INDIAN SOLAR SALT - QUALITY IMPROVEMENT

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Indian solar salt traditionally has been of poor quality. With the advent of economic reforms in the early nineties all soda ash and caustic soda manufacturers were looking for reduction in cost of production. As salt is a basic raw material we in Gujarat Heavy Chemicals Limited attempted to take up salt quality upgradation as a major project so that the following two components of cost of production of soda ash could be reduced significantly 1) salt consumption 2) Purification chemicals consumption. This paper deals directly with the process of upgradation of salt and the results obtained through trials.

1. INTRODUCTION

India ranks 6th amongst the salt [1] producing countries of the World. Table - 1 and Table -2 give type of salt produced in different states of India and all India production of salt during last fifty years.Table -3 gives actual production of caustic soda and soda ash and the salt consumed during last ten years. Table - 4 gives details of caustic soda / soda ash units having their own captive salt fields and the ones not having such units. The salt quality from representatives areas of Gujarat and Tamil Nadu which constitute 82 % of total production of India is depicted in Table - 5. The poor quality of salt fed to the Chlor Alkali Industries not only increases the brine purification cost but also poses serious effluent disposal problems.

Poor quality of salt is also one of the reasons of India's poor performance on export front. Gujarat Heavy Chemicals Limited is an ISO 9002 Company is the 2nd largest producer of soda ash in India with a capacity of 440,000 MT. per annum. We are also 2nd largest producer of Industrial grade salt 700,000 MT. per annum of the following quality

NaCl	98.5 %	Minimum (dry basis)
Ca	0.2 %	Maximum
Mg	0.1 %	Maximum
SO_4	0.6 %	Maximum
Insolubles	0.4 %	Maximum

Table - 1
Types of salt produced in India

STATE	TYPE OF SALT PRODUCED	SHARE IN THE COUNTRY'S PRODUCTION
Gujarat	Marine and Inland salt	70 %
Tamil Nadu	Marine salt	12 %
Rajasthan	Inland & Lake salt	10 %
Andhra Preadesh, Maharashtra, Karnataka, Orissa, West Bengal, Goa, UT of Dam & Diu	Marine salt	08 %
Himachal Pradesh	Rock salt	-

Table - 2
Salt production in Gujarat

YEAR	ALL INDIA PRODUCTION (MILLION TONNES)	PRODUCTION OF GUJARAT (MILLION TONNES)
1947	1.93	-
1957	3.67	-
1967	4.49	-
1977	5.33	-
1987	9.90	-
1990	12.40	-
1991	12.40	8.43
1992	13.56	9.12
1993	13.72	9.31
1994	12.34	8.69
1995	12.54	8.82
1996	14.47	10.40
1997	14.25	10.1

Table -3
Chlor - Alkali production (Quantity in Million Tonnes)

ITEM	1988	1998	1990	1991	1992	1993	1994	1995	1996	1997
Caustic soda	0.85	0.94	1.02	1.03	1.09	1.08	1.12	1.22	1.34	1.42
Soda ash	1.14	1.37	1.38	1.37	1.37	1.51	1.52	1.59	1.61	1.62
Total	1.99	2.31	2.41	2.35	2.47	2.60	2.53	2.81	2.96	3.04
Salt used up	3.98	4.63	4.38	4.71	4.95	5.20	5.07	5.63	5.92	6.09
Salt for misc., Industries	0.39	0.46	0.48	0.47	0.49	0.52	0.50	0.56	0.49	0.60
Total	8.35	9.71	10.12	9.87	10.37	10.91	10.73	11.81	12.42	12.77

Table - 4
Chlor - Alkali industries with captive salt fields

	ANNUAL SALT PRODUCTION MT.	ANNUAL SALT REQUIREMENT MT.
Caustic soda units with own salt fields	360,000	640,000
Soda ash units with own salt fields	2,510,000	3,528,000
Caustic soda units with out own salt fields	-	1,850,050
Total	2,870,000	6,018,750

Table - 5 Available salt quality [2] from major salt producing areas in India - % dry basis

	NaCl	$CaSo_4$	$MgSo_4$	$MgCl_2$	INSOLUBLES	UNDETERMINED
Bhavnagar	97.7	0.34	0.58	0.91	0.48	-
Jamnagar	98.1	0.66	0.21	0.67	0.05	0.28
Kandla	98.7	0.53	0.22	0.21	0.05	0.25
Mithapur	97.9	1.03	-	0.53	0.06	0.4
Kharagoda	96.68 - 98.6	0.71 - 1.55	0.05	0.44 - 1.13	0.09 - 1.42	-
Tuticorin	98.24	0.42	0.25	0.7	0.39	-
Chennai	96.9	0.64	0.15	0.41	1.04	0.84
Vedaranium	96.1	0.73	0.16	0.15	2.57	2.24
Adirampathnam	96.5	0.55	1.09	1.11	0.74	-

2. PROCESS

Over the years we were planning to improve the quality of the salt we were feeding to the soda ash plant. We then deliberated amongst ourselves and decided to make the following changes in the crystallisation process of solar salt.

2.1 Crystallisation of salt in large crystallisers

Traditionally the size of the crystallisers in India are 0.75 acre or less. GHCL (Gujarat Heavy Chemicals Limited) decided to go in for 7 to 10 acres crystallisers at its location at Jafrabad, Port Albert Victor & Una salt fields in 1997. The crystallisers were deep Charged with brine of depths ranging from 30 cms to 60 cms. During preparation of the crystalliser beds enough care was taken to ensure the bed level was uniform. Similar precaution was taken to construct the walls of the crystallisers so that there was no erosion due to wave action of brine. This also guaranteed a very low level of insoluble matter in salt.

2.2 Series feeding of brine

The benefits of series crystallisers over parallel layout are well known. Good brine control is very important for maintaining the correct feed density to minimise the Ca levels and to discharge bitterns of 29 Be. The operating depth of brine in the crystalliser is very sensitive to deposited salt crystal size and in GHCL we have controlled both the above parameters effectively. The feed brine density was maintained between 25.5 Be. to 25.8 Be. Table - 6 gives effects of operating depths on salt crystal size. The one most important thing in operating the series crystallisers is that sufficient quantity of right quality brine should be available all the time for feeding the crystallisers.

2.3 Traditional raking or agitation as in smaller crystallisers has been stopped

Excellent results have been obtained by not agitating the salt bed. Insolubles have gone down to 0.05 % from 0.4 %. As our salt will be mechanically harvested the agitation is not required.

3. BENEFITS OF CHANGE IN PROCESS MANUFACTURE

3.1 Increase in yield MT. per acre i.e. productivity

In India eight to nine cropping are done in the traditional manual crystallisers to produce salt. By switching over to large crystallisers and single harvesting higher yield of approximately 10 % has been achieved.

3.2 Salt quality improvements

Salt of very high purity :

	NaCl %
Unwashed	98.0 - 98.6 %
Washed	99.6 - 99.7 %

is obtained. This will not only reduce brine purification chemicals consumption but also increases the membrane life in caustic soda units. Table - 7 depicts unwashed salt quality obtained from the series crystallisers of Jafrabad salt field.

3.3 Crystal size

Referring to Table - 6 it was observed that at lower operating depths of brine the salt was coarse, the bed was hard and it was showing a higher bulk density compared to greater operating depths of brine where the salt was fine, with lower bulk density. In the former case, high load bearing capacity of salt is seen more suitable for mechanical operation of salt harvester.

Table -6
Effect of operating depth on size of salt crystals
Salt crystallisers in %

DEPTH cms	4mm	2.8 mm	2 mm	less than 1.0 mm
60	5.2	12.3	42.1	40.4
40	14.1	70.4	10.3	5.2
30	25.4	64.3	8.2	2.1

Table - 7
Jafrabad large crystallisers

	Series feed						Parallel feed
UNWASHED	1	2	3	4	5	6	7
NaCl	98.1	98.23	98.54	98.61	98.2	98	96.46
Ca	0.14	0.1	0.08	0.06	0.06	0.06	0.21
Mg	0.3	0.31	0.33	0.27	0.35	0.37	0.57
So_4	0.9	0.78	0.6	0.45	0.54	0.6	1.51
INSOLUBLE	0.08	0.05	0.05	0.05	0.05	0.05	0.60

4. WASHING OF SALT

An upgradability test of above salt was carried out and it was observed that salt of the following international quality could be easily obtained

NaCl	99.6-99.7	% Minimum (dry basis)
Ca	0.03-0.05	% Maximum
Mg	0.02-0.03	% Maximum
SO_4	0.11-0.15	% Maximum
Insolubles	0.03-0.05	% Maximum
Moisture	3-4	% Maximum

5. SUMMARY

Experience shows that accurate process control in the production of salt has helped tremendously in improving the quality. The selection of series crystallisers and the change in basic design has not only reduced process losses but also provided operating flexibility.
This approach to quality has made it possible to meet the current product requirements and produce a consistent and high quality product.

The savings in purification chemicals for a Chlor Alkali Industry would be to the extent of 13.2 Kg per MT. of soda ash if the impurity level Ca is reduced from 0.2 to 0.04 % and Mg from 0.1 to 0.02 % in salt.

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7. REFERENCES

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2. CSMCRI, Bhavnagar report on salt quality