Technical Notes

IMPROVED SOLAR SALT PRODUCTION USING POLYTHENE LINE BED IN THE FINAL CRYSTALLIZATION STEP

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Introduction

Common salt is produced in Bangladesh by solar evaporation of seawater. The production sites include: localities in the districts of Cox's Bazar and Chittagong along the shore of the Bay of Bengal and nearby islands, namely, Moheshkhali and Kutubdia etc. Common salt produced by solar evaporation in these areas contain a large amount of insoluble matters as well as other salts of Calcium and Magnesium. Current production of salt is about one million tonnes per year. Land area employed is about 50,000 acres by about 42,000 salt farmers. The productivity per acre land is in the range 10-18 tonnes of salt. The production season is for about five months beginning from the end of November and ending towards the end of April or early May if weather permits.

The quality of solar salt produced by the farmers is poor. It contains insoluble in the range 5-12% wt while the content of NaCl is in the range 70-80% wt., and moisture 10-15% wt. This salt often termed as the crude salt is refined by washing in salt refineries and the refined washed salt is sold in the market for human consumption. The good quality refined salt contains insolubles up to 1.0% wt. Insolubles include clay, sand, shells, fish dropping and scales etc.

This paper deals with performance of polythene lined bed vis-a-vis traditional clay beds plus beds formed with brick, and brick lined with polythene in the final crystallization step of salt production by solar evaporation. Solutions of sodium chloride are highly corrosive, However, polythene has a very good resistance to corrosion in salt solutions[1].

Study Area

The study area was located at BSCIC demonstration-cum-training centre at Lemshikhali (Kutubdia) in 1999-2000 season.

Production Procedure

Four equal size parallel beds (10 ft x 300 ft) each consisting of six compartments were prepared following the traditional sizing techniques. The sizes of the compartments were 10 ft x 68 ft, 10 ft x 63 ft, 10ft x 57ft, 10 ft x 50 ft, 10 ft x 45 ft and 10 ft x 17ft. The large four beds were called concentrators, the 10 ft x 45 ft bed was called the semi-crystallizer while the smallest bed was the final crystallizer from where the salt was harvested. The beds were sloped towards the crystallizer so that the salt solution could be transferred from the upper bed to lower bed by gravity. The beds were prepared by rolling as usual and sun dried. The fifth and sixth beds were rolled by adding brine solution and dried repeatedly. A slope of 5 inch to 6 inch was maintained in each bed.

The sixth bed which was called the crystallizer had four different bed preparations as following[2] :

1. conventional rolled clay bed
2. polythene sheet placed on the conventional rolled clay bed
3. bed lined with brick (brick soling), and
4. brick with polythene lined bed

The seawater (2.0 to 3.5 °Be in December and mid may respectively) was first pumped to the 1st bed (10 ft x 68 ft), and when the brine concentration rose to 4° Be, it was transferred to the second bed (10ft x 63 ft). The transfer from the 2nd bed took place when the concentration reached 7 °Be. When the concentration in the 3rd bed rose to 10 °Be, it was transferred to the 4th bed where the concentration would reach 17 °Be. Thereafter it was transferred to the 5th Bed (semi-crystallizer) where it would reach concentration 22 °Be in 24 hours. Then the brine solution was brought to the 6th bed (crystallizer) through a filter. The salt crystals started to form in this bed. When the brine concentration reached 29 °Be, the salt was collected manually and separated from brine by bamboo basket. The crystallization process was completed in 8-9 hours (change of °Be from 25 to 29).

Results and Discussion

Total production period for this study was 110 - 111 days. Table 1 shows the production of each of the four

beds along with some cost data. The use of polythene sheet in the final crystallization bed yielded about 30% more salt compared to conventional mud bed (505 kg against 388 kg). The color of the salt was snow white. In view of the additional cost and lower yield of salt in brick lined bed compared to polythene lined bad, the brick lined bed does not look promising.

A systematic field trials for salt production in the conventional mud bed and Polythene (PE) lined crystallization bed were carried out in 2003-2004 season. Results for raw salt analysis with moisture for several fields containing different clusters of production are presented in Table 2. In PE lined bed NaCl content increased by 6.8% while the insolubles decreased by 5.9%. Average moisture content in both conventional mud bed and PE lined bed is about 14% wt. The crude salt produced in the conventional mud bed contained on the average 77% wt NaCl while the range of NaCl content was 70-83% wt for 15 clusters[3]. The SSP India[4] reported the following analysis (wt % basis) of Chittagong crude salt with moisture, produced in the conventional mud bed:

NaCl	75-77%
Insolubles	10-12%
Moisture	10-11%

There is a striking similarity between the average NaCl content in the present study with conventional mud bed and the SSP reported value (77% against 75-77%).

Table 3 shows the crude salt analysis on dry basis calculated based on data in Table 2. NaCl content in the conventional mud bed and PE lined bed are about 90% and 97% respectively. This improvement in the salt quality in the PE lined bed is due to avoiding contact with the mud bed, especially in the last bed called crystallization bed.

Further the quality of crude salt produced in the PE lined bed was slightly poorer in quality compared to a typical refined table salt using semi-automatic mechanical washing, Table 4.

Conclusion

This study shows that the polythene lined bed crystallization step if used by the salt farmers will benefit the farmers through increased yield and improved quality of salt.

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References:

1. Barnes and Noble, "Sodium Chloride", in Chemical Technology: An Encyclopedic Treatment, Vol.1 p.413. (1968),
2. Report on Field Trials, Salt Project, BSCIC, Cox's Bazar (2000)
3. Report on Salt Composition Analysis, Salt Project, BSCIC, Cox's Bazar, 22 August, 2004.
4. "Analysis of Raw Salt from Chittagong", SSP Limited, India.

Table 1: Production Data of Four Beds[2]

Bed	Total production time (days)	Additional cost of the 6th Bed	Total salt production (kg)
Conventional mud bed	111	-	388
Polythene lined bed	110	Tk. 120/-	505
Brick lined bed	111	Tk. 1500/-	337
Brick with Polythene	111	Tk. 1620/-	465

Table 2: Crude salt analysis with moisture (% wt)[3]

Bed	Insolubles	Ca	Mg	NaCl	Moisture	Total	Color of salt
Conventional mud bed	7.47	0.33	0.82	77.03	14.35	100.00	blackish
Polythene lined bed	1.56	0.22	0.63	83.83	13.76	100.00	snow white
Difference	5.91			6.80			

Blackish salt: No. of fields = 9, No. of clusters =15
Snow white salt: No. of fields = 6, No. of clusters = 9
Period: March – April, 2004

Table 3: Crude salt analysis on dry basis (% wt)

Bed	Insolubles	Ca	Mg	NaCl	Total	Color of salt
Conventional mud bed	8.72	0.39	0.96	89.93	100.0	blackish
Polythene lined bed	1.81	0.26	0.73	97.20	100.0	snow white

Table 4: Comparison of polythene lined bed crude salt with a typical locally refined salt analysis on dry basis[3]

	Insolubles	Ca	Mg	NaCl	Total
Polythene lined bed	1.81	0.26	0.73	97.2	100.0
Locally refined salt*	1.11	0.23	0.26	98.4	100.0

* Moisture content 7% wt., Bangladesh standard: 6% moisture (max)