# Comparative Investigation on Seasonal Variation of Sea Water Quality and Determination of Heavy Metal Contents in its Sediments Around the Kyaikkhami Coastal Area

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## Abstract

This research work is a part of the research project of BOBLME (Bay of Bengal Large Marine Ecosystem). In this research, three sea water samples around the Kyaikkhami areas were collected. Collections of samples were made nine times during the period September, 2011 to November, 2014 and samples were collected seasonally and annually. The aim of this research is to study the sea water quality around the Kyaikkhami coastal areas, to identify the pollution hotspots and to determine the remedial strategies. In this research, three sea water samples around the Kyaikkhami areas were collected, the sampling location were (16° 2.416'N, 97 ° 33.443'E - 16 ° 2.216'N, 97 ° 33.343'E - 16 ° 2.236'N, 97 ° 33.043'E )for sea water samples A, B and C, respectively.

The spectrophotometric method based on formation of the blue bismuth-phosphomolybdate complex (BiPMo) was used for the determination of phosphate in the sea water samples. According to the result, the orthophosphate values of all the samples analyzed did not have much variation and were between 0.023 ppm and 0.156 ppm. The highest value of total nitrogen (1.980 ppm) was found in rainy, 2014. The seasonal variation in this studied area was very large. This may be due to the nutrient inputs to aquatic ecosystem, especially agricultural wastes.

Atomic absorption spectrophotometric method was used for the determination of trace elements in the sea water samples. The highest value of copper concentration (0.021 ppm) was found in rainy, 2011. This value exceeds the permissible level of ASEAN standard (0.008) ppm. Copper is widely used metal employed in many fields: transportation of electricity, construction (roofing, decoration …) and agriculture (fungicide, herbicide). Copper free agricultural products should replace for controlling the environmental pollutant of copper.

The arsenic (As) and Cadmium (Cd) were not detected in the course of the research work for all seasonally and annually collected samples. The maximum value of Hg (1.25 ppb) was found in summer, 2013. These values were higher than the permissible level of ASEAN standard (1.160 ppb). Mercury can be toxic to people's nervous system, lungs and kidney. Mercury is used in variety of industrial and medical products. Hospitals with mercury waste incinerators are also a major contributor to the mercury problem. Replacing mercury-free devices for mercury containing products may reduce environmental pollution of mercury. So the toxicity of sediment to benthic-dwelling organisms are predicted to be probable from the viewpoint of Cr toxic.

Fluorometric method with the standard chrysene solution was used in the determination of total petroleum hydrocarbons values in the sea water samples. The highest value of total petroleum hydrocarbons (0.468 ppm) was found in winter, 2013. The obtained results provided the background information on the extent of TPHs in the sea water and pointed out the need to further control of TPHs pollution in coastal area.

**Keywords**: BOBLME, ecosystem, Kyaikkhami, sediment, total petroleum hydrocarbons (TPHs)

## Introduction

Myanmar has an extensive coastal approximately 2,400 kilometers in length. The coastal areas of Myanmar are divided into three portions according to background information about the bio-graphical features of Myanmar. Kyaikkhami coastal area in the Tanintharyi coastal zone is concerned in this research work. In this research work, seawater samples were collected from the three sampling site seasonally and annually. Sampling sites were recorded

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with GIS positions. Major sources of pollution in the Myanmar coastal regions are probably the sewage, excess nutrients from agriculture and aquaculture, chemical fertilizer residue, POPs from used pesticide residue and used household materials like plastic bags, medical wastes, and excreted pharmaceuticals.

**Heavy metal pollution**

**Chromium**

Chromium (Cr) is one of the world's most strategic, critical and highly soluble metal pollutants having wide range of uses in the metals and chemical industries. Cr is used principally in stainless steel and non-iron alloy production for platting metals, development of pigments, leather processing and production of catalysts, surface treatments and in refractories.

Chromium exists in the environment in several diverse forms such as trivalent [Cr (III)] and hexavalent, of which hexavalent chromium [Cr (VI)] is a so-called carcinogen and a potential soil, surface water and ground water contaminant. Whereas it's reduced trivalent form ($Cr^{3+}$) is much less toxic, insoluble and a vital nutrient for humans. Cr (III) occurs naturally in the environment and is an essential nutrient required by the human body **(**Flora, 2000).

**Copper**

Copper is a widely used metal employed in many fields: transportation, manufacturing, currency, transportation of electricity, construction (roofing, decoration ...) and agriculture (fungicide, herbicide). Sources of copper in water are extensive, in addition to natural levels originating from rocks weathering and atmospheric deposition, its use by humans induces environmental releases. These releases can be punctual (factories effluents, sewages ...) or diffuse (runoffs from land, roads and roofs) (TDC Environmental Report, 2004).

**Mercury**

The largest source of emissions to the atmosphere is currently coal fired power stations, however, the widespread use of mercury in dental amalgam means that in the future, crematoria could become the most significant source. Hospitals with medical waste incinerators are also a major contributor to the mercury problem, and although emissions are decreasing as the number of medical waste incinerators is reduced, there is concern within the health community that the use of mercury in healthcare products is exposing patients and other vulnerable groups (Gibb, 2006).

## Experimental

In this research, seawater samples were collected from three sampling sites in Kyaikkhami coastal areas. The sample sites were recorded with GIS positions. Collection of samples were made nine times during the period September, 2011 to November, 2014 and samples were collected seasonally and annually. Determination of some physicochemical properties (pH, DO, COD, BOD, TSS, total alkalinity, total hardness, orthophosphate or inorganic phosphate, organic phosphate, chlorinity, turbidity, total nitrogen) of the seawater samples were carried out in this research work. Spectrophotometric methods were used for the determination of orthophosphate and total nitrogen in seawater sample (Sastry,2011). Some metals concentrations such as Zn, Fe, Mn, Cu, Cr, Hg, Pb, As and Cd in collected seawater samples were determined and compared with acceptable level of international and ASEAN standard. Total petroleum hydrocarbon values in the seawater samples were measured as chrysene equivalence by using UVF spectrofluorometer (Pisal, 2006). Biological properties of seawater samples were investigated by membrane filtration method. Some metal such as Zn, Fe, Mn, Cr, and Cu concentrations in collected sediment samples around the Kyaikkhami

coastal area were determined and sediment quality was assessed by using the Consensus Based Sediment Quality Guidelines (CBSQGs).

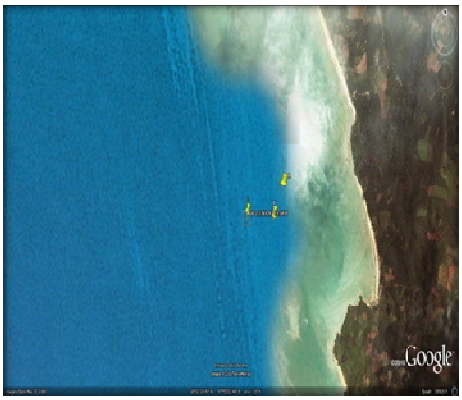


**Figure 1 Satellite image of the sample collection sites**

**Figure 2 Photograph of sampling of sea water at field site**

## Results and Discussion

**Table 1 Analytical water quality parameters in the sea water and sediment samples**

| Sr. no | Parameters | Lowest (Season, Year) | Highest (Season, Year) |
|---|---|---|---|
| 1. | pH | 6.1 (rainy and winter, 2014) | 7.9 (summer, 2013) |
| 2. | Alkalinity | 87 ppm (rainy, 2012) | 141 ppm (winter, 2014) |
| 3. | Total hardness | 1030 ppm (summer, 2012) | 1730 ppm (rainy, 2011) |
| 4. | Salinity | 7.509 ppt (rainy, 2012) | 23.32 ppt (summer, 2014) |
| 5. | Turbidity | 6.2 FTU (winter, 2012) | 32.01 FTU (rainy, 2013) |
| 6. | Orthophosphate | 0.023 ppm (rainy, 2011) | 0.156 ppm (rainy, 2014) |
| 7. | Organic phosphate | 3.010 ppm (summer, 2012) | 6.625 ppm (rainy, 2014) |
| 8. | Total phosphate | 3.073 ppm (summer, 2012) | 6.773 ppm (rainy, 2014) |
| 9. | Dissolved oxygen | 6.02 ppm (rainy, 2011) | 8.19 ppm (rainy, 2014) |
| 10. | Biochemical oxygen demand | 3.09 ppm (summer, 2014) | 4.98 ppm (rainy, 2011and 2014) |
| 11. | Chemical oxygen demand | 16.00 ppm (rainy, 2011) | 36.09 ppm (summer, 2014) |

**Table 2 Heavy metal contents in sea water and sediment samples**

| Sr. no | Parameters | Lowest (Season, Year) | Highest (Season, Year) |
|---|---|---|---|
| 1. | Orthophosphate | 0.023 ppm (rainy, 2011) | 0.156 ppm (rainy, 2014) |
| 2. | Organic phosphate | 3.010 ppm (summer, 2012) | 6.625 ppm (rainy, 2014) |
| 3. | Total phosphate | 3.073 ppm (summer, 2012) | 6.773 ppm (rainy, 2014) |
| 4. | Total nitrogen | 0.010 ppm (summer, 2012) | 1.980 ppm (rainy, 2014) |

| Sr. no | Parameters | Lowest (Season, Year) | Highest (Season, Year) |
|---|---|---|---|
| 5. | Copper in the seawater sample | 0.001 ppm (rainy, 2011 and (summer, 2013) | 0.021 ppm (rainy, 2011) |
| 6. | Chromium in the sediment sample | 14.63 ppm (rainy, 2012) | 61.20 ppm (winter, 2014) |
| 7. | Mercury in seawater sample | Was not detected | 1.25 ppb (summer,2013) |
| 8. | TPHs | 0.052 ppm (rainy, 2013) | 0.468 ppm (winter, 2013) |

From the study results, the concentration variation of Zn. Fe, Mn and Cu were observed in seasonally and annually collected samples. The highest value of copper concentration (0.021 ppm) was found in rainy, 2011. This value exceed the permissible level of ASEAN standard (0.008) ppm. The mercury (Hg) were not detected in early years, 2011 and 2012. It was detected in summer and winter,2013 and 2014. The maximum value of mercury (1.25 ppb) was in summer, 2013.These values were higher than the permissible levels of ASEAN standard (0.160 ppb).The lead (Pb) in the course of this research work for all seawater samples were in the slight variation and the range of 0.0002 ppm to 0.0065 ppm. The observed lead concentrations were within the permissible level of ASEAN standard (9 ppb). The arsenic (As) and Cadmium (Cd) were not detected in the course of the research work for all seasonally and annually collected samples. The highest value of total petroleum hydrocarbons (0.468 ppm) was found in winter, 2014. In the sediment sample Zn, Cu and Fe were detected under the toxicity level of concern. Unfortunately, the chromium value in sediment samples was found in the range of (49.61mg/kg -61.20 mg/kg) in (2014). These values were higher than 43 mg/kg; the threshold effect concentration (TEC) concerned in Consensus Based Sediment QualityGuidelines (CBSQGs). The highest value of total petroleum hydrocarbons (0.468 ppm) was found in winter, 2014.

## Conclusion

The total phosphate and total nitrogen value indicate the high trophic level of seawater. These values pointed out to control the input of agricultural wastes. The copper concentrations exceed the permissible level of ASEAN standard (0.008) ppm. Copper is trace element essential to life, but at high dose it can be toxic to humans. Copper is widely used metal employed in many fields: transportation of electricity, construction (roofing, decoration…) and agriculture (fungicide, herbicide). Copper free agricultural products should replace for controlling the environmental pollutant of copper.

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probable from the viewpoint of Cr toxic. High doses of chromium (IV) have been associated with birth defects and cancer. Chromium has wide applications in various industries such as stainless steel, electroplating of chrome, dynes, lather tanning and wood preservatives. Therefore, some remediation techniques to reduce chromium contamination should be considered.

The highest value of total petroleum hydrocarbons (0.468 ppm) was found in winter, 2014. TPHs concentrations in the seawater samples varies with seasons, showing a decreasing order of winter>rainy>summer. The lower TPHs in summer may be due to evaporation of TPHs. The obtained results provided the background information on the extent of TPHs in the sea water and pointed out the need to further control of TPHs pollution in coastal area.

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