EVALUATION OF MERCURY (HG) LEVEL IN WATER FROM WATERSHED OF THE KOWSAR DAM

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Abstract- Among the inorganic contaminants of the river water, heavy metals are getting importance for their non-degradable nature and often accumulate through tropic level causing a deleterious biological effect .The Kowsar dam supply water for different usages such as drinking, industrial, agricultural and aquaculture farms usages and located next to the city of Dehdashat in Kohgiluye and Boyerahmad province in southern Iran. There are some towns and villages on the Kowsar dam watersheds, which Dehdasht and Choram are the most important and populated cities in this area. The study was undertaken to assess the status of water quality in the urban areas of the Kowsar dam. A total of 28 water samples were collected from 6 stations on surface water and 1 station from groundwater on the watershed of the Kowsar dam. All the samples were analyzed for Hg concentration using standard procedures. The results were compared with other national and international standards. Among the analyzed samples, as the maximum value of Hg (0.001 mg/L) was observed on the station 5 at the Spring 2010, all the samples analyzed were within the maximum admissible limits by the United States Environmental Protection Agency, EU, WHO, New Zealand , Australian, Iranian, and the Indian standards. In general results of the present study have shown that Hg mean values of stations No. 1 and 2 with 0.0009 and 0.0005mg/L respectively are higher than the other stations. Although Hg level of all samples and stations have had normal values but this is an indication of pollution potential and hazards because of human activity and waste water of towns in the areas, which can effect on human health implications in future. This research, therefore, recommends the government and other responsible authorities to take suitable improving measures in the Kowsar dam watersheds.

Keywords: Kowsar Dam, Drinking Water Quality, Mercury (Hg), Maximum Admissible Limit, World Health Organization,

I. INTRODUCTION

W e know less than 0.007 percent of all water on Earth is available to drink and less than 1 percent of all fresh water is readily accessible for human use. So pollution control and protection of water resources systems are necessary and water quality has an important role on the human health and aquatic ecosystems. As we need development for better living, and some of development plant have some disadvantages on environment and water systems, the development plant have to sustainable for decreasing the human activity on water pollution. Of the 6 billion people on earth, more than one billion lack accesses to safe drinking water and, about 2.5 billion do not have access to adequate sanitation services [1]. In addition to these shortcomings, various types of waterborne diseases kill on an average more than 6 million children each year i.e. about 20,000 children a day [1]. Besides the shortage, drinking water may be contaminated by different contaminants which have an impact on the health and economic status of the consumers [2]. Contaminants such as bacteria, viruses, heavy metals, nitrates and salt have found their way into water supplies due to inadequate treatment and disposal of waste (human and livestock), industrial discharges, and over-use of limited water resources [3]. Even if no sources of anthropogenic contamination exist, natural sources are also equally potential to contribute higher levels of metals and other chemicals that can harm human health [4]. The toxic effects of mercury depend on its chemical form and the route of exposure. Methyl mercury [CH_3Hg] is the most toxic form. It affects the immune system, alters genetic and enzyme systems, and damages the nervous system, including coordination and the senses of touch, taste, and sight. Methyl mercury is particularly damaging to developing embryos, which are five to ten times more sensitive than adults [5].

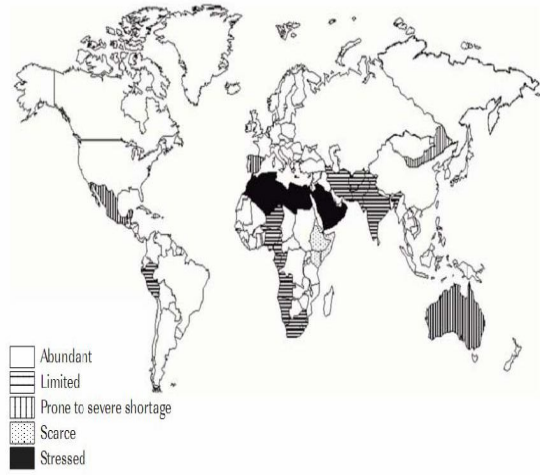


Fig. 1 Water availability in different region of the world



Fig. 2 Location of the Kohgiluye & Boyer-Ahmad in Iran

The physio-chemical characteristics of mercury have made it a favourable component for many industrial and agricultural applications. Significant anthropogenic Hg sources include fossil fuel combustion, the chloralkali industry and pharmaceuticals. Modifications to industrial practices and stricter regulations have led to emission reductions in many countries; however, this has been countered by the increased use of Hg for gold amalgamation, particularly in tropical, developing countries. Under any of these circumstances, varying quantities and forms of Hg have been inevitably released to environments where it can pose a risk to human and ecological health [6]. Industrial activities use Hg for various purposes and can therefore introduce Hg into the environment in many different forms. As the toxicological impacts of Hg are largely dependent on speciation, understanding its transformations and the impacts of various chemical forms is vital to the prevention of harmful human and environmental health effects. Ultimately, the Hg species present in a given environment depends on the initial released form, the thermodynamic stability of this compound and the transformation rate of the released form to a more stable one. These issues must be well understood to effectively design and evaluate appropriate remedial solutions in Hg impacted areas [7]. Depending on the mercury source and how it was released into the environment, mercury may be present in concentrated "hot spots" or dispersed over extensive areas, as is often the case in agricultural applications or atmospheric deposition adjacent to power generating facilities [6].

In highly polluted areas where mercury has accumulated through industrial or mining activities, natural processes may bury, dilute, or erode the mercury deposits, resulting in declines in concentration. In many relatively pristine areas, however, mercury concentrations have actually increased because atmospheric deposition has increased. For instance, concentrations of mercury in feathers of fish-eating seabirds from the northeastern Atlantic Ocean have steadily increased for more than a century. In North American sediment cores, sediments deposited since industrialization have mercury concentrations about 3-5 times those found in older sediments. Some sites may have become methylmercury hot spots inadvertently through human activities. Lake acidification, addition of substances like sulfur that stimulate methylation, and mobilization of mercury in soils in newly flooded reservoirs or constructed wetlands have been shown to increase the likelihood that mercury will become a problem in fish. Although scientists from USGS and elsewhere are beginning to unravel the complex interactions between mercury and the environment, a lack of information on the sources, behavior, and effects of mercury in the environment has impeded identification of effective management responses to the Nation's growing mercury problem [5]. Kowsar Dam has been constructed on Kheirabad River in Kohkiluye and Boyerahmad Province (Fig .2) southwest of Iran. There are some towns and villages on the Kowsar dam watersheds, which Dehdasht and Choram are the most important and populated cities in this area. The study was undertaken to assess the status of water quality in the urban areas of the Kowsar dam.

II. MATERIALS AND METHODS

The main goal of this paper is to determine the levels/concentration of the Hg as a heavy metal in water in different parts of the Kowsar dams watershed to compare the values with the national and international organization (like WHO) recommended drinking water standards (Table.1). The dam will supply water to the Persian Gulf littoral cities and ports for nearly 20 years. It will offer water to 2.4 million habitants in south of Iran. Kowsar Dam will flow 70 million cubic meters of water to farmlands in Lishter, Boneh and Zeidoun deserts. The dam can hold 684 million cubic meters of water per annum. In order to evaluation of water quality of the Kowsar dam water sampling were done with seasonally duration on the Kowsar dam reservoir and its watersheds have been shown in figure 3. Information about sampling stations are shown in table 1.

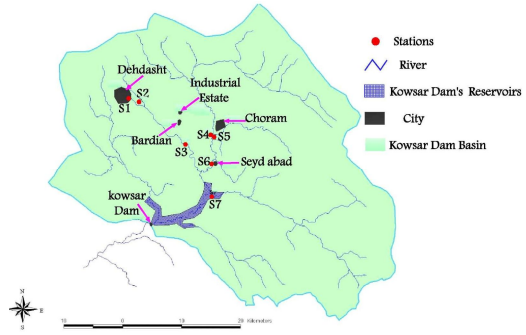


Fig. 3 Location of the sampling station on the streams and the Kowsar damreservoir.

TABLE I.
Information about sampling stations in study area

No.	Stations	UTM. X	UTM. Y	elevation
S1	Dehdasht	459458	3406145	1631
S2	Dezhkam well	461525	3405728	1630
S3	Barm- Morghabi	469329	3398564	1534
S4	Toughar river	473853	3400147	1524
S5	Kam-Lisho river	473962	3399945	1524
S6	seyd-Abad	473899	3395254	1489
S7	Kousar Dam	473794	3389578	1454

A standard method was used for sampling. Water was collected in polyethylene bottles 0.5 m below the surface. All glass and plastic ware used for sampling and analyses were rinsed with milli-Q water.

TABLE II.
Drinking water contaminants and maximum admissible limit set by different national and international organization.

Standards	Hg
	mg/L
USEPA 2008	0.002
EU,1998	0.001
WHO,2008	0.001
Iranian,1997	0.001
Indian,2005	0.001



Fig 4. Station 1 is located on the main waste water collection canal in Dehdasht.

Hg has been determined by atomic absorption spectroscopy using either direct aspiration into a flame or a furnace spectrometric technique. The detection limit is 5 µg/liter with the flame method and 0.1 µg/liter with the furnace procedure [13,14,15,16]. The situations of stations No. 1, 2 and 4 in the watershed of the Kowsar dam were showed in figures 4 to 6.

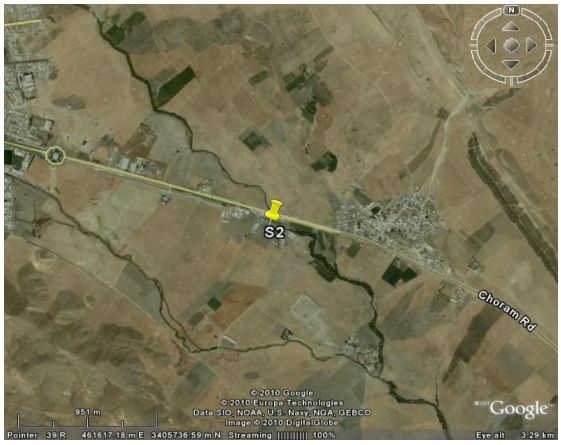


Fig5. Location of station 2 (a groundwater well)

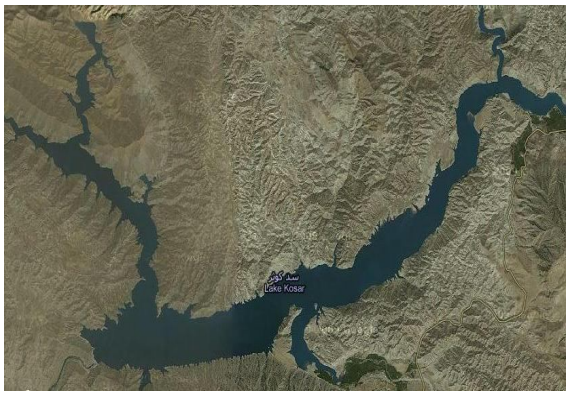


Fig 6.The Kowsar dam reservoir

III. RESULTS AND DISCUSSION

First statistical parameters of values such as mean maximum, minimum, standard deviation, skewness, Kurtosis, were determined. The values of Hg concentration and their statistical parameters of the the water samples are illustrated in Table 2. Based on measured value of all stations an seasons, maximum Hg concentration (0.001 mg/L) was recorded in station 5 near Choram at spring 2010, and stations 4 has had minimum value (0 mg/L) at winter 2010. Comparison of mean values were illustrated in figure 7 .As this chart shows ,mean values of Hg concentration during 4 seasons in station 1and 2 have had higher level related to other stations. Station 1 is located on the main waste water collecting canal of Dehdasht, and station 2 is located near the Dehdasht city. Hg levels in station 4, 1and 4 were increase because of rising in human activity near the mentioned station.

TABLE III
Hg concentration in Stations of study area

Season	Hg (mg/L) in Stations						
	1	2	3	4	5	6	7
Winter2009	0.00098	0.00057	0.00013	0.000	0.00011	0.000066	0.000075
Spring 2010	0.00086	0.00063	0.00063	0.00062	0.00105	0.000069	0.00003
Sumer 2010	0.0008	0.00025	0.000096	0.00021	0.000021	0.000065	0.000021
Autumn 2010	0.00098	0.00065	0.00023	0.00013	0.00015	0.0002	0.00021
MAX	0.00098	0.000650	0.00063	0.00062	0.00105	0.00020	0.00021
MIN	0.0008	0.00025	0.00010	0.00000	0.00002	0.00007	0.00002
AVR	0.00091	0.00053	0.00027	0.00024	0.00024	0.00010	0.000084
STD	0.00009	0.00019	0.00025	0.00027	0.00048	0.00007	0.00009
Skew	-0.370	-1.809	1.698	1.379	1.924	1.996	1.598
Kurt	-3.901	3.292	2.852	2.281	3.764	3.987	2.387

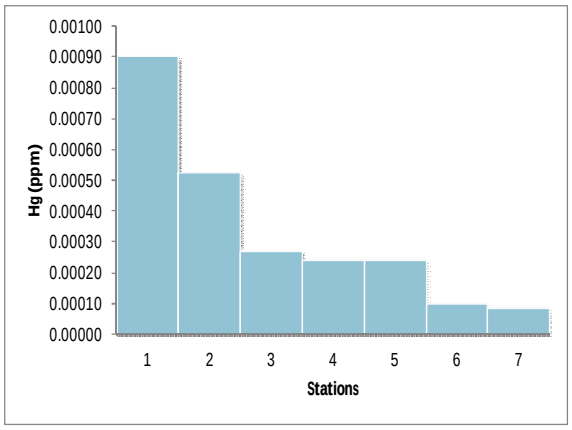


Fig 7. Mean value of Hg levels on all Stations (mg/L)

CONCLUSION

The study was done to evaluate the status of Mercury concentration in the upstream watershed of the Kowsar dam. A total of 28 water samples were collected from 6 stations on surface water and 1 station from groundwater on the watershed of the Kowsar dam. The results were compared with other national and international standards. Among the analyzed samples, as the maximum value of Hg (0.001mg/L) was observed on the station 5 at the spring 2010, all the samples analyzed were within the maximum admissible limits by the United States Environmental Protection Agency 2008(0.002 mg/L) ,and almost as high as EU 1998 (0.001 mg/L) ,the WHO 2008(0.001 mg/L) , the Iranian,1996 (0.001 mg/L) and the Indian,2005 (0.001 mg/L). In general results of this present research have shown that Hg mean values of stations No. 1 with 0.00098 mg/L are higher than the other stations. Although Hg level of all samples and stations have had normal values currently ,but this is an indication of pollution potential and hazards because of human activity and waste water of towns in the areas, which can effect on human health implications in future. This research, therefore, recommends the government and other responsible authorities to take suitable improving measures in the Kowsar dam watersheds.

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