



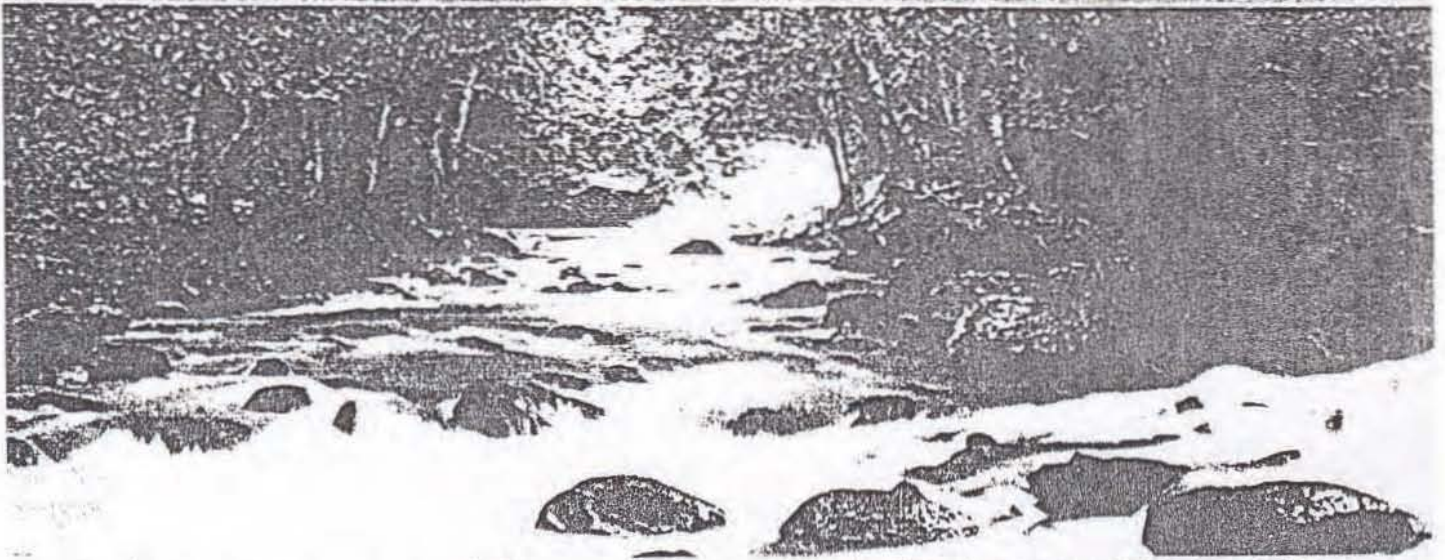
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Some Physicochemical Properties of Sea Water in Tanintharyi Coastal Zone, Myanmar

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Abstract

In this research, some physicochemical properties and lead (Pb), mercury (Hg) and cadmium (Cd) concentrations of the thirty-two sea water samples from Tanintharyi coastal zone in Myanmar were determined and compared with acceptable levels of international and ASEAN standards. The average dissolved oxygen (DO) and total suspended solid (TSS) values were found to be 5.46 ppm and 7.06 ppm, respectively. These values were lower than the acceptable levels for aquatic life protection. The concentrations of ammonia nitrogen (0.031 ppm), nitrite nitrogen (0.026 ppm) and orthophosphate (0.025 ppm) were under the acceptable levels of ASEAN and other countries. It can be deduced that the studied regions are not eutrophicated with nitrogen and phosphorus species. Average concentrations of Pb, Hg and Cd were found to be 5.64, 0.65 and 1.95 ppb, respectively. These values (except Hg) were lower than the acceptable levels of ASEAN.

Keywords: Tanintharyi coastal zone; sea water; Pb; Hg; Cd; orthophosphate; TSS

Introduction

This research work is a part of the research project of BOBLME (Bay of Bengal Large Marine Ecosystem). The BOBLME covers 3.8 million sqkm of sea area. The countries involved – Bangladesh, India, Indonesia, Malaysia, Maldives, Myanmar, Sri Lanka and Thailand. Over 400 million, people live in the Bay of Bengal Area. To implement the BOBLME project, there are four Components which composed of 16 Subcomponents. A key area under project **Component 4** deals with coastal pollution loading and water quality criteria, more specifically, the development of a regional collaborative approach to identifying important coastal water pollution issues and to develop remedial strategies (Subcomponent 4.2) [1]. To fulfill it, studies on some physicochemical properties of sea water samples from Rakhine, Deltaic and Tanintharyi coastal zones in Myanmar have been carried out since June 2010. The Tanintharyi coastal area is the longest coastal zone of Myanmar and it covers south of the Gulf of Mottama (Martaban) up to the mouth of Pakchan River. Since August 2010,

samplings in Rakhine, Deltaic and Tanintharyi coastal zones have been carried out seasonally and annually for time series analysis and experimental works are on-going process. It can be expected that detailed assessment of sea water quality of Myanmar may be accomplished during coming years. This paper concerned with the sea water samples only collected in between August 2010 and January 2011.

Materials and Methods

In this work, thirty-two sea water samples from Dawei and Myeik regions in Tanintharyi coastal zone were collected and their physicochemical properties were determined. The sea water samples were collected at 5 meter below the surface through a water sampler. The dissolved oxygen (DO), water temperature and pH were measured immediately after sampling. The sea water samples were kept in polyethylene bottles, which were already cleaned by soaking in 5 M HCl for more than three days and washing with distilled-deionized water thoroughly before use. Table 1 showed the sampling locations of sea water samples. Figure 1 is the map of

sampling locations. Ammonia nitrogen ($\text{NH}_3\text{-N}$) and nitrite nitrogen ($\text{NO}_2\text{-N}$) concentrations were determined by Intergovernmental Oceanographic Commission (IOC) methods [2]. Orthophosphate (inorganic phosphate) concentrations and total suspended solid (TSS) were determined spectrophotometrically by using the bismuth-phosphomolybdate complex method [3] and by filtration with pre-weighed $0.45 \mu\text{m}$, respectively. Chlorophyll *a* was extracted using 90% acetone

and measured spectrophotometrically according to literature [4]. Metal (Pb, Cd and Hg) concentrations were determined by using Perkin Elmer atomic absorption spectrophotometer (Analyst 800) using manufacturer's recommendations. The detection limits are 0.199, 0.763 and 0.479 ppb for Hg (hydride generating), Pb (graphic furnace) and Cd (graphic furnace), respectively.

Table 1. Sampling locations and sampling dates of sea water samples

Sampling station	Sampling location		Sampling Date	Sampling station	Sampling location		Sampling Date
	Longitude (E)	Latitude (N)			Longitude (E)	Latitude (N)	
Tanintharyi coastal zone (i) Dawei Region							
1	97°56'13.6"	14°9'14.5"	15.8.10	17	97°55'15.1"	13°51'10.1"	3.9.10
2	97°58'34.1"	14°11'12.4"	15.8.10	18	97°55'04.7"	14°11'37.8"	3.9.10
3	98°40'9.2"	11°40'9.2"	15.8.10	19	98°27'34.1"	12°26'22.1"	28.10.10
4	97°57'46.5"	14°6'28.9"	16.8.10	20	98°35'29.2"	12°32'49.5"	28.10.10
5	98°43'12.8"	11°57'11.4"	16.8.10	21	98°36'41.1"	12°2'11.2"	28.10.10
6	98°36'7.2"	11°46'9.2"	16.8.10	22	98°43'13.4"	11°40'20.0"	1.1.11
7	98°29'34.8"	11°51'29.8"	17.8.10	23	98°28'12.8"	12°27'2.4"	2.1.11
8	98°30'49.8"	11°31'50.8"	17.8.10	24	98°36'33.6"	12°2'14.6"	3.1.11
9	98°38'14.5"	11°44'36.3"	18.8.10	25	98°27'13.4"	12°26'32.2"	3.1.11
10	98°28'24.6"	12°54'9.1"	18.8.10	26	98°28'12.9"	12°10'30.5"	4.1.11
11	98°43'12.8"	11°57'11.4"	18.8.10	27	98°33'19.5"	11°47'13.6"	5.1.11
(ii) Myeik Archipelago							
12	98°54'28.9"	12°27'49.1"	18.8.10	28	98°48'31.8"	11°28'34.7"	6.1.11
13	98°27'13.2"	12°26'32.5"	18.8.10	29	98°38'21.4"	11°44'28.9"	15.1.11
14	98°37'24.0"	11°51'41.5"	19.8.10	30	98°34'21.9"	11°50'39.4"	15.1.11
15	98°33'36.4"	12°21'49.1"	20.8.10	31	98°41'33.6"	12°11'14.6"	16.1.11
16	98°30'33.9"	11°31'45.6"	20.8.10	32	98°43'46.1"	11°57'36.9"	17.1.11



Figure 1. Locations of the sampling areas in (a) Dawei region (b) Myeik archipelago

Results and Discussion

Average chlorophyll *a* concentrations were found to be 1.51 and 1.22 mg/m³ in the Dawei region and Myeik archipelago, respectively. Average concentrations of TSS, NH₃-N, NO₂-N, and phosphate were 7.48, 0.033, 0.027, and 0.027 ppm in Dawei region and 6.84, 0.029, 0.025, and 0.024 ppm in Myeik archipelago, respectively. Therefore, Dawei region showed higher concentrations than that of Myeik Archipelago. The NH₃-N, NO₂-N, phosphate concentrations were under the acceptable levels of ASEAN and other countries [5]. It can be deduced that the studied regions are not eutrophicated with nitrogen and phosphorus species.

Low concentrations of organic matter can be found in sea water naturally. The sewage, excess nutrients from agriculture and aquaculture, chemical fertilizer residue, persistent organic pollutants from pesticide residue and used household materials like plastic bags, medical wastes, excreted pharmaceuticals, etc. may organic components of land-based source for coastal pollution in Tanintharyi coastal zone. Pb, Hg and Cd

concentrations in Dawei region were in the range of 6.1 to 8.4 ppb, 0.8 to 1.7 ppb and 1.2 to 5.8 ppb, respectively (Table 2). Pb, Hg and Cd concentrations in Myeik archipelago were in the range of 1.1 to 7.7 ppb, 0.0 to 1.6 ppb, and 1.1 to 5.7 ppb, respectively. Among three metals, Pb is highest and Hg is lowest. Moreover, concentrations of three metals in Dawei region were slightly higher than that in Myeik archipelago. Relatively higher concentrations of three metals in Dawei region may related with industrial waste water from ore mining and processing factories in the region. Average concentrations of Pb, Hg and Cd in Dawei region were 7.55, 1.39 and 2.74 ppb, respectively. Average concentrations of Pb, Hg and Cd in Myeik archipelago were 5.50, 1.07 and 1.95 ppb, respectively. These values are lower than the ASEAN acceptable levels except for Hg. However, Hg concentration is lower than acceptable levels of other countries. Table 3 mentioned the general acceptable levels of heavy metals for marine environment. It can be seen clearly that the levels are different from each other and there is no consensus.

Table 2. Some physicochemical properties and heavy metal concentrations of sea water samples

Sampling station	DO (ppm)	TSS (ppm)	NH ₃ -N (ppm)	NO ₂ -N (ppm)	Phosphate (ppm)	Chlorophyll <i>a</i> (mg/m ³)	Heavy metal (ppb) contents (ppb)		
							Pb	Hg	Cd
Tanintharyi Coastal Zone (i) Dawei Region									
1	5.78	7.44	0.043	0.031	0.024	2.41	7.8	1.6	1.2
2	6.12	6.01	0.043	0.023	0.028	2.01	8.2	1.4	2.4
3	5.12	7.95	0.026	0.021	0.023	1.28	8.1	1.4	1.4
4	5.01	7.44	0.037	0.048	0.018	2.26	7.8	1.3	1.2
5	5.06	7.01	0.027	0.020	0.016	2.11	7.2	1.6	2.7
6	5.14	7.34	0.025	0.022	0.026	1.89	7.2	1.7	4.1
7	5.24	7.07	0.032	0.020	0.025	1.54	7.8	0.8	4.8
8	5.14	7.11	0.061	0.028	0.027	1.79	6.1	1.6	5.8
9	5.06	8.12	0.021	0.036	0.043	0.47	8.4	1.1	1.5
10	5.10	8.34	0.025	0.030	0.029	0.34	6.9	1.5	2.9
11	5.11	8.49	0.028	0.019	0.035	0.56	7.6	1.3	2.1
(ii) Myeik Archipelago									
12	5.10	6.48	0.028	0.021	0.021	1.74	7.1	1.1	1.3
13	5.06	7.43	0.037	0.029	0.022	1.54	6.9	1.1	1.4
14	5.14	6.63	0.030	0.012	0.022	2.01	7.4	1.2	1.1

Table 2. Some physicochemical properties and heavy metal concentrations of sea water samples

Sampling station	DO (ppm)	TSS (ppm)	NH ₃ -N (ppm)	NO ₂ -N (ppm)	Phosphate (ppm)	Chlorophyll <i>a</i> (mg/m ³)	Heavy metal (ppb) contents (ppb)		
							Pb	Hg	Cd
15	4.98	6.21	0.040	0.020	0.022	1.77	5.4	0.5	1.2
16	5.00	6.04	0.042	0.023	0.021	1.45	5.4	1.4	1.4
17	5.04	6.27	0.037	0.021	0.023	1.38	3.9	0.8	2.4
18	5.04	6.24	0.028	0.033	0.032	1.74	7.6	0.5	2.8
19	5.21	7.89	0.017	0.017	0.020	1.77	7.0	1.5	2.5
20	5.23	6.23	0.024	0.014	0.027	1.49	7.4	1.3	1.2
21	5.23	6.56	0.032	0.026	0.020	1.80	5.4	1.3	5.7
22	5.45	5.81	0.033	0.020	0.035	1.55	4.7	0.9	1.4
23	6.12	6.8	0.021	0.021	0.020	1.79	2.5	1.5	1.1
24	6.12	6.37	0.016	0.040	0.023	1.49	4.7	1.1	2.1
25	6.16	8.56	0.036	0.040	0.033	0.14	3.8	1.6	2.1
26	6.83	7.09	0.041	0.028	0.014	0.39	1.1	ND	2.0
27	6.01	8.11	0.033	0.030	0.027	0.77	3.9	1.1	1.7
28	6.11	7.54	0.029	0.021	0.022	1.01	6.1	0.6	1.9
29	6.90	6.36	0.016	0.010	0.012	0.84	7.7	0.8	1.8
30	5.64	7.11	0.034	0.030	0.026	0.40	4.7	1.1	1.7
31	5.32	7.36	0.031	0.031	0.028	0.21	7.4	0.4	1.5
32	5.14	6.49	0.011	0.035	0.029	0.35	5.4	1.6	2.7

Table 3. General acceptable levels of heavy metals for marine environment

Country	Heavy metal content (ppb)		
	Hg	Pb	Cd
Australia	<1.0	< 1-7.0	< 0.5-5
ASEAN	0.16	8.5	10
India	1.0	1.0	1.0
Kenya	5.0	10	10
New Zealand	<1.0	< 1-7.0	< 0.5-5
Philippines	2.0	50	10
United States	1.8	210	42

Conclusions

According to data obtained, the studied regions are unpolluted with nitrogen and phosphorus species. Highest chlorophyll *a* concentration was found as 2.41 mg/m³ in sampling station 1 (sampling date 15.8.2010), whereas lowest concentration was found as 0.14 mg/m³ in station 25 (sampling date 3.1.2011). In general Pb, Cd and Hg

concentrations were under acceptable levels. Concentrations of the three metals in Dawei region were slightly higher than that in Mycik archipelago. For both regions, Pb is highest and Hg is lowest. One of the most important threats to the health and productivity of the BOBLME region is pollution from land-based sources [6]. Human activities are causing serious environmental pollution/degradation and are threatening the sustainable

management and health of the BOBLME region. To identify the pollution hot spots in Myanmar coastal regions and to perform remedial strategy for pollution hot spots are on-going process.

References

- [1] FAO 2006, The Bay of Bengal Large Marine Ecosystem (BOBLME) Project, FAO, Rome, p.5.
- [2] Intergovernmental Oceanographic Commission 1983, Chemical methods for use in marine environment monitoring, IOC Manuals and Guides No.12, UNESCO, Paris, p. 29.
- [3] Mihajlovic, R.P., Kalijevec, V.M., Vukasinovic, M.P., Mihajlovic, L.V. and Pantic, L.D. 2007, Spectrophotometric method for the determination of phosphorus in natural waters using the bismuth-phosphomolybdate complex, Water SA., 33: 513-517.
- [4] Strickl, J.D.H. and Parson, T.R. 1972, A Practical Hand Book of Sea Water Analysis, Fisheries Board of Canada Bulletin, Toronto, p.310.
- [5] Tong, S.L. and Deocadiz, E.S. 1999, Principles for developing ASEAN marine environmental quality criteria. In: C.A. McPherson, P.M. Chapman, G.A. Vigers and K.S. Ong (eds.). ASEAN Marine Water Quality Criteria, Department of Fisheries (Malaysia), Kuala Lumpur, pp. 1-12.
- [6] Kaly, U.L. 2004, Review of land-based Sources of pollution to the coastal and marine environments in the BOBLME region, BOBLME Project, FAO, Rome, p.6.