RJC
http://www.rasayanjournal.com

RASĀYAN ***J. Chem.***
Vol.2, No.4 (2009), 912-919
ISSN: 0974-1496
CODEN: RJCABP

IMPACT OF INDUSTRIAL POLLUTION ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF SEA WATER IN THOOTHUKUDI COASTAL AREA

C. Puthiya Sekar[1] , S. Poongothai[2] and M.A. Neelakantan[3*]

[1]Department of Civil Engineering, National Engineering College, K.R.Nagar, Kovilpatti-628 503, Thoothukudi District, Tamilnadu, India

[2]Department of Civil Engineering, Annamalai University, Annamalai Nagar, Chidambaram-608 002, India

[3]Department of Chemistry, National Engineering College, K.R.Nagar, Kovilpatti-628 503, Thoothukudi district, Tamilnadu, India

Email: maneels@rediffmail.com

ABSTRACT

Seawater samples were collected from four different sampling points in Thoothukudi coastal to study the physico-chemical characteristics. The physical and chemical parameters such as temperature, pH, salinity, nitrite, ammonia, silicates, dissolved oxygen and inorganic phosphate were studied using various analytical techniques. The studies reveal that the physical and chemical composition of all the samples collected from the sites mainly depends on seasonal variations and discharge from domestic and industries.

Keywords: Physico – chemical parameters, temperature, salinity, pH, dissolved oxygen

INTRODUCTION

Water is the most important chemical compound for the perpetuation of life on this planet. Water covers about 3/4th of the earth's surface, but only 3% of it is available for human use. Owing to the rapid industrialization on one side and exploding population on the other, seawater gets polluted. Seawater pollutant is a chemical substance present in it at the excessive levels capable of causing harm to living organisms. During the last few decades, several studies were carried out on the hydrology and biology of the coastal waters of Thoothukudi. Chacko et al. (1957) investigated the hydrographical parameters in relation to fisheries in Gulf of Manner[1]. Freda et al. (1968) had undertaken the study on hydrography and planktonology of pearl banks[2]. Marichamy et al. (1990) studied the hydro biological investigations with special reference to plankton production during the period of 1976-1985 in the inshore waters of Thoothukudi [3]. Ganesan et al (1995) elaborated the iron and manganese concentrations in seawater, sediment and marine algae of this coast[4].

The polluted seawater affects the ecological system. Though there are some reports available on hydrology and biology for the Thoothukudi coast, little attention has been paid to the status of physico-chemical characteristics in the coastal waters of Thoothukudi. The present study covers details of impact of domestic sewage and industrial effluents on the physico-chemical characteristics of the Thoothukudi coastal seawater during July 2006 to July 2008.

Geographical Description

Thoothukudi is an industrial town located between latitude 8˚15' to 9˚0' N and longitudes 77˚50' to78˚15' E in Gulf of Mannar. This coast is sheltered by Sri Lanka. The population of Thoothukudi town is approximately 16 lakhs. A number of major and minor industries are located in and around its coast.

EXPERIMENTAL

Method for sample collection

The sample collection was done as per standard method[5]. The sample container was cleaned by 1.0 mol/L of nitric acid and left it for 2 days followed by thorough rinsing of distilled water. The samples were

collected in clean polythene bottles without any air bubbles. The bottles were rinsed before sampling and tightly sealed after collection and labeled in the field. The temperature was measured in the field itself at the time of sample collection as per standard method[6]. The samples were kept in refrigerator maintained at 4˚C.

The collected samples were analyzed as per standard method. The pH value of the collected samples under investigation[7] was measured using Systronics μpH meter System361. Salinity[8], ammonia-N[9], nitrate-N[10], silicates[11] and inorganic phosphate[12] were analyzed for the above collected samples. Dissolved oxygen (DO) was measured for all the samples using Winkler's method[13]. Rainfall was recorded for every month of the studied years. The sample collection was carried out for the following 4 stations.

Station 1: is situated in the fishing harbour, where the municipal sewage of the town enters the sea. The Madura Coats spinning mill is situated near by the coast. The pollutant load from sewage, industrial effluents and fishing vessels are obviously high in this station.

Station 2: is situated in the back water zone adjacent to the thermal power station. The fly ash is being dumped along the coast. Adjacent salt pans let out their waste water nearby this station.

Station 3: is situated inside the new harbour, which is a major port. The major industries like Southern Petrochemical Industries Corporation (SPIC) and Tuticorin Alkali Chemicals (TAC) are also situated near the coast.

Station 4: is situated 5 km off the major port in the southern direction. This offshore station was selected as the control station in the present study, in order to study the dilution effects and the distribution nature of the pollutants entering along the various parts of the seacoast.

RESULTS AND DISCUSSION

Monthly variations in meteorological and physico-chemical parameters viz. rainfall, air and surface water temperature, salinity, pH, dissolved oxygen, inorganic phosphate, nitrite, silicates and ammonia in water were recorded for a period of two years from July 2006 to July 2008. The physico-chemical parameters analyzed as per standard methods.

Rainfall:

The bulk of rainfall was observed in October-December due to North-east monsoon. The monthly rainfall varied from 0.0 to 463.5mm during 2006-07 and 0.0 to 319.8mm was observed in 2007-08. During the monsoon season, all the stations received bulk rainfall. This brings about important changes in the physical and chemical characteristics of the samples. Figure-1 explained the variation of monthly rainfall in the studied stations.

Temperature

During the study period, water temperature varied from 24.0˚C to 32.3˚C. The minimum temperature was recorded during January 2007 at station 2 and maximum during May 2008 at station 1. In general, all the four stations showed similar temperature variations during seasonal changes (Fig.2). From these observations it could be understood that the surface water temperature is governed by the atmospheric temperature. Similar trend was reported by S.R. Well and R.B. Seymour Se Well for the atmospheric temperature over the Indian seas[14]. A general increase in the water temperature recorded between April to June for the studied years can be attributed to

(1) The general increase in atmospheric temperature

(2) Lack of intensive rain

pH, Salinity and Dissolved Oxygen

The pH value of the water sample in the study area ranged from 7.10 to 8.26. The station 1 recorded minimum pH value during November 2007. The maximum pH value was recorded at station 2 during October 2007 (Fig. 3). Generally, during north-east monsoon the pH value slightly decreased may be due to dilution effect. This may also be demonstrated by the increase in pH value during the summer (April-May). Station 1 receives the domestic sewage showed a drop in pH during monsoon.

Salinity range was varied from 10.20 parts per thousand (ppt) to 39.41 ppt. All the stations showed similar seasonal pattern in salinity distribution and registering low values during monsoon season and high values during the summer season (Fig 4). The station 2 showed a wide fluctuation in salinity. The lower salinity in December could be due to the flow of fresh water from Korampallam storage as it overflowed during rainy season. The higher value recorded in month of May may be attributed to the shallowness and the effluent discharge from the salt pans nearby. The salinity ranges observed in the present study were comparable with those reported earlier for the waters of Thoothukudi.

Dissolved oxygen concentration was varied from <1 ml/L to 4.910 ml/L. The minimum was recorded during November 2007 at station 1 and the maximum was recorded during January 2008 at station 3 (Fig 5). The minimum value observed in station 1 may be due to the discharge of untreated sewage entering this zone causes eutrophication and other deleterious effects. The levels of DO recorded in the present study were compared with the work and carried out by Manikandavelu,et al[16] and Santhanam et al.,[17] clearly indicates that the water at station 3 is polluted by the effluent discharge from the surrounding industries.

Nitrite, Silicate, Inorganic phosphate and Ammonia

The nitrite concentration was varied from 0.009 µmol/L to 4.312 µmol/L. Minimum nitrite concentration was recorded during July 2007 at station 3 and the maximum was during May 2007 at station 1 (Fig 6). The source of nitrite in seawater is considered to be ammonia and nitrate. The high nitrite content in station 1 is an index of the balance of active biological oxidation by nitrifying bacteria and phytoplankton. The maximum value recorded in August could be due to the sequential regeneration process, especially the oxidation of ammonia.

The silicates concentration was varied from 1.011 µmol/L to 14.312 µmol/L. Minimum silicate concentration was recorded during February 2008 at station 4 and maximum was recorded during March 2007 at station 2 (Fig 7). During the monsoon, more dissolved silicates in the water are witnessed by its peak values till the post-monsoon period. Its high value in summer may be due to the regeneration by biological activities.

Ammonia concentration was varied from 0.700 µmol/L to 38.409 µmol/L. Minimum ammonia concentration was recorded during October 2006 at station 4 and maximum was recorded during March 2007 at station 1 (Fig 8). The high values of ammonia observed in all the stations except station 4 may be attributed to the raw sewage and effluents entering here. The land runoff plays a major role in the enrichment of ammonia.

The concentration of inorganic phosphate was varied from 0.060 µmol/L to 8.034 µmol/L. Minimum inorganic phosphate concentration was recorded during July 2006 at station 2 and maximum was during October 2006 at station 1 (Fig. 9). The inorganic phosphate registered peak values during the monsoon season. The concentration was decreased during the post monsoon season. High concentration of inorganic phosphate was obtained during monsoon season may be due to the heavy rainfall and input of domestic sewage water. Low concentration of inorganic phosphate was observed during the post monsoon seasons may be due to the decreased land drainage and sewage disposal from the land drainage.

CONCLUSIONS

The physico-chemical characters of sea water evaluated in the present work demonstrates that the changes in the properties are due to both monsoon and direct discharge of effluents from surrounding environment.

ACKNOWLEDGEMENT

The authors (Dr.MAN and C.P) wish to thank the Management and Principal of National Engineering College, Kovilpatti for their keen interest and constant encouragement throughout this investigation.

REFERENCES

1. P.I. Chacko and C. Malupillay, *Ind. Com. Jour.,* **12**, 194 (1957).

2. F. Chandrasekaran and A. Sudhakar, *Madras Jour. Fish.*, **1**, 28(1968).

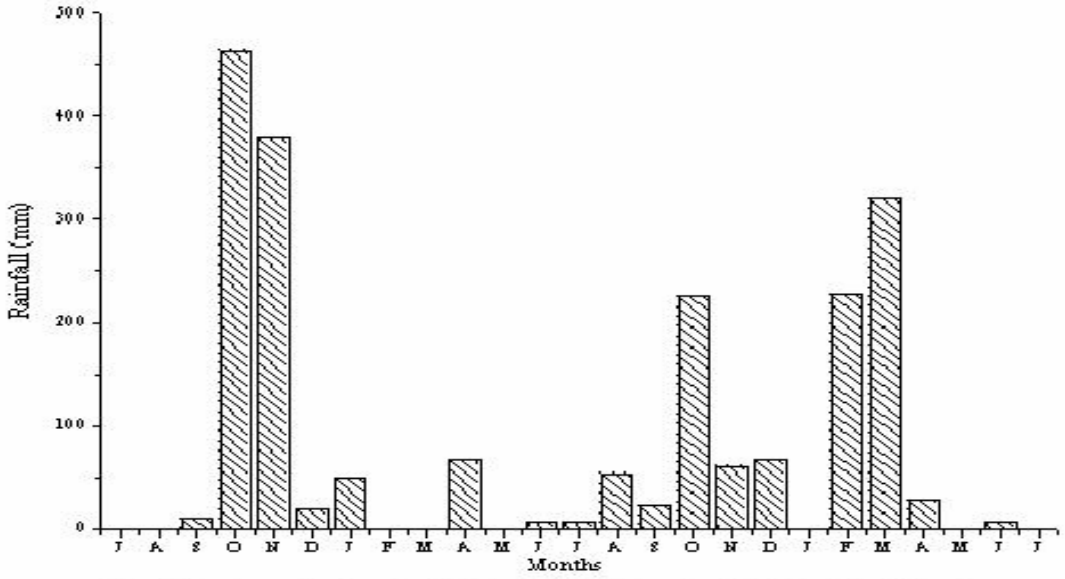

Fig. 1: Monthly variation of rainfall during July 2006 to July 2008 for Thoothukudi

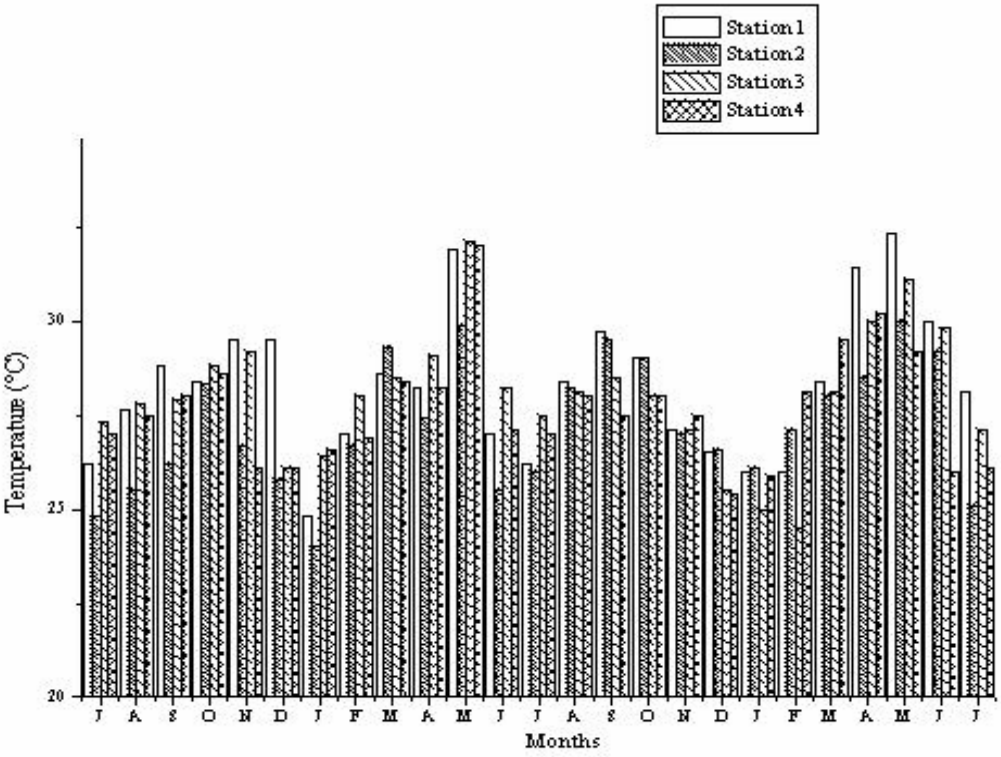

Fig. 2: Variation of temperature during July 2006 to July 2008 for stations 1, 2, 3 and 4

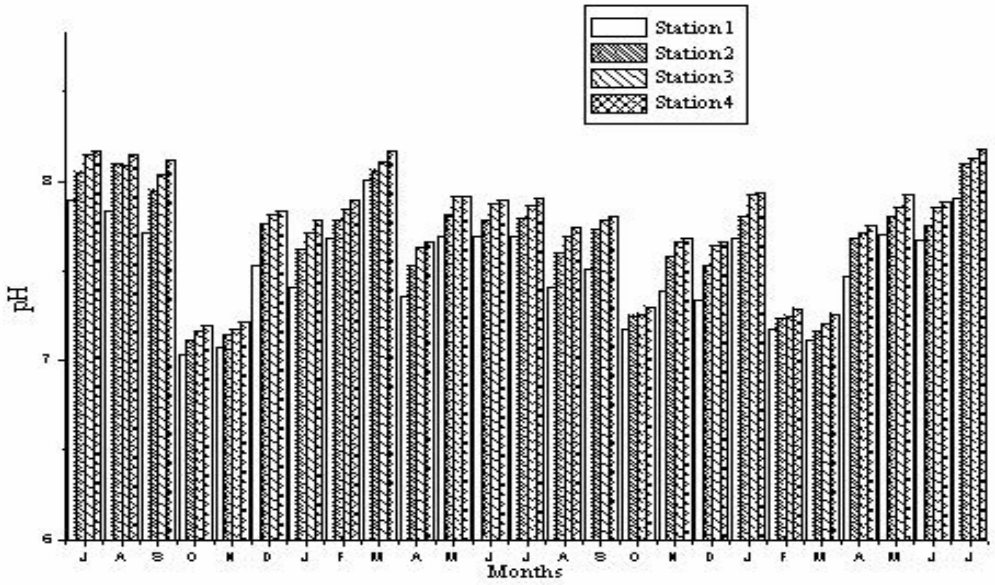

Fig.3: Variation of pH during July 2006 to July 2008 for stations 1, 2, 3 and4

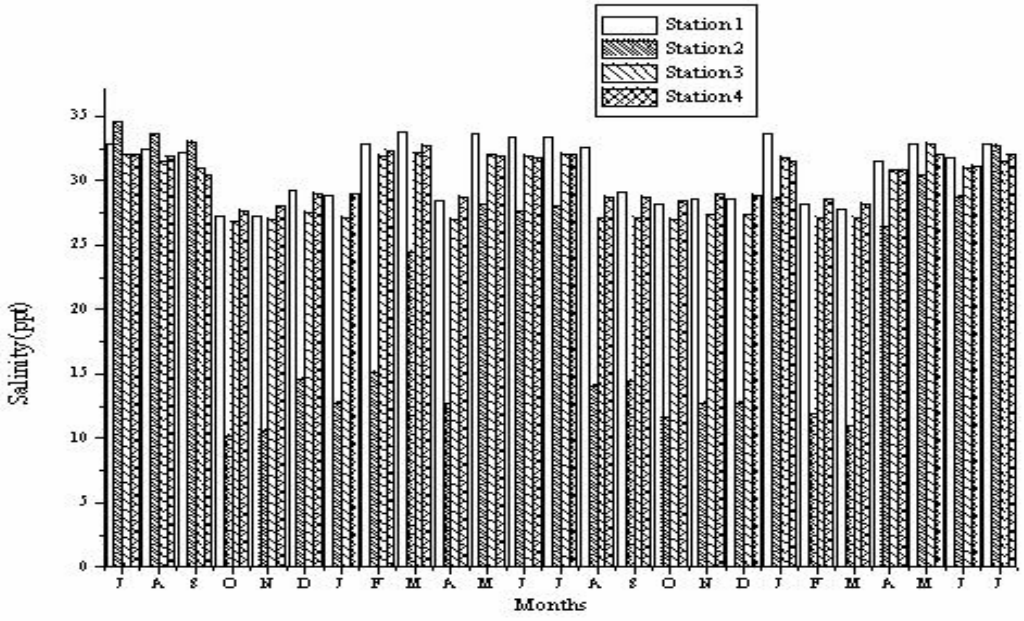

Fig.4: Variation of salinity during July 2006 to July 2008 for stations 1, 2, 3 and 4

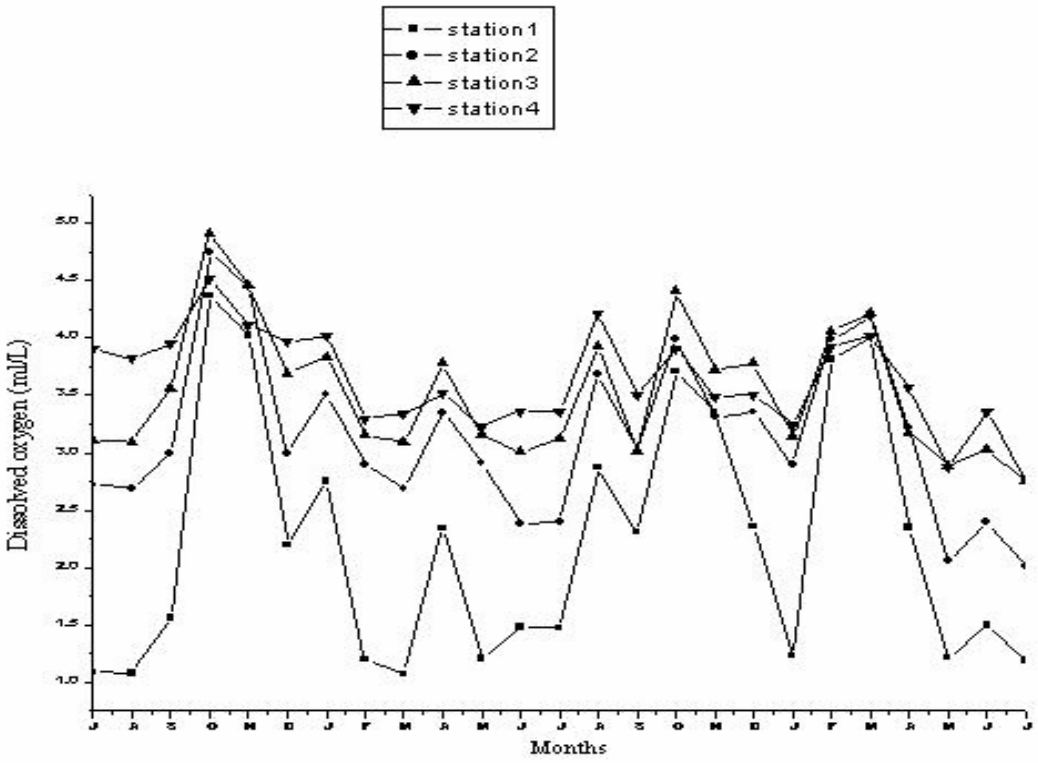

Fig.5: Variation of dissolved oxygen during July 2006 to July 2008 for stations 1, 2, 3 and 4

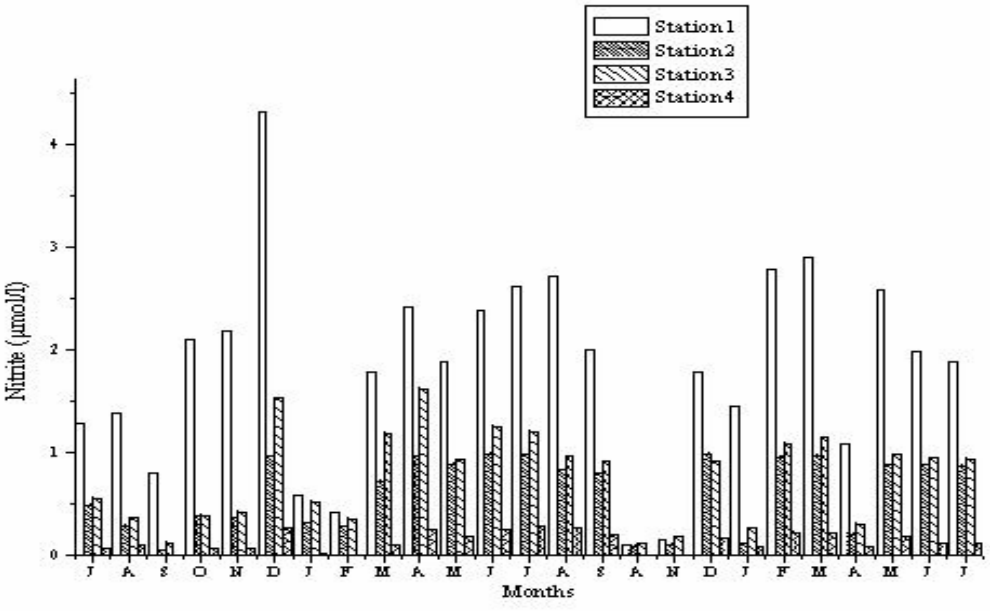

Fig.6: Variation of nitrite during July 2006 to July 2008 for stations 1, 2, 3 and 4

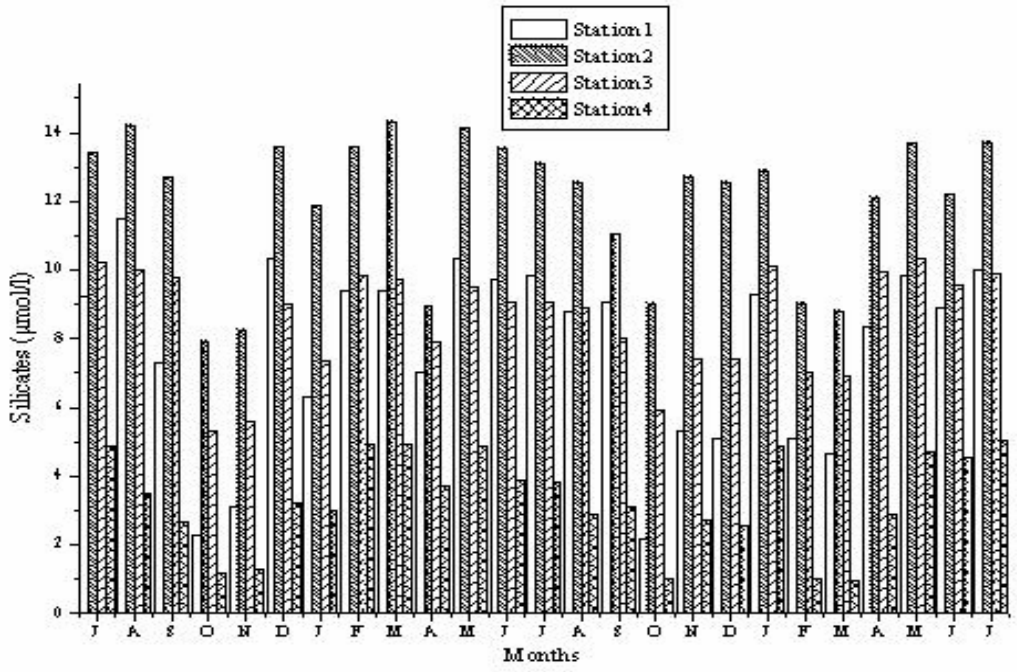

Fig.7: Variation of silicates during July 2006 to July 2008 for stations 1, 2, 3 and 4

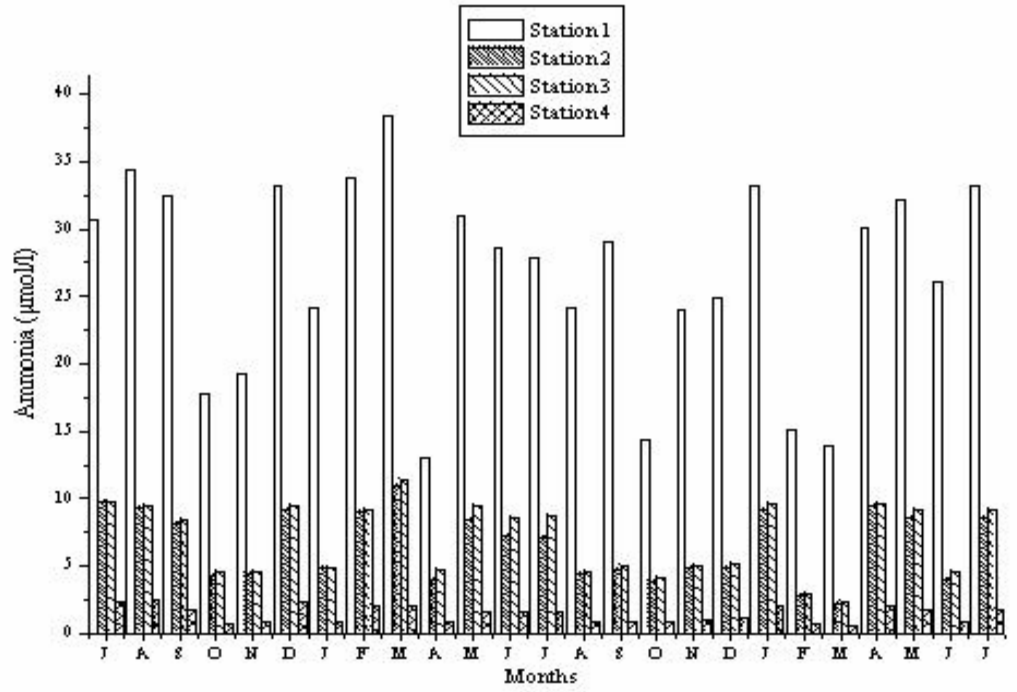

Fig.8: Variation of ammonia during July 2006 to July 2008 for stations 1, 2, 3 and 4

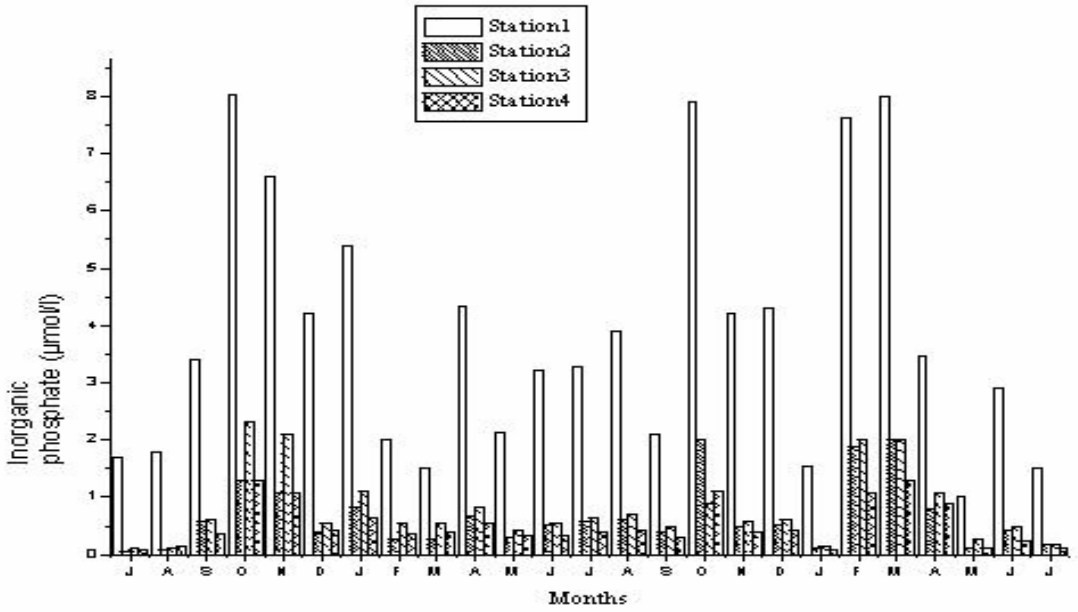

Fig.9: Variation of inorganic phosphate during July 2006 to July 2008 for stations 1, 2, 3 and 4

3. R. Marichamy and C.P. Gopinathan, Proc. Second. Indian Fisheries Forum, Mangalore, 257(1990).
4. M. Ganesan and L. Kannan, *Indian J. Mar. Sci*., **24**, 236(1995).
5. Indian standard methods of sampling and test (Physical and Chemical) for water and waste water Part I sampling (first revision) IS 3025 (Part I)-1987(Reaffirmed 1998), Edition 2.1 (1999-12).
6. American Public Health Association, APHA, Standard method for examination of water and waste water, 2500-B Laboratory field method, Newyork, p.2-61(2005).
7. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-H^+-B Electrometric method, New York, p.4-90 (2005).
8. J.D.H. Strickland, and T.R. Parsons, A Practical Hand book of Seawater Analysis Bulletin, **167**, 311 (1968).
9. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-NH3-F Phenate method, New York, p.4-108 (2005).
10. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-NO_2-B colorimetric method, New York, p.4-118 (2005).
11. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-Sio_2-D Heteropoly blue method, New York, p.4-164 (2005).
12. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-P-D stannous chloride method, New York, p.4-146 (2005).
13. American Public Health Association, APHA, Standard method for examination of water and waste water, 4500-O-C Azide modification method, New York, p.4-136 (2005).
14. S.R. Well and R.B. Seymour Se Well, Geographic and oceanographic Research in Indian waters, Daya Pub. House, Delhi (1994).
15. D. Manikandavelu and V. Ramadhas, *Indian jour. Mar. Sci*., **23**, 108(1994).
16. R. Santhanam, A. Srinivasan, V. Ramdhas and S. Devaraj, *Indian J. Mar. Sci*., **23**, 27(1994).

(Received: 12 November 2009 Accepted: 27 November 2009 RJC-484)