Commun. Fac, Sci. Univ. Ank. Serie B
V. 34. pp. 129-134 (1988)

THE CALCULATION OF THE ÇAMALTI SALT POND MATERIAL BALANCES

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ABSTRACT

The material balance is calculated for the Çama tı salt pond. The ratio y (bittern) to s (salt) is found different from what is reported. If the data were accurate, these ratios would be equal. This indicates that a program should be set up to obtain reliable meteolorogical data.

INTRODUCTION

Until now, the mother liquor volume of Çamaltı Saltworks is not known exactly. Çamaltı is presently reported to produce 450.000 tons of salt per year and 800 000 cubicmeter or 1 008 000 tons of bittern. The ratio y (bittern) to s (salt) is 1 008 000 / 450 000 = 2.24. The production of salts is directly related to evaporation rate and brine temperature. For this reason, care should be used in setting up the station and in measuring weather parameters. But there is no sufficient data about the meteorological parameters. The purpose of this study was to control the data by calculation of the Çamaltı salt pond material balances.

SOLAR POND STREAMS AT STEADY STATE

Figure 1 shows the basic streams of a solar pond (Butts, 1986). Feed Brine - This includes all brine, salt, water, plant recycle or any other flow introduced to the solar pond.

Evaporation - This is the water leaving the pond in vapor form from the surface of the brine to the atmosphere. It also includes precipitation (negative evaporation).

ISSN 0570-1414 A. Üniv. Basımevi

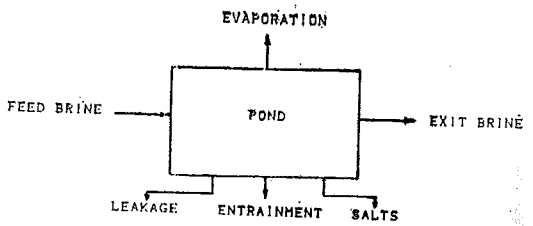


Figure 1. The basic streams of a solar pond.

Exit Brine - This includes all brine being discharged from the pond except for leakage and entrainment.

Salt - This is the solid phase mineral cyrstalizing from the pond brine. Any water of hydration is considered as part of the salt in material balance calculations.

Entrainment - This is the brine that exists between salt crystals themselves. The concentration of entrained brine is always assumed to be the concentration of the exit brine in steady state operation.

Leakage - This is the brine that seeps into the pond floors and is lost. The concentration of this brine is the same concentration as the entrainment and exit brine.

Feed Brine=Evaporation+Exit Brine+Salt+Entrainment+Leakage

To addition of these, several items must be known. Because of their importace they will be listed here.

Concetration Profile -Figure 2 shows an example of a concentration profile (Özbay, 1976). Profiles at constant temperature are not good enough because the effect of diurnal temperature swings are not included in the plots. Actual data taken from the solar ponds themselves, are best. Usually tree plots will provide the needed information. One plot for winter, one plot for spring and fall, and the third plot for summer. The temperatures of spring and fall are generally the same, and therefore one plot will do for both seasons. If not, then each must be described separately.

Evaporation Plot-An evaporation plot is essential to properly manage a pond system. It is also needed to study by-products, design solar production systems, control brine flows, and estimate past and future production volumes. Figure 3 is an exemple of a net yearly rate used to

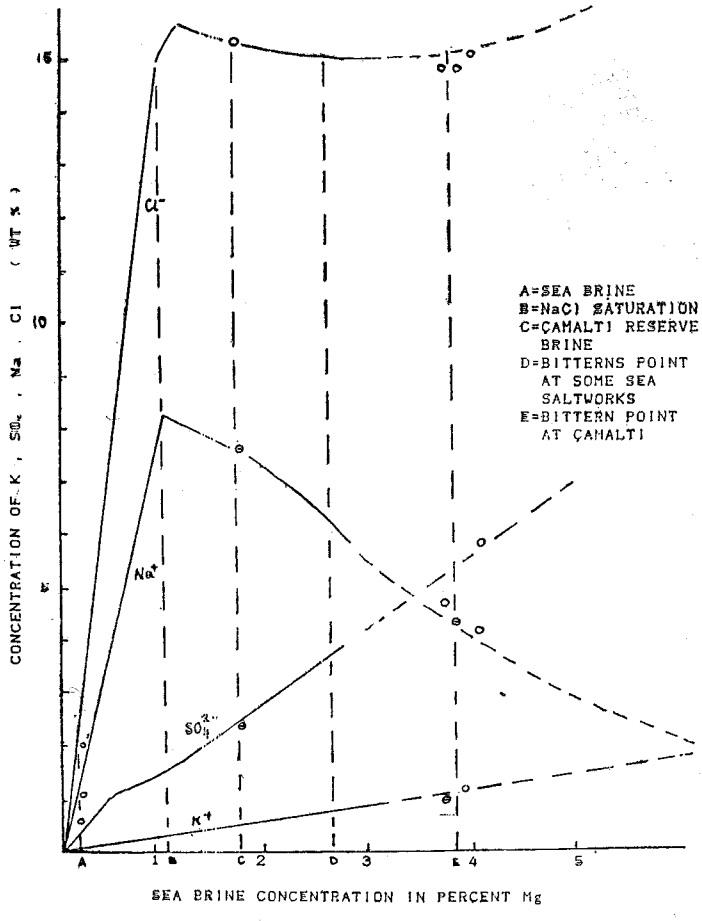


Figure 2 .Estimate of Çamaltı brine concetration path up to 6 percent Magnesium.

illustrate material balances in this study. Yearly rates are not very benefical when it comes to detailed design.

THE CALCULATION OF MATERIAL BALANCES

For the basic Çamaltı salt pond material balances, two points will be chosen. These are crystallizer feed brine (reserve brine), and bittern, Table 1 (Tekel, 1984).

Figure 4 shows the balance. It may not represent a true and accurate representation of Çamaltı because actual month by month evaporati-

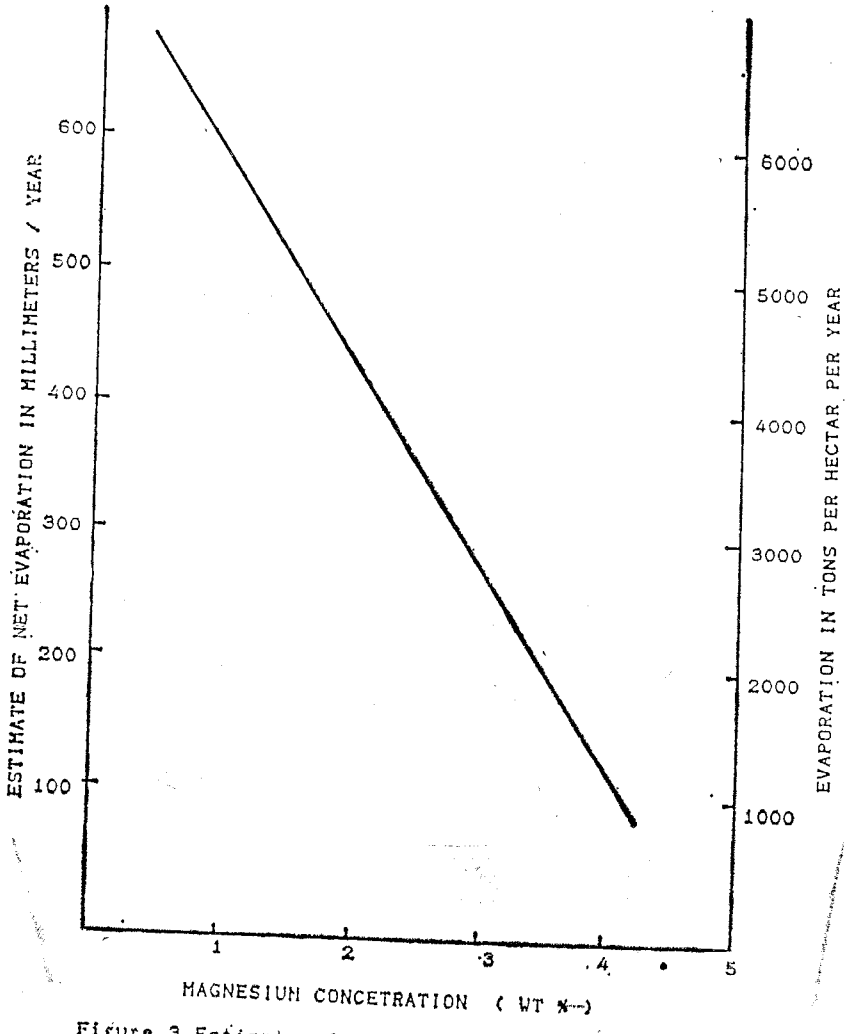
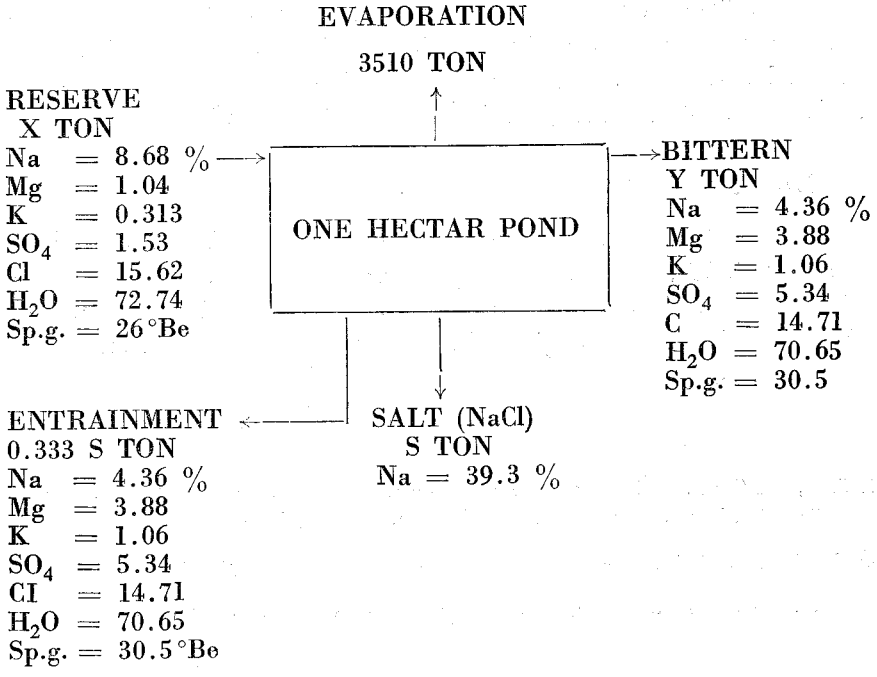


Figure 3. Estimate of brine evaporation rates at Çamalti Saltworks.

Table 1. The composition of two pointschosen.

Constituent	Reserve Brine	Bitterns
Na	8.58	4.36
Mg	1.04	3.88
K	0.313	1.06
SO_4	1.53	5.34
Cl	15.62	14.71
H_2O	72.74	70.65



$$
\begin{aligned}
\text{MASS} \quad & X = 3510 + Y + S + 0.333\,S \\
\text{Na} \quad 0.0868\,X &= 0 + 0.0436\,Y + 0.393\,S + 0.333\,S\ (0.0436) \\
H_2O \quad 0.7274\,X &= 3510 + 0.7065\,Y + 0 + 0.333\,S\ (0.7065) \\
X - Y - 1.333\,S &= 3510 \\
0.0868\,X - 0.0436\,Y - 0.4075\,S &= 0 \\
0.7274\,X - 0.7065\,Y - 0.2353\,S &= 3510 \\
X &= 6704 \text{ TON RESERVE} \\
Y &= 1521 \text{ TON BITTERN} \\
S &= 1262 \text{ TON SALT} \\
Y/S &= 1512 \,/\, 1262 = 1.20
\end{aligned}
$$

Figure 4. Çamaltı crystallizer material balance.

on rates are not known. Neither is monthly nor seasonal brine chemistry known. For each ton of salt produced. 1.20 ton of 30 Be bittern are produced. This calculated from Figure 4 by dividing the total tons of bittern produced (y), by total salts deposited (s), 1512 / 1262 = 1.20.

Since Çamaltı is presently reported to produce 450 000 tons salt per year, then 450 000 × 1.20 or 540 000 tons of bittern should be available. The volume of 540.000 tons of bittern is 430 000 cubic meter. The value is different from it reported.

DISCUSSION

As can be seen in Figure 4, the ratio y to s is different from it reported, If the evaporation plot shown is accurated, these ratios will be equal. This indicates that a program should be set up to obtain reliable meteorological data to make better evaluatinon of the saltwork.

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