

Letters to the Editor

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SEA SURFACE WATER TEMPERATURE AND SPECIFIC GRAVITY AT MADRAS

1. Sea surface water temperature and specific gravity at Madras have not so far been published. With a view to give an idea of these values for the use of the oceanographer and the meteorologist, means based on the eight years' (1952 to 1959) data of Madras have been compiled and presented here.

2. Sea water temperature and specific gravity are recorded at Madras harbour (Latitude $13^{\circ} 04' N$, Longitude $80^{\circ} 15' E$) by the marine surveyor attached to the engineering department of the Madras Port Trust. Everyday, at about 8 A.M., an ordinary brass bucket is lowered into the water and kept under it for about 15 minutes to enable the bucket to attain the temperature of the water, after which they are lifted up. And immediately thereafter, the temperature of the water in the bucket is recorded with a thermometer in degrees Fahrenheit and the specific gravity with the hydrometer (which reads grams per litre). From the daily values for eight years 1952 to 1959, monthly means were worked out.

3. In Table 1 are reproduced monthly mean surface water temperature and specific gravity at Madras at 08 IST.

It is seen from this table that sea surface water temperature gradually increases from January till May, the range diminishing with the progress of the season and then decreases to a small extent till August and therefrom increases till October and then falls steadily till December. May and October are the hottest months, so far as sea surface water at Madras is concerned, with a temperature of $85^{\circ}F$ ($29^{\circ}C$) and December

and January, the coldest months with a temperature of $80^{\circ}F$ ($27^{\circ}C$), the mean annual range working out to $5^{\circ}F$ ($3^{\circ}C$). The extreme range of temperature (*i.e.*, the difference between the highest and the lowest values) recorded during the period under study was $11.5^{\circ}F$ ($6.4^{\circ}C$).

Sea surface water specific gravity rises from December to March and therefrom is very steady till September and falls steeply in October and November. November records the lowest specific gravity of the order of 1.015 and the months of March to September the maximum, of the order of 1.022, the range working out to 0.007.

With a view to have an idea of the difference between the temperature of the adjoining surface layers of air and sea, the surface air temperature as recorded during the same period by the Madras (Nungambakkam) observatory which is 5 miles away from the harbour was compared (as an approximation) with the sea surface water temperature. The mean monthly air temperature at 0830 IST together with the monthly rainfall totals as recorded at Madras (Nungambakkam) observatory during the period under study are also included in Table 1.

The surface air temperature and the surface sea temperature at Madras show more or less similar trend, with the usual difference that the surface air temperature has a greater range than the water temperature. The sea surface water temperature, during the months of January to March is higher than surface air temperature. With the advent of summer (April), the air temperature is higher than the water temperature and continues so till the month of July after which, generally, the water temperature is higher than the air temperature. That is, except during the months of April-July, the surface

sea water is hotter than the surface air. Salinity of sea surface water varies due to the combined effect of evaporation and rainfall (E-R); heavy rainfall reduces the salinity of surface water and evaporation increases it (Stewart 1945). In October and November, there is appreciable seasonal heavy rainfall with the result, that salinity (and specific gravity) falls appreciably. The decrease of sea water temperature from October to November should have resulted in an increase of specific gravity but for the preponderating influence of rainfall.

In the month of December, though there is certain amount of rainfall, probably the evaporation is more and as such there is increase in salinity (and specific gravity). This trend continues in the months of January, February and March. Evaporation to a very great extent depends upon the difference between the air and the sea surface temperature and relative humidity just above the sea. Unfortunately this information is not available and the Nungambakkam observatory values may not be considered as representative of sea conditions for this purpose. As such, an idea of the exact explanation for the increase can be had only with the availability at some future date of the actual observational data just above the sea surface. The rise in the specific gravity can also be related to change in the circulation both of the atmosphere and the sea particularly keeping in view of the gradient of sea surface salinity off and near Madras during this period.

From April to September, the specific gravity of the sea surface water at Madras is exceptionally steady. This may perhaps be due to the combined effect of evaporation and rainfall during the period.

However, fall in the salinity due to the rainfall during the months of July, August and September appears to be nullified due to up-welling caused by divergence of surface current off Coromandel coast (India met. Dep., 1942) bringing to the surface, the sub-surface more saline water.

TABLE 1

	Madras harbour Mean surface sea water		Madras, Nungam- bakkam	
	Temp. (°F)	(Sp. gr.)	Mean air temp. (°F)	Mean monthly rainfall totals (inches)
	(0800 IST)		(0830 IST)	
Jan	79.9	1.0197	76.3	1.95
Feb	81.6	1.0212	77.3	0.44
Mar	83.3	1.0221	81.1	0
Apr	84.1	1.0222	85.7	0.55
May	84.8	1.0221	87.4	3.79
Jun	83.6	1.0222	87.2	1.52
Jul	83.2	1.0223	83.7	4.02
Aug	83.1	1.0221	82.5	4.58
Sep	83.7	1.0218	83.3	3.58
Oct	84.8	1.0178	81.3	12.11
Nov	82.4	1.0154	79.0	8.78
Dec	79.7	1.0170	76.6	4.88

4. The main results emerging from these studies on the surface water temperature and specific gravity at Madras are—

(1) Except during April-July, the sea surface water temperature is higher than the surface air temperature.

(2) The specific gravity of sea surface water at Madras is exceptionally steady from April to September, falls appreciably in October and November, but rises gradually in December, January, February and March.

(3) Northeast Monsoon rainfall in October and November results in an appreciable fall of specific gravity during these months.

(4) During the months of December to March, probably due to increased evaporation and change in the circulation both of the atmosphere and the sea there is a gradual increase of specific gravity of the sea surface water at Madras.

(5) During the months of April to September, the specific gravity is exceptionally steady probably due to the combined effect of evaporation, rainfall and up-welling.

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REFERENCES

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