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Environmental Impact Assessment for Disposal of Sewage into Sea Water at Sabratah, Libya

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Abstract

The increasing of development in countries with high populations is associated with several impacts on the environment due to human wastes. The present work aimed to assessment of environmental contamination of sea water which received untreated sewage effluents generated from Sabratah city since 1998. The study investigated the physical and chemical characteristics of sea water at the disposal point and inside the sea during the period from May 2014 to February 2015. The sampling points were determined using GPS Map 60 CX. Chemical Oxygen demand (COD), Biological Oxygen demand (BOD_5), total dissolved salts (TDS) and nitrogen were determined using international standards methods of water and wastewater. The maximum concentration of COD, BOD and nitrogen was determined at the discharge point, it was 473, 140 and 263 mg L^{-1}, respectively. Among the heavy metals investigated, the highest concentrations were determined for Fe (0.89 mg L^{-1}). It can be concluded that the discharge of untreated sewage into the sea water has an adverse effects on the aquatic organisms diversity in the marine environment and might effect on the human health via consumption of contaminated fishes.

Key words: sewage, COD, BOD, pollution, sea water, Sabratah, Libya

I. INTRODUCTION

The increasing of development in countries with high populations is associated with several impacts on the environment due to human wastes which contains a huge number of pathogenic microorganisms such as bacteria, viruses and parasites [1]. The discharge of sewage is imperative for the recognition of the right to sanitation. Therefore, many of countries have adopted standards, which regulate sewage disposal on the basis of risk to the public health and the environment. In Libya the management of these wastes has been one of the prime environmental issues. The country has yet to adopt a practical, economic and acceptable approach in managing and disposing sewage. The present practice is direct disposal in sea. However, these practices are unacceptable due to increasing of the smells generated and the volume of the wastes involved as well as increasing the risks to health [2].

Sewage is a complex mixture of organic and inorganic compounds. The disposal of sewage untreated/partially treated into the environment might contribute in the increasing of water pollution [3]. The extreme quantities of organic compounds discharged into the water bodies may cause a reduction of the dissolved oxygen resources and rapid bacterial growth [4]. The high microorganism levels in the natural water that received sewage lead to raise the BOD, resulting in depletion of oxygen levels and pH values required for the various types of living organisms supported by the estuary. In addition, human pathogenic organisms could be the sewage content of animal and plant pathogens; these can go on and infect aquatic animals, livestock as well as wildlife [5]. The health risk of human lies in the transfer of pathogenic microorganisms to humans directly or indirectly which occur through contamination of water [6]. Santhiya et al. [7] revealed that seawater and sediments polluted with discarded sewage in Morocco were heavily contaminated with several pathogenic microorganisms.

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The present study aimed to assessment of environmental contamination of sea water which received untreated sewage generated from Sabratah city since 1998. The physical and chemical characteristics of sea water at the disposal point and inside the sea during the period from May 2014 to February 2015 were tested.

II. MATERIALS AND METHODS

A. *Study area*

Sabratah is a city located in the Zawiya District in the northwestern corner of Libya. It lies on the Mediterranean coast about 66 km (41 mi) west of Tripoli (Figure 1). The total population is around 152,521 PE. It has one central sewage treatment plant (STP) established on 1978. The STP was received and treated domestic, hospital and industrial wastewater. However, this STP has stopped since 1998 due to absence maintenance. Recently the sewage are discharged directly into the sea water without treatment.

Figure 1 google map of Sabratah city

B. *Collection of samples*

Hundred sewage and sea water samples were collected from the disposal point and inside the sea during the period from May 2014 to February 2015 (three samples/month). The sewage samples were collected using grape sampling with glass bottles (1 L). The collection of samples (1 L) was carried out from the point of disposal of sewage as determined using GPS Map 60 CX (Figure 2).

C. *Chemical and physical analysis*

Temperature, Electrical Conductivity (EC) and pH of the sewage was measured using YSI 556 MPS (Multiprobe System). Chemical Oxygen demand (COD), Biological Oxygen demand (BOD_5), total dissolved salts (TDS), total nitrogen (TN) as well as heavy metals (Cu, Fe, Pb, As, Cd and Hg) were determined according to international standards methods of water and wastewater (Table 1).

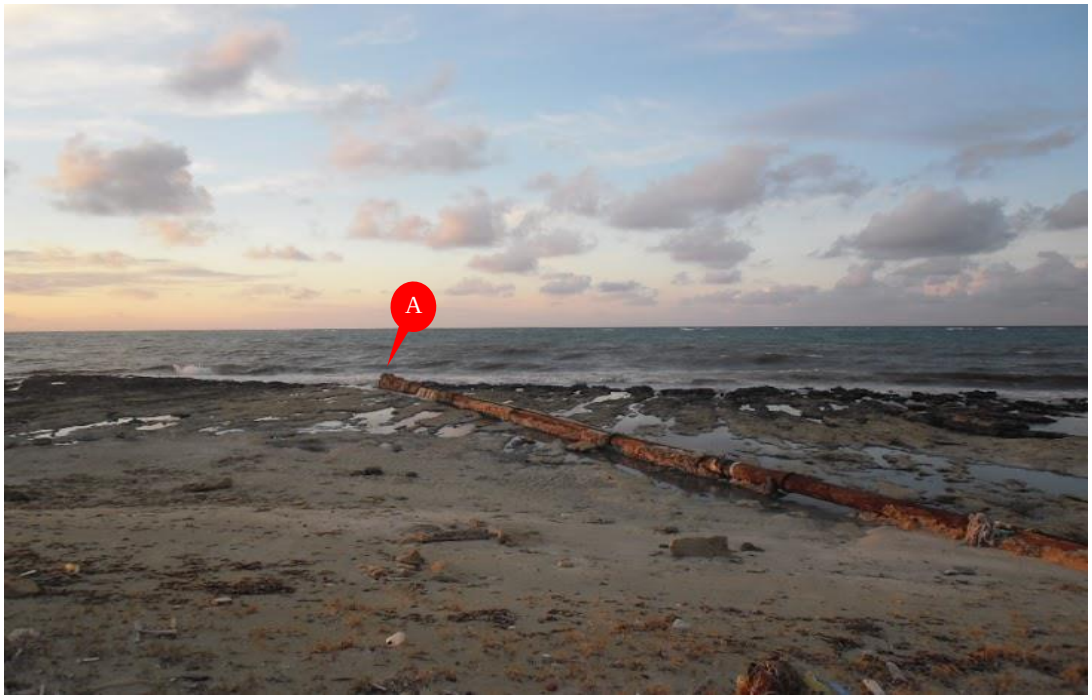

Figure 2 Sampling point

For heavy metals determination, 2.4 mL of a 15 % solution of ethylene di-amine-tetra acetic acid (EDTA) tetra-sodium salt (R & M Marketing, Essex, UK), was added as chelating agent to sample. The samples were transported to the laboratory in a cooler box and the microbiological analysis was carried out within 2 h of collection.

Table 1 physical and chemical analysis of sewage

Parameter	Unit	Method
COD	mg/L	NF T 90-101 (2001)
BOD	mg/L	NF EN 1899-1(1998)
TN	mg/L	NF T 90-015-1 (2000)
Cd	mg/L	NT ISO 15587-1 (2009)
Cu	mg/L	
Fe	mg/L	
Pb	mg/L	
As	mg/L	
Hg	µg/L	PERKIN ELMER (2008)

Chemical Oxygen demand (COD), Biological Oxygen demand (BOD_5), total dissolved salts (TDS), total nitrogen (TN), Cadmium (Cd), Copper (Cu), Lead (Pb), Arsenic (As), Mercury (Hg)

III. RESULTS AND DISCUSSION

The chemical characteristics of sewage samples collected from discharge point of sewage treated plant at Sabratah city is presented in Table 2. It can be noted that the sewage samples contains high concentrations of COD, BOD and TN more than that recommended by international standards for the disposal process.

Table 2 Chemical parameters of sewage samples collected from discharge point

Parameter	Unit	Range of concentrations
COD	mg/L	316-473
BOD	mg/L	113-140
TN	mg/L	263-37.5
Cd	mg/L	0.00127-0.0027
Cu	mg/L	0.008-0.01
Fe	mg/L	0.890-0.560

Pb	mg/L	<0.010
As	mg/L	0.005-0.007
Hg	µg/L	2.98-3.25

Chemical Oxygen demand (COD), Biological Oxygen demand (BOD_5), total dissolved salts (TDS), total nitrogen (TN), Cadmium (Cd), Copper (Cu), Lead (Pb), Arsenic (As), Mercury (Hg)

The concentrations of heavy metals was low and within the WHO guidelines. However, the disposal of these wastes into sea water with high chemical paparmetrs (COD, BOD and TN) represent a real hazards of aquatic organisms.

The physical and chemical characteristics of sea water samples are illustrated in Table 3. Temperature was between 21 and 29 ºC, while pH was in average 8.1. COD and BOD were quit high compared to the international standards of disposed wastewater.

Table 3 Average of Physical and chemical parameters of collected sea water samples around sewage discharge point

Month	**Temperature (ºC)**	**pH**	**EC**	**COD (mg L)**	**BOD (mg L)**	**TN (mg L)**	**TDS (mg L)**
May-14	21.8	8.16	52401	52.7	31.62	0.01	3572
Jun-14	22	8.17	52880	48.4	29.04	0	3590
Jul-14	22.3	8.22	52848	49	30	0.03	3590
Aug-14	22.35	8.23	53388	53.3	31.98	0.01	3597
Sep-14	27.85	8.22	59579	40.1	24.06	0.02	36160
Oct-14	28.31	8.19	60237	49.2	29.52	0.03	36180
Nov-14	29.1	8.13	60825	38.6	23.16	0.01	36110
Dec-14	28.66	8.19	60429	51.1	23.7	0.01	36000
Jan-15	21.97	7.76	60566	68	40.8	0.05	3646
Feb-15	22.1	7.78	53721	52.5	31.5	0.4	3645
Average	**24.64**	**8.1**	**56687.4**	**50.29**	**29.54**	**0.02**	**16609**

Chemical Oxygen demand (COD), Biological Oxygen demand (BOD_5), total dissolved salts (TDS), total nitrogen (TN)

The high values of COD used as an indicator of the chemical reaction between the organic compounds of sewage which consume the oxygen and thus generate high COD. While BOC represent the ability of microorganisms to oxidise organic material in the sewage into carbon dioxide and water based on the molecular oxygen which used as an oxidizing agent. High concentrations of BOD in sewage lead to the reduction of dissolved oxygen of the receiving water bodies and thus reduction in pH values and microbial growth, as well as deaths of aquatic animals [8]. The domestic sewage contains low concentration of heavy metals compared to the industrial wastewater due to chemical substances used in the industries which generate high content of heavy metals in their wastewater [9]. Presence of TN in the sewage lead to microalgae growth and algae bloom in the water

The temperature of the sewage is one of the important factors which influence in the chemical and biological reactions of aquatic organisms in the water bodies. Temperature also affects the conductivity, pH, saturation level of gases and various forms of alkalinity [10].

The inorganic constituents of sewage include total hardness (calcium, sodium, magnesium, potassium) and heavy metals [11]. Some heavy metals such as Pb, Cu, As, Cd, Fe, and Hg have reported to be present in sewage [9,12,13,14] where they come from the detergents and chemical products used for the bath pipes and other metal water fixtures, but presented with low concentrations and in most cases. However, the main concern with heavy metal lies in their accumulation in the plants tissue and their transmission into humans and animals, since the heavy metals are non-biodegradable, thus their accumulation

in the organs can cause several diseases when they reached a high dose [15, 16].

IV. CONCLUSION

It can be concluded that the direct discharge of sewage into the sea water represent a serious risk for the environment and all organisms in the sea water including fish. The human infection might take place via the consumption the contaminated of sea food. Therefore, STP at Sabratah should be rework gain with annually maintenance to insure the efficiency of the treatment and produce high quality sewage effluents before the final disposal into the sea water.

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