

# Assessment of Cadmium Level in Water from Watershed of the Kowsar Dam

Fardin Boustani

**Abstract**—The Kowsar dam supply water for different usages such as drinking, industrial, agricultural and aquaculture farms usages and located next to the city of Dehdasht in Kohgiluyeh and Boyer-Ahmad 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 Cd concentration using standard procedures. The results were compared with other national and international standards. Among the analyzed samples, as the maximum value of cadmium (1.131 µg/L) was observed on the station 2 at the winter 2009, 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 Cd mean values of stations No. 4, 1 and 2 with 0.5135, 0.04733 and 0.4573 µg/L respectively are higher than the other stations. Although Cd 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 watershed's.

**Keywords**—Kowsar dam, Drinking water quality, Cadmium, Maximum admissible limit, World health organization,

## I. INTRODUCTION

WE 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 (TWAS, 2002) [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. This is highlighted recently in Bangladesh where natural levels of arsenic in groundwater were found to be causing harmful effects on the population [4].

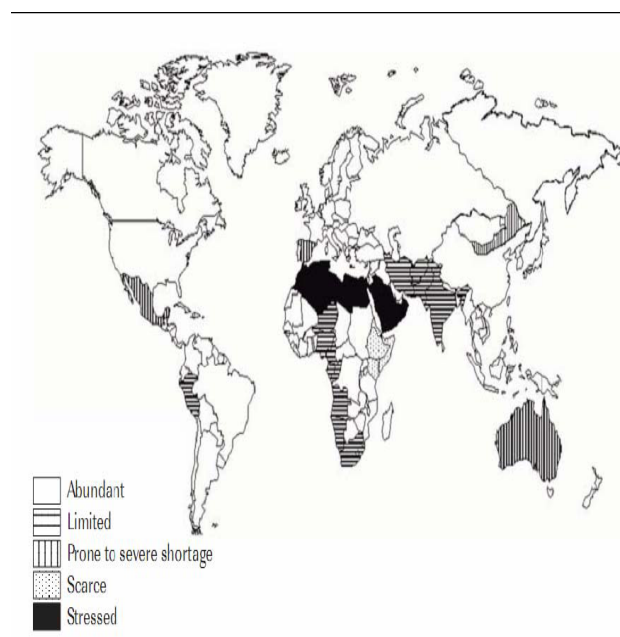


Fig. 1 Water availability in different region of the world [1]

Fardin Boustani is, assistant professor of Science and Research Branch, Islamic Azad University, Fars, Iran (fardinboustani@gmail.com).



Fig. 2 Location of the study area

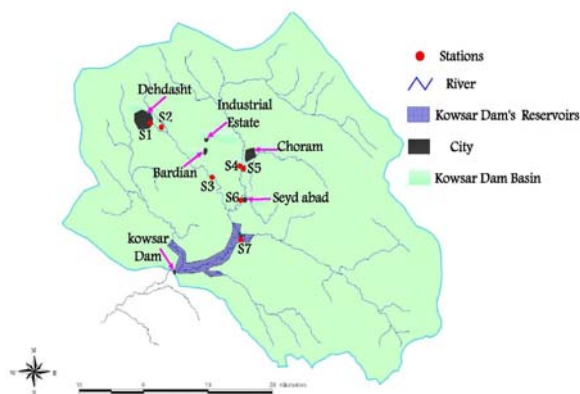


Fig. 3 Location of the sampling station on the streams and The Kowsar damreservoir

Cadmium concentrations in unpolluted natural waters are usually below 1  $\mu\text{g/litre}$  [5]. Median concentrations of dissolved cadmium measured at 110 stations around the world were  $<1 \mu\text{g/litre}$ , the maximum value recorded being 100  $\mu\text{g/litre}$  in the Rio Rimao in Peru [6]. Average levels in the Rhine and Danube in 1988 were 0.1  $\mu\text{g/litre}$  (range 0.02–0.3  $\mu\text{g/litre}$ ) [7] and 0.025  $\mu\text{g/litre}$  [8], respectively. In the sediments near Rotterdam harbour, levels in mud ranged from 1 to 10 mg/kg dry weight in 1985–1986, down from 5–19 mg/kg dry weight in 1981 [9]. Although earth's crust concentration of cadmium is 0.1 to 0.5 mg/kg, but accumulation in sedimentary rocks, marine phosphate and phosphorites may be much as high as 500 mg/kg [10]. Due to weathering and erosion of rocks, it is estimated that 15000 metric tonnes of cadmium is transported to oceans through rivers (WHO, 1992; OECD, 1994) [10]. Volcanic activity and forest fires are also major natural sources of cadmium release to the atmosphere.

### Anthropogenic Emissions

Man- made emissions of cadmium either from the manufacture, use and disposal of cadmium containing products. The cadmium containing products included:

- Nickel- Cadmium Batteries
- Cadmium pigmented plastic, ceramics, glasses, paints and enamels
- Cadmium stabilized Polyvinyl chloride (PVC) products
- Cadmium coated ferrous and Non-ferrous products
- Cadmium alloys
- Cadmium electronic compounds
- Cement
- Phosphate fertilizers

### Phosphate fertilizers

Cadmium metal is used mainly as an anticorrosive, electroplated onto steel. Cadmium sulfide and selenide are commonly used as pigments in plastics. Cadmium compounds are used in electric batteries, electronic components and nuclear reactors [5,9].

## II. MATERIALS AND METHODS

The main goal of this paper is to determine the levels/concentration of the Cd 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 as have been shown in figure no.3.

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.

Cadmium have been determined by atomic absorption spectroscopy using either direct aspiration into a flame or a furnace spectrometric technique. The detection limit is 5  $\mu\text{g/litre}$  with the flame method and 0.1  $\mu\text{g/litre}$  with the furnace procedure [11,12,13,14]

TABLE I

DRINKING WATER CONTAMINANTS AND MAXIMUM ADMISSIBLE LIMIT SET BY DIFFERENT NATIONAL AND INTERNATIONAL ORGANIZATION.

Standards	Cd
	µg/L
USEPA 2008	5
EU,1998	5
WHO,2008	3
Iranian,1997	10
Australian,1996	2
Indian,2005	10
New zealand,2008	4

The situation of stations No. 1,2 and 4 in the watershed of the Kowsar dam were showed in figures 4 to 6



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

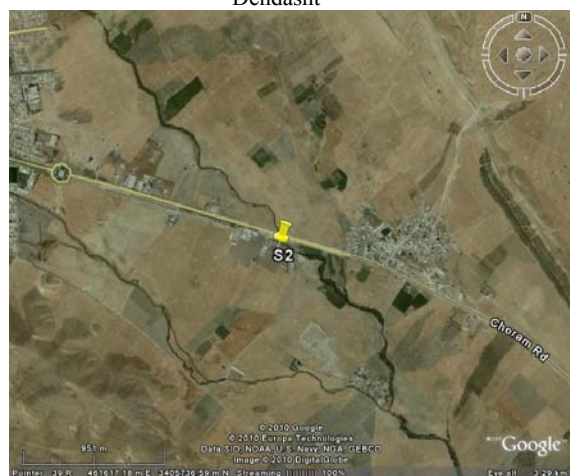


Fig. 5 Location of station 2 (a groundwater well)



Fig. 6 Station 4 is located on the upstream of Kowsar dam basin next to Choram



Fig. 7 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 Cadmium concentration and their statistical parameters of the the water samples are illustrated in Table II and III.

Based on measured value of all stations an seasons ,maximum cadmium concentration(1.131 µg/L) was recorded in station 2 from a groundwater well near Dehdasht at winter 2009,and stations 1 and 5 have had minimum value(0 µg/L) at autumn 2010. Comparison of mean values were illustrated in figure 8.As this chart shows ,mean values of Cadmium concentration during 4 seasons in station 4,1 and 2 have had higher level related to other stations. Station 1 is located on the main waste water collecting canal of Dehdasht ,and station 4 is located on the Komlishi stream at the downstream of Choram . Cadmium levels in station 4,1 and 4 were increase because of rising in human activity near the mentioned station.

### IV. CONCLUSION

The study was done to evaluate the status of Cadmium 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.



TABLE II  
CADMIUM CONCENTRATION IN STATIONS (1,2 AND 3)

Sesons	Cd ( $\mu\text{g/L}$ ) in Stations		
	1	2	3
Winter 2009	0.753	1.131	0.125
Spring 2010	0.750	0.080	0.090
Sumer 2010	0.390	0.380	0.250
Autumn 2010	0.000	0.238	0.119
Mean	0.473	0.457	0.146
Max	0.753	1.131	0.250
Min	0.000	0.080	0.090
Std	0.359	0.466	0.071
Skew	-0.918	1.593	1.714
Kurt	-0.960	2.722	3.233

TABLE III  
CADMIUM CONCENTRATION IN STATIONS (4,5,6 AND 7)

Seasons	Cd ( $\mu\text{g/L}$ ) in Stations			
	4	5	6	7
Winter2009	0.800	0.087	0.091	0.181
Spring 2010	0.850	0.393	0.604	0.123
Sumer 2010	0.220	0.220	0.240	0.290
Autumn 2010	0.184	0.000	0.052	0.978
Mean	0.514	0.175	0.247	0.393
Max	0.850	0.393	0.604	0.978
Min	0.184	0.000	0.052	0.123
Std	0.361	0.171	0.252	0.396
Skew	0.008	0.586	1.442	1.823
Kurt	-5.855	-0.845	1.744	3.368

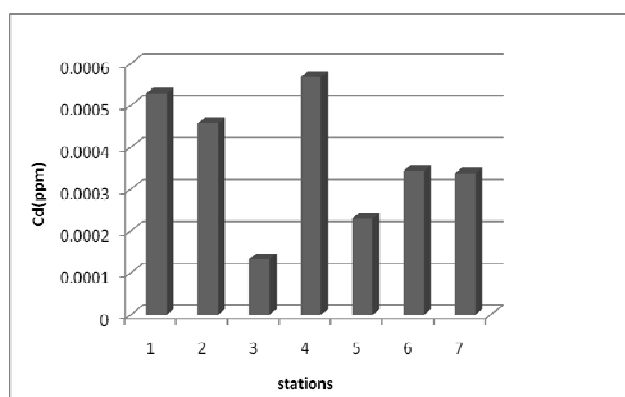


Fig. 8 Mean value of Cadmium levels on all Stations (mg/L)

The results were compared with other national and international standards. Among the analyzed samples, as the maximum value of cadmium (1.131  $\mu\text{g/L}$ ) was observed on the station 2 at the winter 2009, all the samples analyzed were within the maximum admissible limits by the United States Environmental Protection Agency 2008 (5  $\mu\text{g/L}$ ), the EU 1998 (5  $\mu\text{g/L}$ ), the WHO 2008 (3  $\mu\text{g/L}$ ), the New Zealand (4  $\mu\text{g/L}$ ), the Australian, 1996 (2  $\mu\text{g/L}$ ), the Iranian, 1996 (10  $\mu\text{g/L}$ ) and the Indian, 2005 (10  $\mu\text{g/L}$ ). In general results of this present research have shown that Cd mean values of stations No. 4, 1 and 2 with 0.5135, 0.04733 and 0.4573  $\mu\text{g/L}$  respectively are higher than the other stations. Although Cd 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 watershed's.

#### ACKNOWLEDGMENT

The authors wish to thank the research committee of Kohkiluyeh and Boyer-Ahmad regional water authority, Islamic Azad University, Fars Science and Research branch, and Islamic Azad University, Marvdasht branch for funding this research. Further, we thank all whose names are not mentioned here for their valuable contribution to the success of this research.

#### REFERENCES

- [1] TWAS. 2002. Safe drinking water-the need, the problem, solutions and an action plan, Third world academy of sciences, Trieste, Italy.
- [2] Anonymous, 1992. Report on UN Conf. on Environ. and Development, A/CONF. 151/26., 1, 277
- [3] Singh, S & Mosley, L.M. 2003. Trace metal levels in drinking water on Viti Levu, Fiji Islands. S. Pac. J. Nat. Sci., 21:31- 34.
- [4] Anawara, H.M., Akaib, J., Mostofac, K.M.G., Safiullahd, S & Tareqd, S.M. 2002. Arsenic poisoning in groundwater- health risk and geochemical sources in Bangladesh. Environ. Int., 27:597-604.
- [5] Friberg L, Nordberg GF, Vouk VB, eds. (1986) Handbook of the toxicology of metals. Vol. II. Amsterdam, Elsevier, pp. 130-184.
- [6] WHO/UNEP (1989) GEMS, Global fresh water quality. Published on behalf of the World Health Organization/United Nations Environment Programme. Oxford, Blackwell Reference.
- [7] ARW (1988) 45. Jahresbericht 1988. [45th annual report, 1988.] Düsseldorf, Arbeitsgemeinschaft Rhein-Wasserwerke e.V.
- [8] AWBR (1988) 20. Jahresbericht 1988. [20th annual report, 1988.] Karlsruhe, Arbeitsgemeinschaft Wasserwerke Bodensee-Rhein
- [9] Ros JPM, Slooff W, eds. (1987) Integrated criteria document. Cadmium. Bilthoven, National Institute of Public Health and Environmental Protection (Report No. 758476004).
- [10] WHO(1993) Guidelines for Drinking Water Quality. Vol. 1: Recommendations. 2d ed. Geneva.
- [11] Ware GW, ed. (1989) Cadmium. US Environmental Protection Agency Office of Drinking Water health advisories. Reviews of Environmental Contamination and Toxicology, 107:25-37.
- [12] ISO (1985) Water quality — determination of cadmium. Geneva, International Organization for Standardization (ISO 5961:1985).
- [13] ISO (1986) Water quality — determination of cadmium. Geneva, International Organization for Standardization (ISO 8288:1986).
- [14] WHO(2004) Cadmium in Drinking-water, Background document for development of WHO Guidelines for Drinking-water Quality, 7 pages.