%	29%
5/13/09 9:00 PM	Unwashed	43%	3%	0.2%	1%	53%	NA
5/14/09 12:00 AM	Unwashed	36%	6%	0.3%	0%	57%	30%
5/14/09 3:30 AM	Unwashed	43%	2%	0.3%	1%	53%	28%