Link to publisher version: *https://doi.org/10.1016/j.apcbee.2013.05.003*

Citation: Alajtal AI, Edwards HGM and Elbagermi MA (2013) Monitoring of Heavy Metal Content in Tawargah Pond in Libya. APCBEE Procedia. 5: 11-15.

Available online at www.sciencedirect.com
SciVerse ScienceDirect
APCBEE Procedia 5 (2013) 11 – 15
Procedia APCBEE
www.elsevier.com/locate/procedia

ICESD 2013: January 19-20, Dubai, UAE

Monitoring of Heavy Metal Content in Tawargah Pond in Libya

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Abstract

The current study investigated the distribution of inorganic metals in the biggest reservoir in the neighbourhood of Misurata City, Tawargah Pond. The investigation was carried out during the topical periods of dry and wet season between August 2010 and January 2011. Levels of trace metals lead (Pb), copper (Cu), iron (Fe) and zinc (Zn)) were determined in the water samples taken. An atomic absorption spectrophotometer, Model 180-30 Hitachi, was used to determine heavy metal concentrations. The instrument was calibrated and standardized with different working standards. After making sure that the instrument was properly calibrated and results of the standard measurements were in the confidence limit, the concentration of metals in each sample was measured individually. High levels of lead and iron were found in water which indicates a possible contribution from the industrial activities and air pollution.

Keywords: Trace metals, water, Atomic Absorption, Tawargah.

1. Introduction

The problem of environmental pollution due to toxic metals is of major concern in most major metropolitan cities. The toxic metals entering the ecosystem may lead to geoaccumulation, bioaccumulation and biomagnifications. Whereas trace metals are necessary for proper functioning of biological systems, their deficiency or excess can lead to a number of disorders [1]. Water is one of our most important natural resources, and there are many conflicting demands upon it. Skilful management of our water bodies is

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doi:10.1016/j.apcbee.2013.05.003

required if they are to be used for such diverse purposes as domestic and industrial supply, crop irrigation, transport, recreation, sport and commercial fisheries, power generation, land drainage and flood protection, and waste disposal. An important objective of most water management programmes is the preservation of aquatic life, partly as an end in itself and partly because water which sustains a rich and diverse fauna and flora is more likely to be useful to us, and less likely to be a hazard to our health, than one which is not so endowed. To meet this objective, it is necessary to maintain within certain limits factors such as water depth and flow regimes, temperature, turbidity and substratum characteristics, and the many parameters which contribute to the chemical quality of the water [2- 5]. In many parts of the world, rivers and ponds have become contaminated with heavy metals such as zinc, lead and copper as a result of mining and associated activities [6-7]. In our case study the effects of the mining activity are still detectable, but these effects have not been compounded and complicated by those of other forms of pollution associated with modern development. For this reason, they offer the opportunity to investigate the impact of an important group of industrial pollutants—heavy metals—on waters which are relatively unaffected by the pressures which have more recently been unleashed on water bodies in more densely-populated areas [8].This study reports the analysis of the selected metals lead, copper, iron and zinc in Tawargah Pond in Misurata city. Misurata province is the most important industrial centre in Libya.

Table 1. Concentration, mean, standard deviation and range for lead mg/l (ppm) in water samples.

Months	*Min*	*Max*	*Mean*	*S.E ±*
Augusts	*0.19*	*0.40*	*0.27*	*0.114*
September	*0.30*	*0.70*	*0.45*	*0.218*
October	*0.44*	*0.65*	*0.55*	*0.105*
November	*0.11*	*0.71*	*0.34*	*0.317*
December	*0.14*	*0.40*	*0.29*	*0,130*
January	*0.14*	*0.81*	*0.41*	*0.360*

2. Experimental Method

2.1. Study Site

Tawargah pond is located in Libya, about 38 km northeast of Misurata city and receives domestic and industrial wastewater.

2.2. Sampling and Chemical Analysis

Samples of water were taken weakly between August 2010 and January 2011 (dry and wet seasons). A total of 24 water samples were obtained. The water samples were collected in 1-L size acid-washed polypropylene bottles about 1.5 m from the shore at a depth of 15 to 30 cm [9] and transported to the laboratory for further analysis. The evaluated metals were lead, copper, iron and zinc.

Table 2. Concentration, mean, standard deviation and range for copper mg/l (ppm) in water samples

Months	*Min*	*Max*	*Mean*	*S.E ±*
Augusts	*0.51*	*0.58*	*0.56*	*0.027*
September	*0.51*	*0.58*	*0.53*	*0.026*
October	*0.80*	*0.93*	*0.89*	*0.046*
November	*0.75*	*0.92*	*0.85*	*0.070*
December	*0.72*	*0.84*	*0.72*	*0.060*
January	*0.53*	*0.66*	*0.61*	*0.050*

Concentrations of heavy metals were determined according to the Standard Method for Examination of Water and Waste Water [9] by an Atomic Absorption Spectrophotometer

Table 3. Concentration, mean, standard deviation and range for iron mg/l (ppm) in water samples

Months	*Min*	*Max*	*Mean*	*S.E ±*
Augusts	*0.25*	*0.36*	*0.33*	*0.040*
September	*0.24*	*0.31*	*0.26*	*0.025*
October	*0.31*	*0.80*	*0.57*	*0.194*
November	*0.46*	*0.65*	*0.52*	*0.069*
December	*0.62*	*0.83*	*0.68*	*0.77*
January	*0.55*	*0.82*	*0.65*	*0.095*

2.3. Instrumental Analysis

An atomic absorption spectrophotometer, Model 180-30 Hitachi, was used to determine heavy metal concentrations. The instrument was calibrated and standardized with different working standards. After making sure that the instrument was properly calibrated and results of the standard measurements were in the confidence limit, the concentration of metals in each sample was measured individually. The limits of detections were calculated as the average laboratory blank value plus three times its standard deviation. These values were 0.001, 0.003, 0.001, and 0.001 mg/kg for Pb, Cu, Fe and Zn, respectively.

Also, the limit of quantification (LOQ) of the element was determined which is taken as the average laboratory blank value plus 10 times its standard deviation ; these were 0.003, 0.010, 0.003 and 0.003 mg/kg for Pb, Cu, Fe and Zn, respectively

2.4. The Permissible Limits (P.L) of Heavy Metals

Safe values for lead (Pb), copper (Cu), Iron (Fe) and zinc (Zn) in water are 0.05, 1, 0.3 and 5ppm, respectively [9, 10].

3. Results and Discussion

The results clearly indicate that heavy metal concentrations were commonly exceeding the international permissible limits of heavy metals reported in the literature [9, 10]. According to tables 1 to 4, both lead and iron are higher than the other metals studied compared with the international permissible limits of heavy metals [9, 10], The possible reason for this could be due to Tawargah being predominantly a farming region and that the higher concentration of lead in the air arises from oil extraction and vehicular exhaust emissions; according to tables 1-4, there was a significant variation during different seasons, however in October and December the highest mean concentrations of lead and iron were 0.55 and o.68 mg/l , respectively. The concentrations of copper are about the same or less than the values reported for the international permissible limits of heavy metals [9, 10]; the maximum mean concentration of this metal in October was 0.89 mg/l but the minimum mean concentration was 0.56 mg/l in August. The iron concentration was observed at 0.26 to 0.68 mg/l which is higher than the international permissible limits of heavy metals, except in the month of September when it was found to be lower than the international permissible limits of heavy metals.

Table 4. Concentration, mean, standard deviation and range for zinc mg/l (ppm) in water sample

Months	*Min*	*Max*	*Mean*	*S.E ±*
Augusts	*0.48*	*0.63*	*0.58*	*0.053*
September	*0.57*	*0.71*	*0.61*	*0.050*
October	*0.49*	*0.61*	*0.58*	*0.045*
November	*0.81*	*0.93*	*0.89*	*0.053*
December	*0.79*	*0.68*	*0.71*	*0.041*
January	*0.65*	*0.77*	*0.72*	*0.043*

The mean concentration of zinc ranged between 0.58 and 0.89 mg/l for the dry and wet season water samples (all months). These concentrations for both seasons are lower than the international permissible limits of heavy metals.

4. Conclusions

Seasonal variations in the concentrations of selected heavy metals in Tawargah pond were investigated using an atomic absorption spectrophotometer. The results of this study indicate that lead and iron were in the highest concentration and that concentrations of copper and zinc were lower than the international permissible limits of heavy metals. This situation can be ascribed to Tawargah being a farming and industrial area and that the higher concentration of lead in the air emanates from oil extraction and vehicular exhaust emissions.

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