

## Analysis of Environmental Pollution Status in Isfahan City

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**Abstract.** Air, water and soil are three fundamental factors in human beings' life. Each of these factors can impose their undesirable impacts on human and other species' life directly or indirectly, when they are exposed to pollution. The present study aims to determine the environmental pollution status in Isfahan city and its surrounding areas. By applying an experimental method and taking samples from water and soil of Isfahan city and analyzing them in laboratory, this study has attempted to investigate the pollution status of this region. Results reveal that intensification of industrial activities from one side and not observing environmental standards and issues from the other side are main sources of pollution in this area.

**Keywords:** Air pollution soil, Environment, Health, Human, Industry, Traffic

### 1. Introduction

During these 4 decades, population of Isfahan increased from 450000 to over 1600000 in 2010 [14]. Based on the population rate of 4% during these years and also the algebraic model:

$$P_1 = P_0 e^{rt}$$

it has been predicted that in the case of current population growth, the population will be doubled within 16 years [11].

Table 1: Rate of pollutants caused by cars' petrol and gas oil in terms of tone in 2010

| Type of pollution                        | R-CHO | PH  | Solid materials | CH    | NOX  | SOX  | CO     |
|--|-------|-----|-----------------|-------|------|------|--------|
| Production rate from petrol consumption  | 207   | 228 | 44              | 13229 | 4638 | 369  | 119480 |
| Production rate from gas oil consumption | 89    | —   | 360             | 944   | 9515 | 2341 | 5774   |

Source: The researcher's processed information based on the environmental studies, and Planning Organization

### 2. Situation of Geographical Features of Isfahan

Annual slow air current exceeds 50% in summer, fall, and winter and even rises up to 70% in fall. According to the international standards, some areas like Isfahan in which air current exceeds 70% in fall are not suitable regions for the development and expansion of heavy industries and any industrial program in this area should be performed cautiously and the prevention aspects regarding the air pollution should be carefully observed [8].

The other factor influencing air pollution is air consistency and inversion state in Isfahan. Because of Isfahan climatic condition the number of inversions is high. According to the previous studies, inversion conditions create a suitable situation for air to be polluted during 263 days in a year. The thickest inversion with a diameter about 700 meters can be observed in Isfahan during fall. In general, Isfahan faces inversion state about 72% of the days of the year and it is tangibly higher in late summer and early fall.

#### 2.1. Causes of Air Pollution

Isfahan is the second industrial city in Iran. It's also the second polluted city in Iran due to industry and transportation density. Based on the previous studies, generally 91% of air pollutants in Isfahan are gases and

9% are some particles like zinc, copper, and aluminum; these particles can be far more dangerous than gases [1].

Different sources of pollutants in Isfahan are as follow:

Industry and transportation 78%

Power generating centers 12%

Business and home consumption 6%

Other sources 4%

There are over 5000 industrial and manufacturing zones in Isfahan and its suburb that have exerted negative impact on the human's health and environment. Table 1 shows the rate of pollutants caused by the consumption of the industrial units' fuel in Isfahan and the suburb.

Table 2: Rate of pollutants caused by the consumption of the industrial units' fuel in Isfahan in terms of tone in 2010

| Type of pollution | R- CHO | PH | Solid materials | CH   | NOX   | SOX   | CO  |
|-------------------|--------|----|-----------------|------|-------|-------|-----|
| Rate of pollution | 419    | 30 | 5836            | 1352 | 45934 | 21436 | 205 |

Source: The researcher's processed information based on the environmental studies, Planning Organization

## 2.2. Effects of pollutants

Air pollution has an undesirable effect on the human's health and polluted particles in the air can negatively stimulate the respiratory system. Respiratory diseases, allergies, ear, nose, and throat diseases, skin, chronic cancers, blood circulation disorders, neuropathies, respiratory poisoning, and finally eye diseases are mostly due to this undesirable air pollution. For example, the analysis of ophthalmic diseases in Isfahan, which are highly under the influence of industries, and its comparison with the whole Isfahan province has indicated that the percentage of such diseases is considerably high in Isfahan industrial zone.

The other effect of air pollution is the gradual destruction of tens of Isfahan monuments with over 400-year history. Right now, 700000 cars and over 300000 motor bikes are shuttling in this historical city. In addition, various factories and industries in the suburb have left chemical effects on the outward appearance of the city and the structure of the monuments in the long run causing their gradual destruction. According to the precise studies done by the environmental protection organization, air pollution has destroyed some monuments and precious cultural heritage [7].. Acetic acid and sulfuric gases produced by burning coal in industrial factories have dimed plant's leaves and wounded their ribs [3].. Studies done in industrial zone of Isfahan in which there are heavy melting metal industries show that many plants and trees have been eradicated or their growth has slowed down. The effects of industrial pollution on rice paddy, plants diseases, and low productivity of agricultural yields are considerable as well[13].

Studies done by Isfahan municipality and parks organization indicate that from among 2 million trees in Isfahan parks, the majority especially sycamores have been poisoned by air pollution and their leaves turn to yellow and fall earlier than the arrival of autumn.

The other negative effect of air pollution is on Zayandehrood River. It is the only shallow water stream that meets the urban, rural, industrial, and agricultural needs of a large area in Isfahan. There are some heavy metals in water areas such as water current, particles, and sedimentary which can be considered as major carriers. The evaluation of the amount of heavy metals in water areas can be regarded as a valuable criterion to examine the conditions of the environment and their dispersion mechanisms. One of the heavy metals that make destructive effects on human life is lead sediment. During its cycles, scattered lead in the environment enters human's alimentary sources so human beings would be in danger of receiving this element under any circumstances[9].

Water, soil, air, and food are the main ways of entering lead compounds to the human body. After receiving the lead compounds, a part of them repels and another part enters the blood, soft tissues and bones.[2].

The main courses in dispersing lead in the environment are munitions actions, molding, paint making, melting lead, production of battery, making water pipe and containers and making lead balls. After burning in the engine of vehicles and spreading in the air, lead may contaminate surface waters gradually.

FAO experts have estimated the amount of temporary absorption of lead for an adult as 3mgr per week, also the threshold amount of lead for foodstuff has been estimated to be 2.56mgr/kg [5]. They have reported the average lead of subterranean water as 1.01mgr/liter [4].

The studies done about the amount of lead in “zayandehrood” in last decade, show different figures, the studies done by experts of environment protection organization in 1994, showed the amount of lead in higher part of river as zero, and in the middle part of river about 0.19mgr. Also, the amount of this element in “Gavkhuni” swamp and at the low-lying part of the river was considered to be more than the standard limit[7].

In two other reports published by counselor engineers in 1979&1999, the concentration of lead in low-lying section of “zayandehrood” river was proclaimed to be more than the permissible extent[14].

The researcher conducted a research in 2010 by sampling of water “zayandehrud” river.

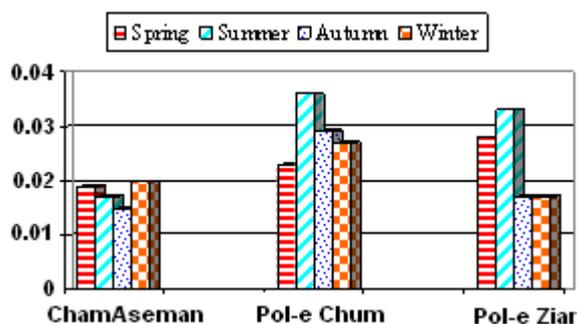


Fig. 1: The Zayandehrood lead concentration in the water sample in 2010

As figure 1 represents, the concentration of lead of “zayandehrood” in “cham aseman” station (up the river) is less than 0.02mgr/liter in all seasons. The reason is that there aren’t any industries in this area of the river and there aren’t any large population centers in the riverside. The maximum concentration of lead in the water of “zayandehrood” is in “Charm bridge” station in the suburb of “Isfahan” [10]. The important causes of this amount of concentration are large populated centers, specially the existence of eight towns in this area and the excessive traffic of gas burning cars in the river margin. Also the existence of large industries in the margin of “zayandehrood”, and almost 80% of national heavy industries and other different industries near the river are other reasons for the increase of lead concentration in this area [11].

Also results of laboratory analyses of soil samples at depth of (0-10 cm) in northern part of Isfahan city where major industries such as Petrochemical, Thermal power plant, Oil refinery and other industries are located, indicate that the amount of Cadmium (Cd) and Lead (Pb) in soil of this region is higher than the standard level.

Table 3: Descriptive Statistics for Cadmium Contamination of Soil in Isfahan City

|    | N  | mean   | Std. Deviation | Std. Error mean |
|----|----|--------|----------------|-----------------|
| Cd | 41 | 3.0854 | .78184         | .12210          |

Null hypothesis:

H0) In Isfahan city, the average amount of Cadmium metal is equal with the standard level of this metal which is 2 mg/kg.

Alternative Hypothesis:

In Isfahan city, the average amount of Cadmium metal is not equal with the standard level of this metal which is 2 mg/kg.

According to the research results and since the sig. level is lower than 0.05 the null hypothesis is rejected. The value of mean difference is in the 95% Confidence Interval of the Difference which suggests that the amount of cadmium in soil samples is higher than the standard level, thus, cadmium contamination is obvious in soil of this region.

Likewise, laboratory investigations through analyses of area's soil indicate that the amount of lead metal in the soil of Isfahan city is also higher than the standard level. Table 4 displays mean comparison for lead metal.

Table 4: Descriptive Statistics for Lead Contamination of Soil in Isfahan City

|    | N  | mean    | Std.Error mean |
|----|----|---------|----------------|
| Cd | 41 | 37.2317 | .70907         |

Table 5: T-test Results for Lead Contamination of Soil in Isfahan City

| Test value=1 |        |    |                    |                     |  |         |
|--------------|--------|----|--------------------|---------------------|--|---------|
|              | t      | df | sig.<br>(2-tailed) | Mean<br>Differences | 95% confidence interval of the<br>difference |         |
|              |        |    |                    |                     | Lower  | upper   |
| Pb           | 24.302 | 40 | 0.000              | 17.23171            | 15.7986                                      | 18.6648 |

Null Hypothesis:

H0) The average amount of Lead metal in the area under investigation is equal with the standard level of this metal which is 20 mg/kg

Alternative Hypothesis:

The average amount of Lead metal in the area under investigation is not equal with the standard level of this metal which is 20 mg/kg

Based on the research results and since the sig. level is lower than 0.05, the null hypothesis is rejected. The value of mean difference is in the 95% Confidence Interval of the Difference which suggests that the amount of lead in soil samples is higher than the standard level and, therefore, lead contamination is obvious in soil of this region.

### 2.3. Conclusion

As Isfahan has been changed to a manufacturing city since 1970's, a lot of people have emigrated to this city and its population has quadrupled during the last four decades .The climatic condition of Isfahan causes that the weather is calm in most days of the year and because of 263 days of inversion state in each year, it has a special situation for being polluted.

The pollution of Isfahan can be mainly due to the large number of cars and developing industries. Thus, 78% of the pollution can be attributed to cars and industries that each in turn enters a considerable amount of poisonous gas and solid material in the air.

Another destructive effect of air pollution on this ancient city is its negative impact on the valuable cultural heritage of this city destroying some of them. This is an important issue that requires due consideration. Also, the effect of air pollution on the trees, plants, and rice fields in Isfahan district has been proved. "Zayanderood" River, on which the social and economical life of this city is dependent, is at the risk of being polluted. The important factor in the pollution of this river is the lead caused by cars and industries.

It should be noticed that in developing countries, because there is an urgent need to perform industrial projects, without considering the environmental rules, the development of these countries would not be permanent. Hence, Isfahan district is not a proper place for the establishment of heavy industries. In present conditions, the expansion of heavy industries should be prohibited up to 100km out of the city.

Other necessary actions that should be taken in civic plans for decreasing air pollution are as follow:

- True planning for civic traffic, public transportation system, traffic management, erecting intellect lights on 150 intersections in Isfahan, and making unparalleled intersections
- Creating car technical examination centers and discarding old cars
- Organizing the industries and transferring most of them to the industrial zones and preventing farms to change to other places
- Accepting this point that the main reason of pollution is the lack of education and unawareness of environment users. So it is necessary to create a proper field for observing rules and preventing environment destruction through constant education via mass media.
- Expanding parks from 17m<sup>2</sup> per capita to 40m<sup>2</sup> per capita because of special climatic conditions of Isfahan. Also, preventing the destruction of gardens and farms is another basic measure that needs to be taken.

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### 3. References

- [1] Aero logy organization, (2007). *Studies about air pollution in Isfahan*. Aero logy organization publishing.p70
- [2] Asadi. M., (1996). Management of Dangerous and Superfluous Material. Environment.p118
- [3] Banan. Gh., (1997). *Human Environment and Preventing Its Pollution*. National association of environment protection and human environment.p53
- [4] Dezuanr. J., (1997). *Drinking Water Quality*. International Thomas publishing company.p49
- [5] Harrison. R.D., (1993). *Pollution; Cause, Effect, and Control*. the royal society of chemistry.p84
- [6] General department of environment protection, (1994). Studies about “Zayanderoon” river, chapters 1-12.
- [7] Isfahan environment protection, (2009). *Water & Soil Studies in Isfahan Industrial District*. Isfahan environment publishing.p36
- [8] Kavyani. M., (1997). *Analyzing of Wind Regime of Isfahan*. Papers collection of geography seminar, No. 2. Islamic Azad University Najafabad publishing.p43
- [9] Momeni. M., (2002). *Ecologic Investigation of Pollution Arising from Lead in Ecosystems of Surface Water (sampling of “Zayanderood” river)*. Paper collections of first national congress of environmental crisis in Iran and its improving strategies, Ahvaz, science & research department.p284
- [10] Momeni. M., (2005). A Study on the Variation of Lead in “Zayanderood” River in Isfahan. River basin management, Wit Press.p611
- [11] Momeni. M., (2010). A Study on the Variation of Lead in “Zayanderood” River in Isfahan., geography conference.Islam Azad University,Najafabad Branch.
- [12] Momeni. M., (2008). Principles and Methods of Regional Plan. Islamic Azad University Press.p45
- [13] Sharafi. M., (2000). Iron Melting and Its Effect on the Enviroment. Isfahan University Press.p32
- [14] Statistics book of Isfahan province, (2010). Budget and plan organization of Isfahan province, 1970 to 2010.
- [15] Naeimi. Z., (2000). Investigation of statistics summary of water quality of “Zayanderood” river. Isfahan regional water organization.p118