STUDY ON DUST AND ITS EFFECTS ON WATER OF RAEIS-ALI-DELWARI DAM

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Abstract

Dust is one of the most important types of air pollution which find a way to the air via human and natural activities. In recent years, Boushehr province in SE Iran has been exposed to increase of dust, and the problem has worsened dramatically. In the present descriptive-analytical research, it has been tried, using library and information studies, to determine the amount as well as the effects of dust upon turbidity of water of Raeis-Ali_Delwari dam in Boushehr province during 1395 AH. Sampling of water level was done at 8 points of the dam during 12 days including clear days (9 days) and dusty days (3 days). The average levels of turbidity were measured in clear days at 6.11 up to 6.59 NTU, and in dusty days at 6.81 up to 7.73 NTU. Also, the density of suspended particles was approximately 688 μ gr/m^3 in dusty days, and 134 μ gr/m^3 as for usual days. The results showed that although the density of particles in dusty days had reached 5 times that in usual days, the turbidity of the water of the lake behind the dam was 0.1 times higher. One could infer that 3 days after a remarkable decrease of the dust in the province, there had been no considerable effect on turbidity of the dam water. Besides, it was implied that the decline in dust had occurred due to air mass movement and not because of the particles sediment.

Key words: *dust, water turbidity,*Pm_{10}

Introduction

One of key factors in air pollution, dust arise from human as well as natural activities, and they affect on air quality hence on ecosystem and health conditions, as a consequence. They comprise the coarse irrespirable particles of diameter size 2.5 to 10 μm, and tiny particles of less than 2.5 μm diameter. The presence of dust in the air is more perilous for human health than ozone and other pollutants such as carbon monoxide. The chemical constituting elements of the dust are various including nitrate, sulfate, organic and elemental carbon, organic compounds (multi-cycle aromatic hydro carbons), biological and metal compounds (iron, copper, nickel, zinc and vanadium) (Kim et al., 2015).

As a result of intense wind blowing on the surface of the soil whence creating storms, air dust take place in arid and semi-arid regions yielding suspended particles of soil in the atmosphere and becoming the major source of inorganic dust (Morris et al., 2006).

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Owing to population increase and high use of water resources, Iran is extremely vulnerable to desertification (Amirarsalani, 2011). Since the year 2000 onwards, there has been a considerable increase in frequency and intensity of dust storms over Iran especially in west and south-west. Surprisingly enough, these storms are happening parallel to drought, desertification, and dehydration which may well be due to growth in global warming. As of 2001 up till now, it is the warmest decade during the past 30 to 40 years in which the process of dryness escalation is increasingly spread out to new regions (Solomon 2007).

The studies undertaken in China show that the density of the 2.5 pm dust particles during occurrence are 4 times more as in the case of not been scattered in the region (wang 2004).

Along with increasing of deserts levels the water resources become more and more restrictive, so that the control and maintaining of them matters more. An important effect of the dust may be the quality of surface water resources being in danger. Air pollution may be transferred into water resources in different ways such as dissolving in rain droplets or sedimentation of suspended particles in surface waters. In another investigation, the influence of the dust on Red Sea was studied and it was shown that dust phenomenon causes air coolness as well as heating of the water after absorbing of the sun's energy (Brindley 2015). Various studies on the effects of dust storms upon the oceans confirm the transfer of some chemical elements to the aquatic environment (Tagliabue et al., 2014).

Nowadays, environmental hazards caused by suspended particles in water are known, such as aesthetic effects, high costs of water treatment, reducing fishing resources, destruction of aquatic animals (Bilotta, 2008).

Turbidity of water is of important effects on the quality and aquatic environment both in terms of drinking and in terms of aquatic ecosystem. Turbidity can be arisen from, or a booster of microbiologic contaminants (Robert et al., 2016).

Statistical studies concerning the effect of pm 10, electrical conductivity, and TDS undertaken in Karoon river Ahwaz have verified that there is a direct relation between these two parameters (Sabouri et al., 2011). However, the effect of dust is proportionate to their sizes, according to the fact that the distance transferred by them is dependent on their density. With any $10\mu gm^3$ growth, the transmission attenuation of the particles increases by 10 to 12 percent (Dagsson-Waldhauserova 2016). The effects of dust differ from each region of transfer path to the other, so that different regions require typical investigations.

Since the main source of the dust may occur kilometers ahead of the affected regions (Wang, 2005), particles could reach the farther areas, bearing more possibility of entering the lung. Despite the increasing of dusty days in Iran in recent years, especially in west and south-west, and in the face of necessity for maintenance of water resources as well as prediction of risks, little research has been done in this regard. According to the fact that turbidity may be the result of the effect of air pollution upon water resources, this research undertakes a case study on quality changes in the water behind the Raeis-Ali Delwari dam with the aim of predicting risk effects of the dust on water turbidity.

Materials and Methods

The present research being of analytical-descriptive type was done on laboratory scales. The storage dam of Raeis-Ali _Delwari in Boushehr province is constructed over Shapour River at Shabankare district, 73 km of north-east Boushehr, and 60 km of Borazjan City. With a height of 102 m and having a 240 m crown, the dam possesses a reservoir of 685 million cubic meters volume situated on a 7 km river. The features of the dam are given in the figure 1.

Figure 1
Geographical location of the river of the dam

To obtain statistical data and the number of occurrence of dust phenomenon per days, the Environmental Protection Agency (EPA) was associated with as an assistant. Sampling of the water level (at eight points of the dam) was done from 8 geographical main and sub-ordinate directions north (Station 1), north-west (Station 2), west (Station 3), south-west (Station 4), south (Station 5), south-east (Station 6), east (Station 7), and north-east (Station 8) in 9 clean days and 3 dusty days, and respectively, one and two days after dusty days.

Turbidity was measured by applying the turbidity meter TURB 2100, made in USA. The data of the dust in Boushehr province's air were taken from the Weather Bureau and the Environmental office of the province, containing weight concentration of the suspended pm 10 particles in $\mu g/m^3$.

Results and discussion

The rate of turbidity measured from different points of the dam lake (the eight stations) concerning nine clean days are presented in Table 1, with maximum value as NTU was equal 8 corresponds to Station No.3, and the minimum NTU was equal 4.4 belongs to Station No 5. Also, the maximum average value of turbidity (in the clean days) concerns Station No 4 with NTU 6.59, and the least average value 6.11 corresponds to Station No 6. The last column of Table 1 gives the overall average values of turbidity in the eight sampling stations for the 9 clean days.

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Number of day	Stations								mean
	1	2	3	4	5	6	7	8	
1	5.7	5.5	6.4	6.7	6.1	5.4	7.3	7.8	6.48
2	5.4	6.4	5.5	6.1	7.2	5.5	6.9	7.6	6.41
3	6.6	6.7	5.6	7.1	7.0	6.1	5.6	8	6.52
4	6.5	7.1	6.9	5.4	5.4	6.8	5.9	5.6	6.59
5	6.3	5.7	7.3	7.1	7.5	6.6	6.4	6.6	6.40
6	7.6	7.8	7	4.7	4.4	6.8	6.6	7.1	6.11
7	5.9	5.3	7.9	6.3	6.4	6.6	5.5	4.9	6.35
8	7.0	7.1	6.2	7.3	6.0	6.2	6.9	6.6	6.75
9	7.3	6.1	5.9	7.6	7.6	5.0	6.1	6.8	6.45
mean	6.48	6.41	6.52	6.59	6.4	6.11	6.35	6.78	6.48
SD	0.74	0.84	0.81	0.76	1.05	0.67	0.63	1.02	

SD = Standard Deviation

Table 1 *Measured turbidities (*NTU*) from various points of Dam Lake in clean days*

The Concentration of dust (Pm10) existing in the province air in the clean days of sampling obtained from EPA of Boushehr province are inserted in Table 2. The World Health Standard has determined the Pm_{10} to be as 150 $\mu g/m^3$.

Table 2. *Pm_{10} ($\mu g/m^3$) of Boushehr province air in clean days (Days in which the rate is less than the standard value)*

Number of days	1	2	3	4	5	6	7	8	9	mean
Pm_{10} ($\mu g/m^3$)	140	145	150	130	120	110	140	145	125	133.9

Comparing the averages values of the 8 stations, and considering the concentration of pollutant suspended particles in the province air, one could see that in the days having standard dust, the water turbidity has nothing to do with the alterations of air turbidity. The rates of turbidity measured in the eight stations in three dusty days, and respectively, one and two days afterwards are given in the table 3.

Number of day	Stations								mean
	1	2	3	4	5	6	7	8	
1-1	8.7	6.50	6.8	7.1	8.3	7.1	7.5	8.6	7.57
1-2	5.4	6.6	5.7	7.2	7.7	5.4	6.8	7.9	6.59
1-3	6.6	6.8	5.9	7.7	7.8	6.8	5.9	8.7	7.03
2-1	6.3	7.6	7.5	5.8	5.9	6.8	6.9	7.6	6.80
2-2	6.4	5.6	7.9	7.9	8.4	6.9	6.9	7.5	7.19
2-3	7.6	8.4	7.7	6.7	4.8	8.4	6.9	7.6	7.26
3-1	8.8	7.3	7.9	8.2	7.6	8.2	7.3	6.1	7.68
3-2	6.7	7.9	7.3	8.1	7.1	5.5	6.9	8.7	7.28
3-3	8.2	7.1	6.9	8.6	7.5	6.9	6.8	6.9	7.35
mean	7.20	7.09	7.10	7.13	7.20	6.90	6.80	7.70	
SD	1.19	0.83	0.82	0.87	1.17	1.01	0.44	0.87	

SD = Standard Deviation

Table 3 *Turbidity measured (*NTU*) in different points of dam in dusty days.*

As observed, the maximum value NTU 8/8 corresponds to Station 1, and the minimum NTU 4.5 does to Station 6. The maximum average NTU 7.73 of turbidity regards Station 8, and the minimum average NTU 6.81 belongs to Station 7.
In the table above, the number at the left (1) belongs to the first day, and that on the right (2) corresponds to two day after.

Table 4. *Pm_{10} ($\mu g/m^3$) of Boushehr province air in dusty days*

Number of days	1-1	1-2	1-3	2-1	2-2	2-3	3-1	3-2	3-3	mean
Pm_{10} ($\mu g/m^3$)	760	485	625	810	550	780	690	840	655	688.3

The concentrations of dust sampled in the polluted days are compared with the clean air standard (see Figure 2).

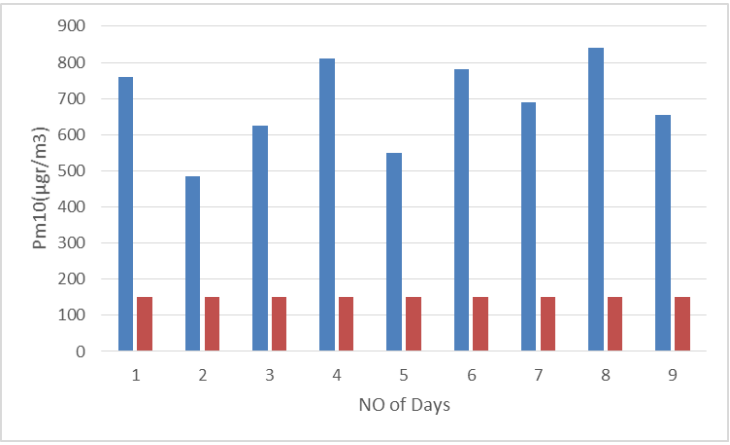

Figure 2
Comparison between concentration of Pm_{10} in dusty days and clean air standard

As seen, the concentrations of the polluted air in the dusty days of sampling have been several times the standard limit.
By comparing the average concentration of polluted air in dusty days inserted in Table 5 with that in days of little concentration of suspended particles, one could see that the polluted air concentration would become up to 5.1 times, whereas the water turbidity would turn out to grow merely 1.1 times higher. The evaluation of the two tables shows an evident change in water turbidity in dusty days, though not as effective as in the alterations concerning the air. As for Table 4, the sampling was done 3 days after establishment of deep air pollution because it was likely that dust would sediment in the water resources. However, the results were unanticipated showing that despite lapse of time no significant growths emerged in the lake water turbidity. Meanwhile, gradual decreases in air pollution concentration occurred during days 1-1 to 3-1, and 2-1 to 2-3, as seen in Table 5. The obtained results in the present study reinforce the hypothesis that a less percentage of the dust in the province has decreased due to sedimentation and the more remaining have been transferred via airstream to other areas, whence there

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would be little worry regarding water turbidity growth and the subsequent risks thereof.

Conclusion

All in all, one may summarize the most results obtained from this research as follows:

- the concentrations of dust in Boushehr province may reach up to 5 times that in usual days;
- the water turbidity at different parts of the lake in clean days has no considerable alterations with the partial changes in the dust concentration, and it is not affected by the concentration of the suspended particles either;
- along with a 5-fold increase of the dust in the province's air, there would be a 1.1-fold growth of the lake water turbidity;
- the main reason of decrease in air dust is not sedimentation, but probably their transfer to other areas through airstream;
- the influence of even a 5-fold increase of dust in Boushehr province has not contributed to a remarkable turbidity of water.

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