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Wind Energy Factor in Salt Crystallization in Thoothukudi Saltpans

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Abstract

From time immemorial, Thoothukudi (Tamil Nadu) is known for pearl and *sangu* diving and salt. Thoothukudi climate with long spells of dry and hot weather conditions promotes salt manufacturing. Thoothukudi salt producers observed the important role played by wind in salt crystallization. There is a clear dependency of salt production with wind parameters, viz., velocity and direction. Wind helps blow out water vapour rising from salt pans due to solar radiation. It reduces vapour saturation and humidity levels, allowing consistent evaporation. Salt manufacturing is being carried out from the January to last week of September every year. The process comes to end, on setting of northeast monsoon. The peak period of salt production is during June to August every year. It matches with the period of high winds. Monsoonal reflections are discernible in the salt production statistics. Wind speed maxima are 55.61 m/ s and 42.12 m/ s during northeast monsoon and southwest monsoon respectively. With statistical evidences, the authors attempt to justify the role of wind parameters in salt production.

Keywords: Renewable energy, Wind energy, Saltern, Thoothukudi salt pans

Introduction

The word ‘salt’ generally refers to ‘common salt’ or Sodium Chloride [NaCl]. Sodium (Na) is a highly unstable metal that can burst into flame and chlorine (Cl) is a poisonous gas. But the two combine to give sodium chloride or salt that is physiologically absolutely necessary for human life. Chemically, it is 60.66 percent chlorine and 39.34 percent sodium. Production of salt from the seawater or sea brine, as is commonly referred to in the salt production terminologies, is the dominant method of salt production in India. Almost every element is found in traces in sea water. Out of the various elements present, chlorine, sodium, magnesium, sulphur, calcium, potassium and bromine are present in higher percentage.

Common salt is widely distributed on the earth. In India, the entire production of about seven million tons of salt excepting a negligible quantity of rock salt is obtained by solar evaporation. Almost 71% of the earth surface is covered with sea water and it contains 2.5% of common salt. The technology of salt manufacture depends largely on evaporation, solubility and crystallization. Saline or seawater is evaporated in a large low area for the thin crust of salt to be scraped by a salt. The word largest salt pan is Lake Eyre in South Australia. It is 8430 km squared. There are many places present in Tamil Nadu some of the important places Thoothukudi in India.Thoothukudi (Tamil Nadu) is known for Pearl and *Sangu* diving and salt.Thoothukudi climate with long spells of dry and hot weather conditions which promotes salt manufacturing. Thoothukudi salt producers, observed the important role played by wind in salt crystallization. Wind is the natural movement of air across the land or sea. Wind is caused by uneven heating and cooling of the earth's surface and by the earth's rotation. Land and water areas absorb and release different amount of heat received from the sun. As warm air rises, cooler air rushes in to take its place, causing local winds. The rotation of the earth changes the direction of the flow of air.

Methodology

Study area in Thoothukudi

The Thoothukudi District is located on the extreme southern parts of Tamil Nadu. It has got a coast of 121 km long. It lies between 8° 48′ 36″ N, 78° 8′ 24″ E. Thoothukudi is also called as “Sea Gateway of Tamil Nadu’’ Thoothukudi is located in south India, in the Gulf of Mannar, about 540 km south of Chennai and 125 km north of Kanniyakumari. Thoothukudi is part of the pearl fishery coast and is known for its pearl fishing (in the past) and salt production. Salt pans in and around the city contribute majorly to the economy of the city. The saltpans produce 1.2 million tonnes of salt every year, contributing to 90% of the salt produced in the state and 50% needed by the chemical industries of the state (Fig. 1).

Salt crystallization:

Thoothukudi climate with long spells of dry and hot weather conditions promotes salt manufacturing. Thoothukudi salt producers observed the important role played by wind in salt crystallization. Salt crystallizations the natural process of formation of solid crystals precipitating from a solution, melt or more rarely deposited directly from a gas by wind action.

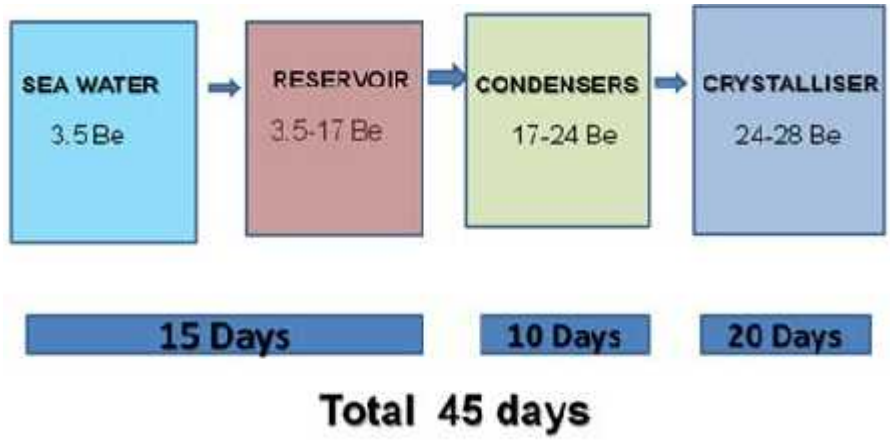

Fig. 2 Number of days by which salt is harvested with intermediate stages
Courtesy: M/s Palanithai Salt Works, Thoothukudi.

Crystallization process has mainly two types, viz., 1. Cooling crystallization and 2. Evaporative crystallization Main factors of crystallization process are Concentration and Temperature.

Reservoirs starting from left hand side. Crystallizers appear as white ponds and condensers are present just above the crystallizer salt heaping area appear as large white patches in the middle.

Baume density

The bore well subsurface brine showed a baume density of 8.2°Be. The average baume density in the pond 1 to 4 remained below 10°Be, which raised to 12°Be between 5^{th} and 8^{th} pond. In the first condenser the maximum baume observed was around 14°Be, while the average baume remained around 13°Be. In the second condenser the maximum baume observed was around 15°Be, while the average baume remained around 14°Be,in each condenser a raise of atleast 1°Be was observed. But in 4^{th} to 5^{th} condenser it was 2°Be (16-18°Be). The difference between 5^{th} and 6^{th} condenser was 3°Be (18- 21°Be).

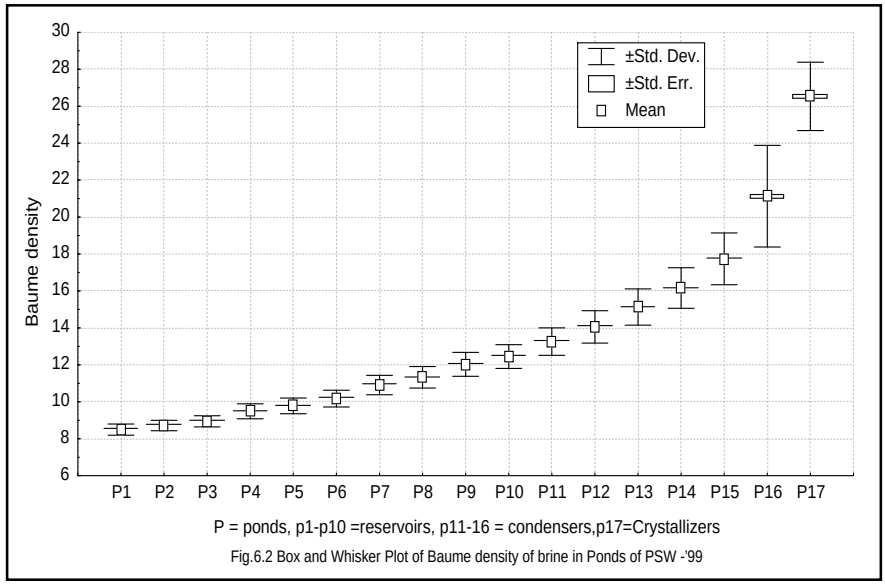

Fig. 3. Trend of Baume density of brine across different purpose oriented pans

Salt production:

Another important feature of salt production by the small producers is that they justproduce the basic edible salt. They are constrained by their scale of operation and the emphasise is on volumes.Consequently, substantial quantity of their production is of lower quality. This lower quality salt is identified as `light weight salt'. Light weight salt is scrapped once in five days whereas table salt requires nearly fifteen days for crystallization. On an average 157.5 tonnes of salt / acre/ year is being produced from Palanithai salt works. (3.06 tonnes of salt /crystallizer/day)The salt production was ,June-99(11th cycle) > 3.75 tonnes July-99 (16th cycle)- 4.96 tonnes ,August-99 (17th cycle)- 4.64 tonnesSeptember-99 (20th cycle)- 4.875tonnes **,**(25% and 50% more than normal yield due to constant blowing of dry and hot air across the arid region from south west monsoon over the crystallizers).

Effect of External factors on salt production:

The maximum light intensity remained above 126300 units from the month of May-99 (8^{th} cycle) onwards and a maximum 143200 lux was recorded during the month of June-99 (11^{th} cycle). The maximum wind velocity touched above 40 Km h^{-1} from April-99 (6th cycle) onwards and reached the maximum of 70 $Km.h^{-1}$ during July – August (16th and 17th cycles respectively). There is a clear

dependency of salt production with wind parameters, viz., velocity and direction. Wind helps blow out water vapour rising from salt pans due to solar radiation. Itreduces vapour saturation and humidity levels, allowing consistent evaporation. High wind velocity combined with high light intensity increases crystallization in the saltern, which is evident from the fact that maximum production of salt synchronizing with south west monsoon. This is also supported by the factor analysis using Unweighted Least Squares procedure in SPSS 7.5 software. The external factors such as light intensity, wind velocity, relative humidity external temperature measured during the study period were taken in to consideration, indicated that wind as the prime factor followed by the light.

Salt deposition in windward direction:

One can see more deposition of salt on the left hand side southwest corner than on right hand side (Fig. 4). Wind blowing direction indicated by the arrow mark northeast to south west. Wind speed maxima are 55.61 m/ s and 42.12 m/ s during northeast monsoon and southwest monsoon respectively. With statistical evidences, the authors attempt to justify the role of wind parameters in salt production.

Conclusion

Salt manufacturing is being carried out from January to last week of September every year. The process comes to end, on setting of northeast monsoon. Though maximum wind velocity observed during NE monsoon other conditions are not favourable for salt production. The peak period of salt production is during June to August every year due to dry and hot wind blowing during the SW monsoon. It matches with the period of high and dry winds. Monsoonal reflections are discernible in the salt production statistics.

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