HYDROLOGICAL CHARACTERISTICS OF THE VISAKHAPATNAM HARBOUR

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Studies on the distribution of temperature and salinity in the Visakhapatnam harbour during the months of November–December 1966 and June–July 1967, showed marked seasonal variations. In winter both the temperature and salinity values are low throughout the depth column, while in late summer there is a significant increase in their values. The effect of tide and rainfall on the hydrological parameters has been discussed.

In the field of harbour defence systems, harbour navigation and construction of wharfs, studies on temperature, salinity, currents and other oceanographic parameters are essential. Very few data are available in respect of the harbours in our country. Varadachari[1] has discussed the near shore characteristics of the Visakhapatnam area. In the present paper an attempt has been made to study the distribution of temperature and salinity in the Visakhapatnam harbour during November–December and June–July. The effect of tide and rainfall on these parameters has been discussed.

COLLECTION OF DATA AND LIMITATIONS

The area under study together with the location of station positions is given in Fig. 1. The temperature and salinity data were collected at different depths for every three days at a specific time around 10 a.m. at station E during November–December 1966, and at stations E and C during June–July 1967. The rainfall during the period of observations, if any, is noted.

The tide position at the time of observations is noted from the Tide Tables, and the discussions are limited to the observations taken in the above manner.

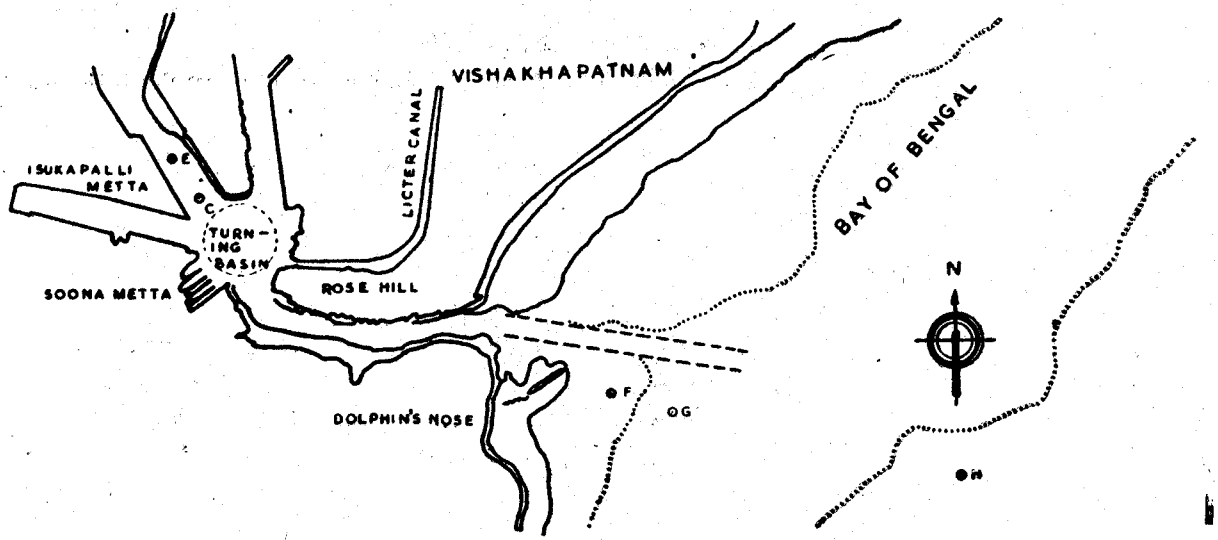

Fig. 1—Hydrological studies at Visakhapatnam.

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RESULTS

Temperature Distribution

November–December 1966 : In the whole depth column at station E, the temperature varies between 23·9° and 27·9°C (Fig. 2). The details of the temperature ranges at different depths are given in Table 1.

Almost throughout the period of observations the temperatures are low. During most of the days of the first half of December, the bottom temperatures are higher than the surface temperatures.

Rains, during this period, do not appear to have much effect on the surface temperatures. The tide data at the time of observations[2] shows that the temperature increases with flood tide and decreases with ebb tide at all depths.

June–July 1967 : At station E, the temperature varies from 26·6° to 30·6°C right from the surface through the bottom (Fig. 3). Intermittent rains during this period reduce the surface temperatures slightly. From the tidal positions at the time of observations[3], it is noticed that in general the temperature increases with high tide and decreases with low tide.

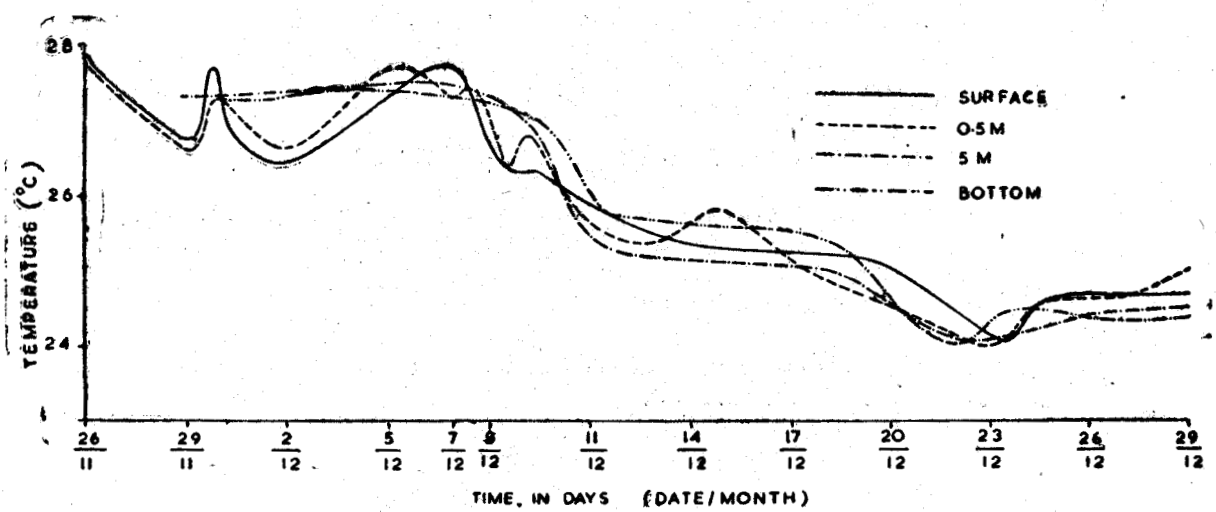

Fig. 2—Temperature variations at station E for the Visakhapatnam harbour during November–December 1966.

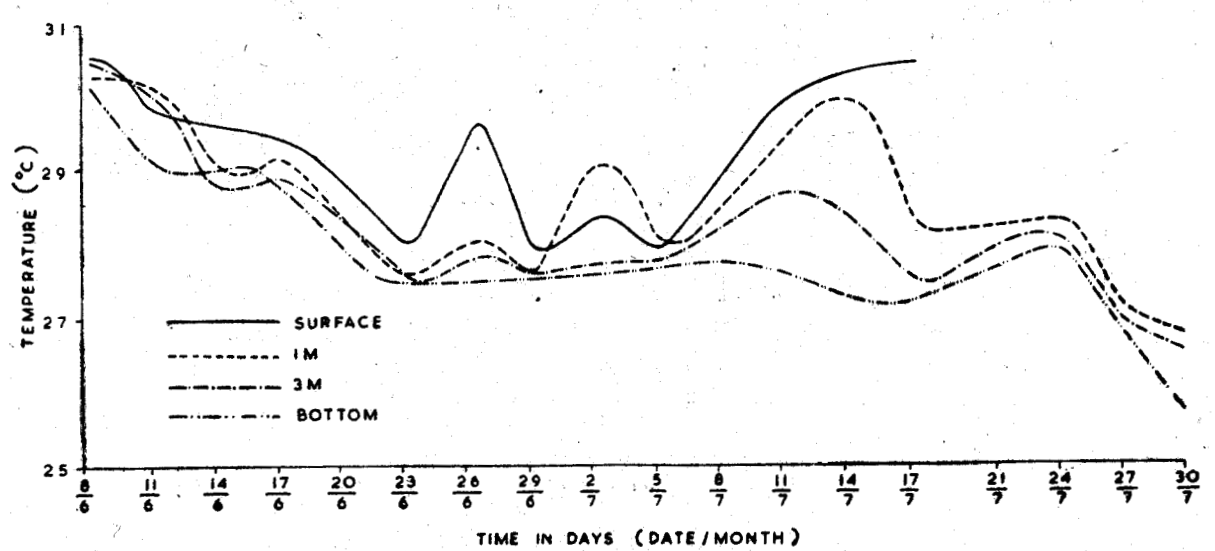

Fig. 3—Temperature variations at station E for the Visakhapatnam harbour during June–July 1967.

TABLE 1

TEMPERATURE AND SALINITY RANGES AT STATIONS E AND C

Station	Period	Depth (M)	Temperature range (°C)	Salinity range (°/oo)
E	Nov–Dec 66	Surface	23·9–27·9	23·2–27·4
		0·5	23·9–27·7	—
		5	24·0–27·4	—
		Bottom	24·3–27·3	24·8–28·4
E	June–July 67	Surface	27·4–30·6	25·3–35·9
		1	27·8–30·3	30·8–35·2
		3	27·6–30·4	30·4–35·2
		Bottom	26·6–30·1	29·8–36·3
C	June–July 67	Surface	27·4–30·7	25·8–35·8
		1	26·8–30·6	32·9–35·8
		5	26·0–30·5	34·0–35·4
		Bottom	25·3–30·3	34·2–35·2

Similar features as observed at station E have been encountered at station C which is situated at the mouth of the North-West channel of the harbour (Fig. 4).

Salinity Distribution

November–December 1966: Low salinities have been found at station E, and the salinity at the surface and bottom varies between 23·2 °/oo and 28·4 °/oo (Fig. 5). The salinity ranges at different depths for stations E and C are also given in Table 1. On comparison of the salinity data with the tide positions, it is found that in general the salinity increases during flood tide and decreases during ebb tide.

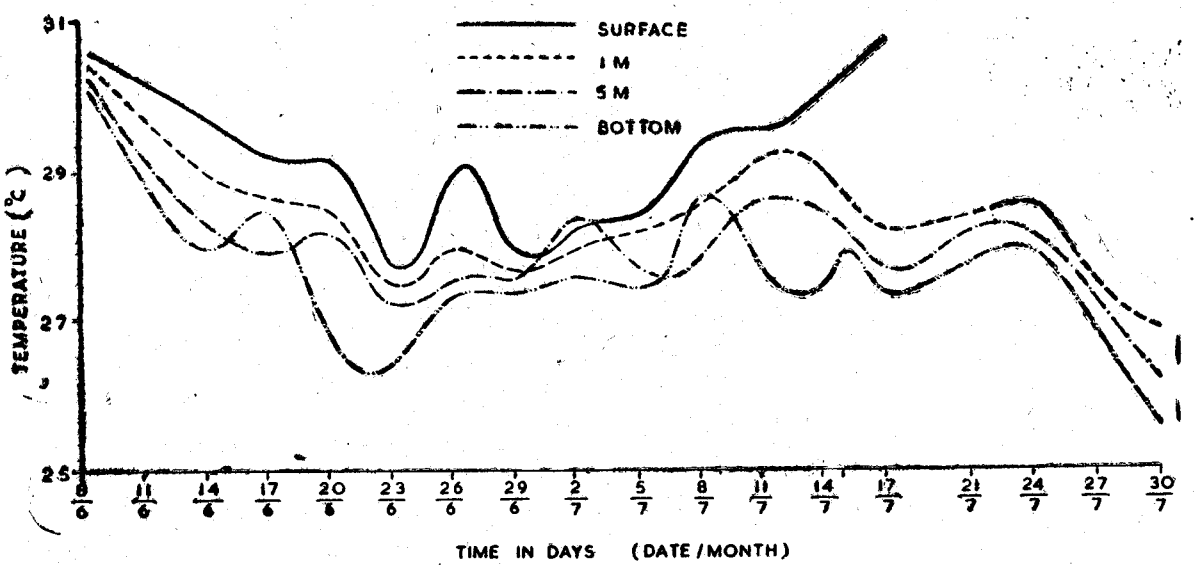

Fig. 4—Temperature variations at station C for the Visakhapatnam harbour during June–July 1967.

June-July 1967 : The salinity distribution throughout the depth column at station E shows a marked increase in their values and ranges from 25·3 °/₀₀ to 36·3 °/₀₀ (Fig. 6). The salinity increases towards the bottom during most of the observed days.

Intermittent rains during this season reduce the surface salinities slightly, but around middle of July heavy rainfall lowers the surface salinities considerably. The salinity increases during flood tide and decreases during ebb tide.

The salinity distribution at station C is almost similar to that of station E (Fig. 7). Station C is at the entrance of the North-West channel and also nearer to the turning basin where as station E is situated a little interior of the North-West channel.

DISCUSSION

Low temperatures throughout the depth column during November-December are thought to be due to the winter conditions prevailing generally over this region. Relatively high temperatures towards the

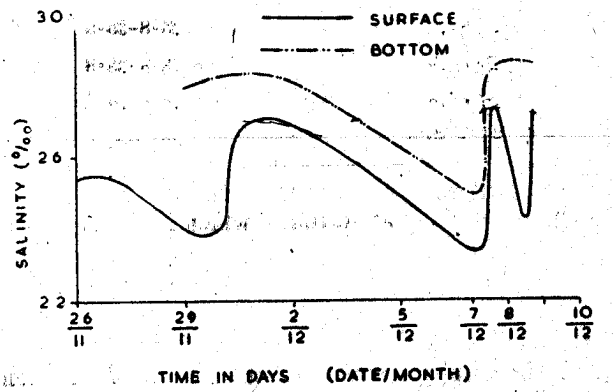

Fig. 5—Salinity variations at station E for the Visakhapatnam harbour during November–December 1966.

TABLE 2

RAINFALL AT VISAKHAPATNAM

Date	*Rainfall at 0830 hrs IST (in tenths of mm)
10-7-67	000
11-7-67	000
12-7-67	000
13-7-67	008
14-7-67	000
15-7-67	518
16-7-67	186
17-7-67	006

*Rainfall at 0830 hrs IST is rainfall since 0830 hrs IST of the previous day.

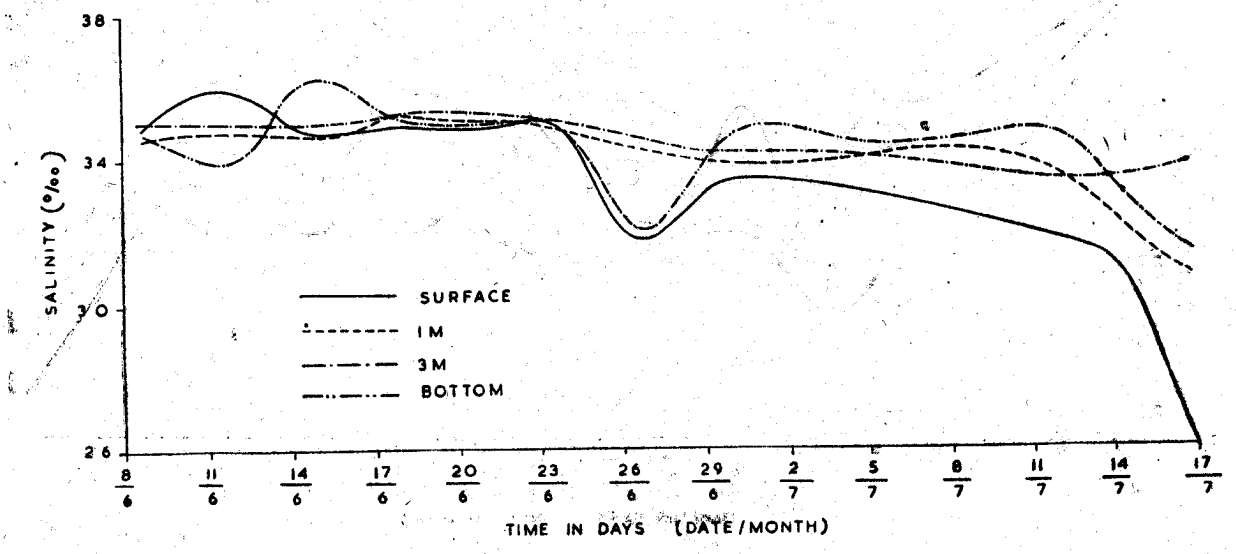

Fig. 6—Salinity variations at station E for the Visakhapatnam harbour during June–July 1967.

bottom may be attributed to the surface cooling and evaporation, and tidal effect on the harbour waters. Deviations to this may be due to the presence of relatively clear skies[4] and this is particularly more effective in shallow waters.

During June–July, there is a significant increase in temperature values at all depths. The higher temperatures are mainly due to the heating of the atmosphere and sea surface during summer and partly due to the tidal effect. Intermittent rains during this season reduce the surface temperatures slightly. The rain and the associated cloud conditions might be responsible for lowering the surface temperatures[5] on some days.

In general, low temperatures and positive gradients during November–December and high temperatures and negative gradients during June–July are comparable with the observations of Varadachari[1].

Low salinities during November–December are the result of the dilution of the Bay of Bengal waters by the river discharges in the northern portion. These diluted waters are brought into the Visakhapatnam region by the prevailing current system probably this effect masks the increase of salinity by evaporation. In addition to this, rainfall during this season contributes to the low saline waters.

High saline waters during late summer are considered to be due to the influence of the Southern Bay of Bengal waters which are brought into the northern parts by the existing circulation pattern. The effect of rainfall on the salinity of the waters is overshadowed by the influx of considerably high saline Southern Bay water. Also very low discharges from the rivers in the south do not have any effect in reducing the salinity.

Although a few exceptions have been noticed, in general, during both winter and summer, the temperature and salinity values at all depths increase with flood tide and decrease with ebb tide. The fluctuations of temperature and salinity with tide are due to the inflow of relatively high temperature and high saline waters into the harbour during flood tide and the recession of the waters during ebb tide. The increase of temperature towards the bottom during winter, as observed on some days, is thought to be mainly due to the influx of relatively high temperature waters into the harbour through the bottom layers during flood tide. The higher temperatures at the bottom, during most of the days of the first half of December, may be due to the initiation of the flood tide before the complete recession of the bottom waters.

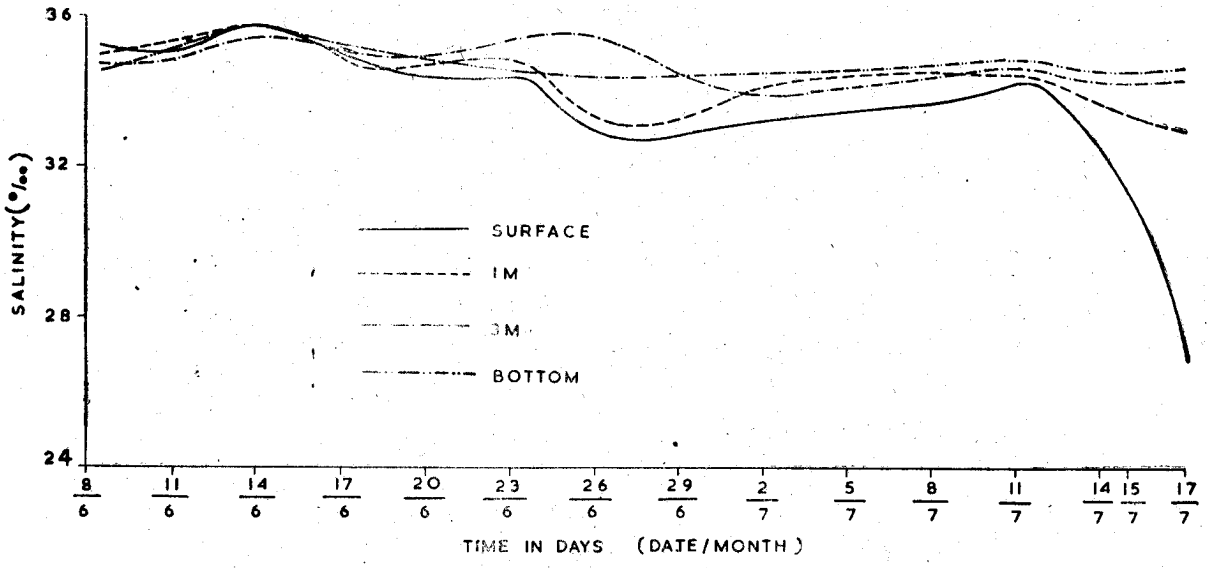

Fig. 7—Salinity variations at station C for the Visakhapatnam harbour during June–July 1967.

On comparison of the bottom temperature and salinity values at stations C and E during June–July, relatively low temperatures and high salinities have been found at station C. This may be attributed to the bottom slope. From the soundings it has been observed that station C is deeper by about three metres than station E. Low surface salinities of the order of 25·5 $^{\circ}/_{\circ\circ}$ have been observed at stations C and E during the middle of July. This is mainly due to the heavy rainfall during this period (Table 2).

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5. "Indian Daily Weather Report", (India Meteorological Department), 1967.