Study Contamination of Lead, Cadmium and Mercury in coastal water along Kelantan coast.

N. A. Abdullah, M. F. M. Nordin* and M. Muhammad.

Faculty of Agro Industry and Natural Resources, Universiti Malaysia Kelantan, Locked Bag 36, Pengkalan Chepa, 16100 Kota Bharu, Kelantan, Malaysia
***e-mail: mariamfirdaus@umk.edu.my**

Abstract

Samples of coastal water ware collected from five sampling station along Kelantan coast base on Department of Environment (DOE) requirement. Sample randomly collected every year since year 1996 until now by DOE, at Sri Tujoh Beach, Sabak Beach, Cahaya Bulan Beach, Irama Beach and Bisikan Bayu Beach base on situation and environmental condition. Heavy metals which are Lead (Pb), Cadmium (Cd) and Mercury (Hg) ware determine using Standard for Examination of Water and Wastewater. The samples preserved and digested using nitric acid (HNO_3) and hydrochloric acid (HCl) before analyzing using Flame Atomic Absorption (AA) and other method Cold Vapor Atomic Absorption (CVAA) required for determination of Hg. Selection of method depend on level of heavy metal concentration present in water sample which is AA used to determination high level of heavy metal, and CVAA use to determine low level of heavy metal. Digestion using HNO_3 and HCl required to remove organic and solubilized solid matter by oxidation and volatilization. The results obtain were compared with Interim Marine Water Quality Standard (IMWQS). It shows that, in the average the coastal water quality cannot qualify as save level because it higher than IMWQS limits.

Key word: Lead (Pb), Cadmium (Cd), Mercury (Hg), coastal water, Kelantan coast.

Introduction

Development of coastal area and island has created significant impact to marine water quality, because of that Department of Environment started marine water monitoring programme since year 1978 for Peninsular Malaysia except for Kelantan started in 1996 and in 1985 expended to Sabah and Sarawak. The quality of marine water depends on the Malaysia: Interim Marine Water Quality Standards (IMWQS) (DOE, 2009).

Metal in marine or coastal water can have either beneficial or dangerous effect depending on the element and the concentration. Some heavy metal required for human and animal as micronutrient, but in higher quantity it becomes toxic. Higher consuming of lead (Pb) can effect physical or mental development in infant and children, cadmium (Cd) cause kidney damage and mercury (Hg) effect on respiratory irritation, digestive disturbances and also kidney damage (Martin *et al.*, 2009).

Heavy metal enter coaster water through rain water, river runoff, land runoff and housing waste, agriculture waste, industrial waste outlet direct to river and enter coastal water. Heavy metal tends to accumulate in the food chain; organism such as plankton absorbed heavy metal from their surrounding than plankton consume by fish and finally its transfer to human (Ahmad *et al.*, 2009, Prasath and Khan, 2008).

Nowadays, along with the development of coastal areas, coastal along Kelantan also not separated from coastal water pollution. Therefore, the objective of this study is to predict selected heavy metal contamination along Kelantan coast since coastal along Kelantan also popular for fishing industry and tourisms industry.

Materials and Methods

Department of Environment (DOE) was collected samples randomly every year since 1996 at five difference locations along Kelantan coasts. The selection of location in this study based on DOE suggested and almost the location located at popular recreation as shows in Figure 1.

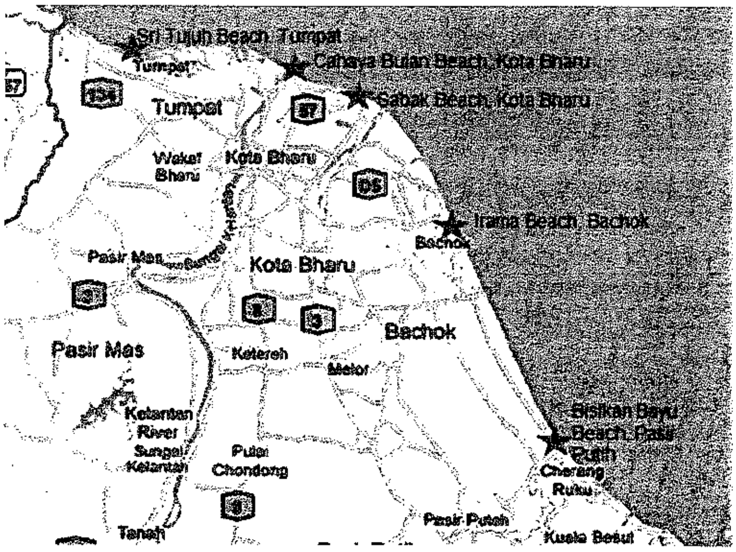

Figure 1: Five sampling location along Kelantan coast.

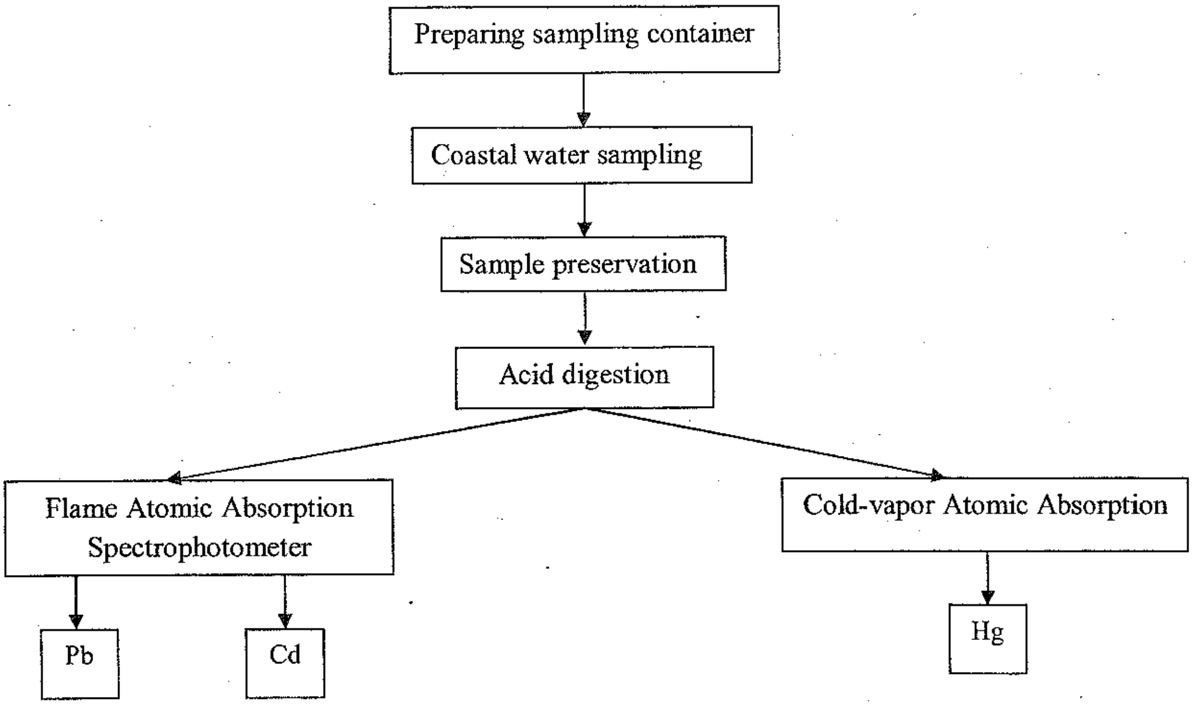

Figure 2: Flow of experiment

Coastal water samples (500ml) were collected in pre-acid cleaning Polypropylene bottle. The sample immediately preserved to avoid contamination and kept in ice box during transportation to avoid vaporization. The analysis must begin within three months after sampling to ensure result is valid (Eaton *et al.,* 2005).

Preliminary treatment of sample before analyzed depends on type of analysis, total metal use Nitric acid digestion without filtering of the sample. 100 ml well mixed acid preserved sample transfer into 125ml Erlenmeyer flask or beaker. Transferred 3ml concentrated nitric acid into samples and heat on hot plate to almost dryness. Again transferred 3ml concentrated nitric acid and heat to almost dryness. Added 2ml of 50% hydrochloric acid, cooling down and wash flask using minimum quantity deionized water, transferred into 100ml volumetric flask and bulk to 100ml (Eaton *et al.,* 2005).

The digested sample introduce to Flame Atomic Absorption Spectrometer for determination of Lead, Pb and Cadmium, Cd. Otherwise Mercury, Hg was detected using Cold Vapor Atomic Absorption Spectrophotometer. The differences between these two methods depend on concentration and stabilization of the metal ion.

Results and Discussion

Figure 3 show lead (Pb) concentrations (mg/l) in five coasts along Kelantan form year 1996 until 2009. Base on Malaysia: Interim Marine Water Quality Standards (IMWQS) acceptable limit for Pb concentration is 0.1mg/l. From year 1996 until 1999, the concentrations of Pb in all coastal was below acceptable limit and it classified as save condition for any coastal water activity. In year 2000 Pb value in all coastal water beyond the acceptance limit Cahaya Bulan beach was higher compare with others coastal which is 0.207 mg/l. The value also increase in year 2001, Irama and Bisikan Bayu beaches is higher compare with others three beaches which is 0.240 mg/l. 2002 the concentration is decrease below acceptance limit. In year 2003 the value is increase over acceptance limit and the Irama beach shows higher concentration 0.670 mg/l. The concentration Pb in Sri Tujuh beach is higher in 2005 until 2008.

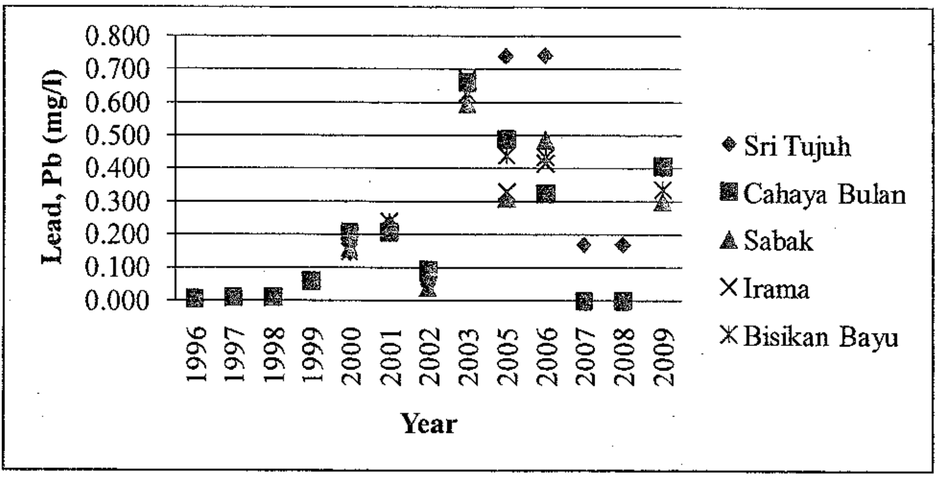

Figure 3: Concentration of lead (Pb) in five beaches.

Other than Pb, cadmium (Cd) also effect human health, high concentration of Cd can cause serious disease, especially on kidney damage. Figure 4 shows concentration of Cd in five sampling station in year 1996 until 2002 there are no obvious changes but in year 2003 four sampling stations except Cahaya Bulan beach, the concentration of Cd increase to 0.103 to 0.116 mg/L. In year 2005, only Sabak and Cahaya Bulan beaches shows concentration of Cd over of acceptance limit which are 0.102 and 0.159 mg/L. The acceptance concentration for Cd is 0.100 mg/L base on IMWQS. 2006 shows increased concentration of Cd in four coastal waters except Cahaya Bulan beach the range of concentration is in between 0.118 to 0.162 mg/L. In year 2007 until 2009 the concentration of Cd decreased below acceptance limit.

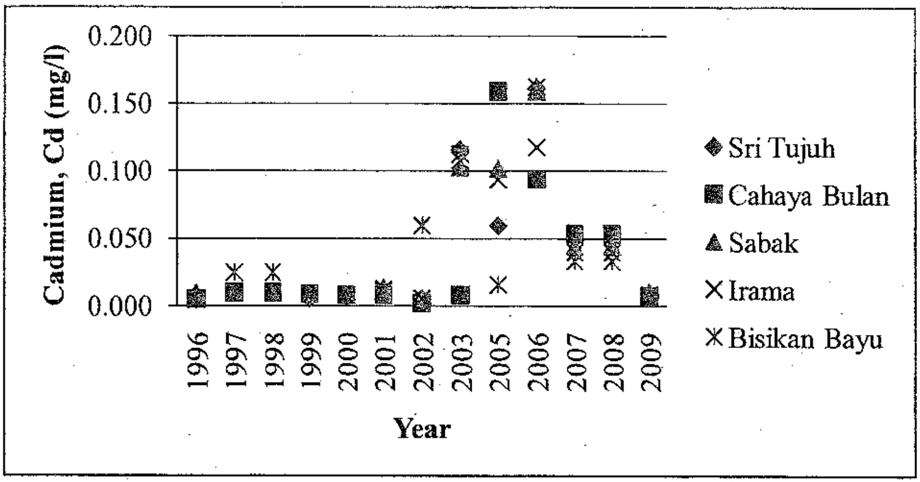

Figure 4: Concentration of cadmium (Cd) in five beaches.

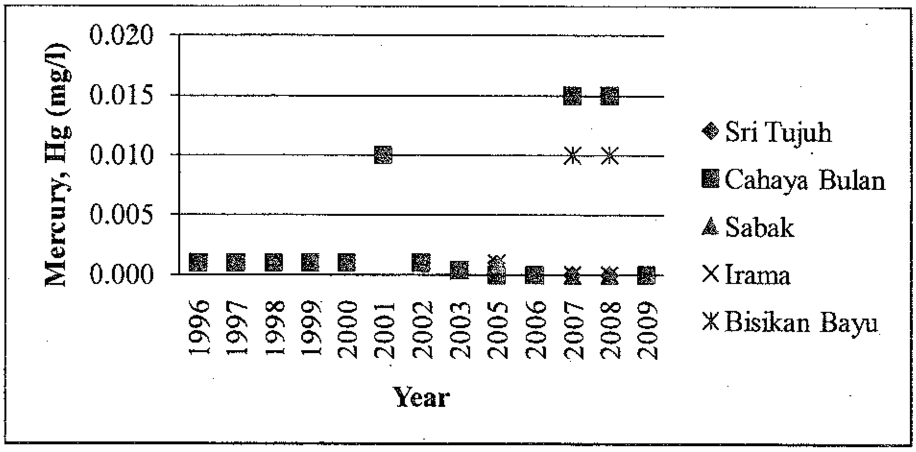

Figure 5: Concentration of mercury (Hg) in five beaches.

Acceptance limit concentration of mercury (Hg) in marine water based on IMWQS is 0.001 mg/L. Figure 5 shows the concentration of Hg from year 1996 until 2009, the concentration of Hg below than acceptance limit except in year 2001 for all coastal it show same value which is 0.01 mg/L. In year 2002 until 2006 the concentration of Hg decrease below than acceptance limit but in year 2007 and 2008 the concentration was increase over acceptance limit in Bisikan Bayu and Cahaya Bulan beaches.

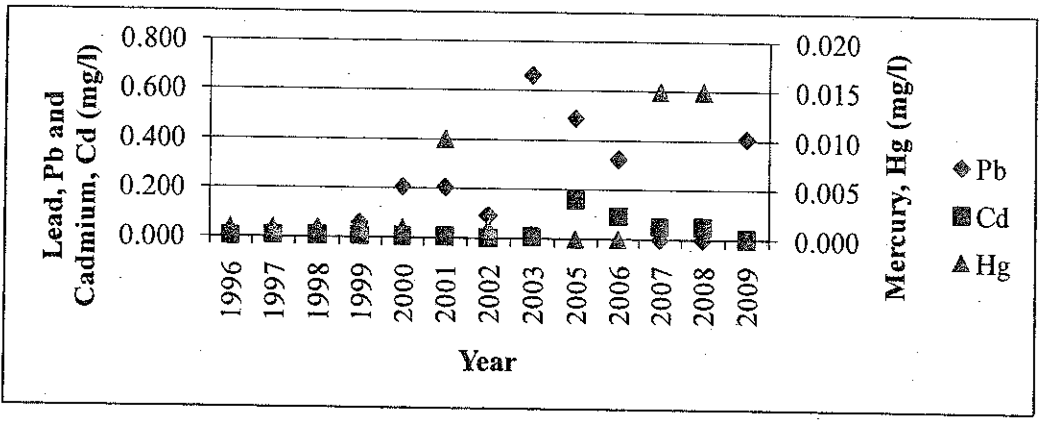

Figure 6: Concentration of Pb, Cd and Hg in Cahaya Bulan beach from year 1996 until 2009.

From five coastal, Cahaya Bulan beach resulted serious heavy metal contamination as shows in Figure 6. The factor such as location of the beach near with town (Kota Bharu), high of population density and many textile industry develop near with this coastal reliable contribute to heavy metals contamination in this coastal. Batik is traditional textile in Kelantan, this industry develop near with the Cahaya Bulan beach because of popularity of this coastal and one of tourist attraction.

Conclusion

As a conclusion most critical heavy metal contamination along Kelantan coasts is Lead (Pb), followed by Cadmium (Cd) and Mercury (Hg). The location with higher of heavy metal concentration consider not suitable for any coastal water activity.

References

A.K. Ahmad, I. Mushrifah, M. S. Othman (2009). Water Quality and Heavy Metal Concentrations in Sediment of Sungai Kelantan, Kelantan, Malaysia: A Baseline Study. Sains Malaysiana 38(4): 435–442.

P. M. D. Prasath, T. H. Khan (2008). Impact of Tsunami on the Heavy Metal Accumulation in Water, Sediments and Fish at Poompuhar Coast, Southeast Coast of India. E-Journal of Chemistry 5(1): 16-22.

A. D. Eaton, L. S. Clesceri, E.W. Rice and A. E. Greenberg (2005). 21st Edition, Standard Method for the Examination of Water and Wastewater. American Public Health Association.

S. E. Martin, W. Griswold (2009). Human Health Effect of Heavy Metal. Center for Hazardous Substance Research, Issue 15. (http://www.engg.ksu.edu/chsr/outreach/resources/docs/15HumanHealthEffectsofHeavyMetals.pdf, excess on 15 September 2011)

DOE (2006). Environmental Quality Report. Kuala Lumpur: Department of Environment.