

# Surveying the Environmental Biology Effects of Esfahan Factories on Zayandehrood Pollution

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**Abstract**—Water is the key of national development. Wherever a spring has been dried out or a river has changed its course, the area's people have migrated and have been scattered and the area's civilization has lost its brilliance. Today, air pollution, global warming and ozone layer damage are as the problems of countries, but certainly in the next decade the shortage and pollution of waters will be important issues of the world. The polluted waters are more dangerous in when they are used in agriculture. Because they infect plants and these plants are used in human and livestock consumption in food chain. With the increasing population growth and after that, the increase need to facilities and raw materials, human beings has started to do haste actions and wanted or unwanted destroyed his life basin. They try to overuse and capture his environment extremely, instead of having futurism approach in sustainable use of nature. This process includes Zayandehrood recession, and caused its pollution after the transition from industrial and urban areas. Zayandehrood River in Esfahan is a vital artery of a living ecosystem. Now is the location of disposal waste water of many cities, villages and existing industries. The central area of the province is an important industrial place, and its environmental situation has reached a critical stage. Not only a large number of pollution-generating industries are active in the city limits, but outside of the city and adjacent districts Zayandehrood River, heavy industries like steel, Mobarakeh Steel and other tens great units pollute wild life. This article tries to study contaminant sources of Zayandehrood and their severity, and determine and discuss the share of each of these resources by major industrial centers located in areas. At the end, we represent suitable strategy.

**Keywords**—Environmental, industrial pollution, Zayandehrood Basin

## I. INTRODUCTION

**T**HE appearance and aggregation of the urban and agricultural centers in riversides has caused the breach expanse of human activities being expanded to the rivers and sources of the surface water, too; thus, because of the convenient access, the rivers have transformed to one of the main receivers of urban sewages, industrial wastewaters, and the surface canals. Alongside the increased growth of the population and industries, more sewages and garbage have been produced every day and the rivers get polluted more [1].

Nowadays, Zayandehrood River as the vital artery of Esfahan province and as a live ecosystem has become the place of the unrefined sewages detrusion and the refineries wastewaters of the most cities, villages, and the existent industries. One of the steps performed towards the prevention of the excessive development in Esfahan and its aftereffects has been the prohibition rule of industries establishment in 50-kilometer distance of this city.

It seems that the rule has been approved without the survey and sufficient documentation. At present and after the passage of years from the approval of this rule, also by the intensive alternation of the physical compages of Esfahan region, the difficulties and shortcomings of the rule has manifested itself.

The purpose of these studies performance is the revision for the prohibited ranges of the industries establishment by relying on the scientific studies, the prevention of the industries aggregation in specific parts, and finally the movement towards the constant development in the region [2]. As the surface waters of the main sources provide the required water for different domestic, urban, agricultural and industrial consumptions, if they get polluted by different kinds of contaminants such as agricultural canals, industrial, urban and domestic sewages, therefore, irrecoverable and ill aftereffects will be created for these vital sources; on the other hand, they jeopardize the societies health and hygienics; In addition, their refining and incorrupt cause the spending of many expenses. Among the effects of the sewage entrance into the river, the most important ones are the reduction of the solution oxygen, the appearance of the repulsive smell caused by the non aerobiosis oxidation, immigration or mortality of the aquatics, the prevention of the sunlight penetration in order to make the photosynthesis, the entrance of many nourishing substances such as Nitrogenic and Phosphatic combinations and the entrance of pathogen factors into the water [3]. Since, each m<sup>2</sup> of unrefined sewage can contaminate about 50 m<sup>2</sup> of water, therefore, if no attention and enterprise about the industrial sewages has been taken into consideration, the water sources of the country stand seriously endanger of the contamination (5).

## II. METHODOLOGY

According to the accomplished studies about the rules, precept and criteria of environmental biology of Islamic Republic of Iran about the living environment protection and the environmental biology evaluation, there are some limited legitimate requirements; yet, beneficial and reliable which some of them are stated hereunder. The capital council of the living environment protection in sanctioned laws number 138, on 1994 approved the hereunder cases. The administrators of these projects have to enterprise to the provision of the evaluation report of the environmental biology effects alongside the feasibility study and location reports of the project: a) Petrochemical Factory, b) Refinery, c) Power Plants, d) Steel Industry, e) dams and other water cons

According to the law about prevention of the air pollution, any function that leads to the air pollution is forbidden. The air pollution refers to the existence and spread of one or some

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contaminants among solid, liquid, gas, radioactive and non radioactive rays in the fresh air in a way that its amount and its staying duration endangers and changes the air quality as being deleterious to human beings, other living beings or plants or heritages and traditional buildings.

According to the law about prevention of air pollution, it is essential that the ministries of industries, mines and metals, agriculture and construction organization, the time of the prescription of license for factories, manufactories and power plants establishment, present a transcript of the related establishment license to the living environment conservation organization. The owners of related license have to determine place of their industrial or manufacturing plant establishment settling according to the establishment criteria and the living environment conservation organization standards. The utilization license prescription depends on the affirmation of the establishment place according to the observation of the law point number 12 and on the basis of the living environment conservation organization annunciation [6].

### III. DISCUSSION

The Air Pollution in Zayandehrood Basin Area: The air and its quality affect directly on the life of plants, animals, and human beings; it is taken into account as the main and vital factor of the environment. The gas nature of the air leads to the fast expansion and spread of the contaminants. Generally, the most important contaminants of the air are CO, CO<sub>2</sub>, NO<sub>x</sub>, SO<sub>x</sub>, H<sub>2</sub>S, Organic Hydrocarbons, ingredients and Oxidations such as Ozone which mainly are produced by three main sources of industries, motorized vehicles and residential and commercial regions. In this study, it is tried to survey the contaminant industries established in the observation domain. The most principal consumed fuel of the industrial departments is gas oil and Mazut with the considerable potential of polluting the air [7].

The Contamination of the air contaminant industries: The vast industrial centers located in the domain which are the most important contaminant sources of the air in Esfahan include ShahinShahr, KhomeiniShahr, Gaz and Khorzoogh. The most popular of them are:

Montazeri Power Plant: It is located in 8 km Northwest of Esfahan. It has the nominal capacity of 16000 kilowatt daily production which operates by daily consumption of about 3 million liters of Mazut. The activated air pollution of this power plant is created by the heavy fuels consumption. The amounts of these contaminants are inserted in table I.

TABLE I  
THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY SHAHID MONTAZERI  
POWER PLANT ACTIVITY (TON PER DAY)

TSM	NOX	SO <sub>2</sub>	HC	CO	Fuel kind
18	54	330	201	3	Density

Eslamabad Power Plant: It is located in 5 kilometers West of Esfahan and 800 meters of Zayandehrood River. The nominal capacity of this department production is 820 megawatt per hour. This power plant pollution is because of

225000 liters Mazut consumption and 890000 cube meters of gas. It is calculated in table II.

TABLE II  
THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY ESSLAMABAD POWER  
PLANT ACTIVITY (KILOGRAM PER DAY)

TSM	NOX	SO <sub>2</sub>	HC	CO	Fuel Kind
6750	20250	12375 0	675	1125	Mazut
216	8640	9	1405	243	Gas
6966	28890	12375 9	68905	1368	Total

Petrochemical Complex of Esfahan: It is located in 7 kilometers Northwest of Esfahan. The productions of this complex are 398 tons per day included 160 tons of gasoline a day, 56 tons toluene a day, 121 tons Parazylen per day, 61 tons Ortozylen. Hereon and in addition to the evacuation of large amounts of the poisonous gases on the way of the production which includes the subsidence of spouts and pulley pipes, different large amounts of the air contaminants evacuate into the environment; this happens because of the daily consumption of about 180000 cube meters of the gas which are inserted in table III.

TABLE III  
THE AMOUNTS OF THE AIR CONTAMINANTS IN PETROCHEMICAL COMPLEX

TSM	NOX	SO <sub>2</sub>	HC	CO	Fuel Kind
4302	1728	2	3	49	Petrochemical

In addition to stated gases, about 390 tons of CO<sub>2</sub> enters the environment from this department. CO<sub>2</sub> is part of the greenhouse gases and will affect the atmosphere warm-ups.

TABLE IV  
THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY ESFAHAN REFINERY  
ACTIVITY

TSM	NOX	SO <sub>2</sub>	HC	CO	Fuel Kind
960	38400	38	960	3800	Gas
5700	17100	104500	665	950	The Heavy Fuel 1600 tons per day
4329	8990	5590	7326	2330	The Light Fuel 333 tons per day
110089	64490	110128	8951	7080	Total

Esfahan Refinery is located on Esfahan-Tehran road which evacuates a vast amount of the contaminant gases into the environment per day. This industry alongside the stated cases will enter a vast amount of the contaminant materials by consumption of different kinds of fuels into the environment air. In addition, the consumed gas which is used in Nitrogen unit contains Metan and Etan and other gases with itself; they are transformed to CO<sub>2</sub> after burning. Annually, this refinery produces about 400 to 500 tons of CO<sub>2</sub>. (Table IV)

Esfahan Brickwork Kilns: The numbers of these brick kilns in Esfahan are 12 which produce around 140000 pieces bricks per day. The amount of consumed fuel for production of the brick is 45000 liters of Mazut per day, the contaminations caused by these departments are calculated in table V.

TABLE V

THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY ESFAHAN BRICKWORK KILNS

Fluoride HF	TSM	NOX	SO <sub>2</sub>	HC	CO	Consumption Amount	Fuel Kind
134	135	405	2475	1305	2205	45000	Mazut

Polliakril Factory: This factory is located in 45 Km South of Esfahan; it is in 6 kilometers of Zayandehrood road. The consumption primary materials of this factory per day are 6405 tons of Akrilic, 205 tons of Metil Akrilic, 4 tons of DMF, 150 tons of DMT, and 48 tons of Etil Kelaikel which is kept in closed depositories. The produced materials are with nominal capacity production of 275 tons per day; its production is 83 tons of akrilic yarns, 22 tons of Polister yarns, and polister thread. In addition, it produces about 45 tons of Metanol. The contamination of this factory is cause of the poisonous gases produced by evaporation from the depositories and their penetration into the environment during the production processes. Unfortunately, the amount of these gases cause of the inexistence sampling is not specified. Besides these gases, a vast amount of the contaminant materials cause of different kinds of fuels consumption evacuated into the environment which are specified in table VI.

TABLE VI

THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY POLI AKRIL FACTORY ACTIVITY

TSM	NOX	SO <sub>2</sub>	HC	CO	Fuel Kind
300	1480	2800	58	8205	Gas Oil of 165000 litres
4506	1824	2	3	5103	Gas of 80000 cube meters
34506	3304	2802	61	13308	Total

Esfahan Cement Factory: This factory is located in 10 Km Southwest of Esfahan. The consumption primary materials of this industry are Maren, limestone, sillice, plaster, scoria, and Sheel; their amount is about 3000 tons per day. The production capacity of this factory is 2100 tons per day. The produced ingredients and dust of this industry activity will be absorbed by electro filter. It should be mentioned that this system is the best contamination controlling among big industries. If it stands in the circuit with entire efficiency which is 99 percent, the amount of the dust will be standardized. Unfortunately, most of the contamination controlling is defective and evacuates vast amounts of ingredients and dust from the chimney into the environment. In spite of this fact, considering the electro filters with entire efficiency in the circuit, the amount of the output ingredients reaches 21 tons a day. Besides the levitative ingredients, 215 kilograms CO<sub>2</sub> gases by limestone consumption enter the environment per day, too. It warms up the earth. The other case is the evacuation of the air contaminant materials caused by the consumption of different kinds of the consumption fuels which are inserted in table VII.

TABLE VII

THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY THE CONSUMPTION FUEL

TSM	NOX	SO <sub>2</sub>	HC	CO	The Consumption Amount Per Day	Fuel Kind
900	2700	11000	105	150	3000 Litres	Mazut
6000	24000	24	40	675	250000 cube meters	Gas
1500	26700	11024	145	825		Total

Sepahan Cement Factory: This factory is located in 13 Km West of Mobarakeh and 1 Km of Zayandehrood River. Its primary consumption materials are Silice, limestone, and plaster stone. The production of this factory is 7000 tons of gray cement per day. The dust caused by this industry activity is absorbed by the electro filter and returns to the production line again. Since, the electro filter efficiency cause of non appropriate conservation reduces, therefore, the amount of output ingredients and dust increases. However, if the electro filter stands with the entire efficiency of 99 percent in the circuit, the amount of 70 tons of ingredients which are ready to be baked and transformed into the cement (the best primary material) will enter into the living environment per day. Thus, if some percents of the electro filter exit the circuit because of the mechanical defects, the amount of output ingredients from the chimney will increase. In addition, the contamination of a vast amount of the poisonous gases evacuate into the environment cause of different fossiliferous fuels consumption which its amount is recorded in table VIII.

TABLE VIII

THE AMOUNTS OF THE AIR CONTAMINANTS IN SEPAHAN CEMENT FACTORY

TSM	NOX	SO <sub>2</sub>	HC	CO	The Consumption Amount Per Day	Fuel Kind
840	2520	15400	84	140	285000	Mazut
72	2880	3	408	81	270000	Gas
912	5400	15403	8808	221		Total

Mobarakeh Steel Industries: This complex is established in South of Esfahan. The required primary materials of steel industries are the limestone of 804 million tons, the limestone with 500 thousand tons and Fluorspar of 16000 tons in a year. The production capacity of this industry is 204 million tons of steel per year. In the removal and accumulation process, the required primary materials of steel complex gathered and deposited in it; then in order to nourish the required construction materials department, direct instauration, lime baking will transfer by entirely uncover strap bands to the furnace. By considering the outlet ingredients density and the contamination controlling designing and its efficiency, each day about 205 tons of dust and levitative ingredients evacuate into the environment air. Also, in steelmaking department about 3 tons, in lime baking department about one ton and in warm rolling department 3 tons of the ingredients enter into the environment. The other contaminants include 6000 cube meters of SO<sub>2</sub>, 205 tons of NOX, and a large amount of CO<sub>2</sub>

gas which produced in each process and evacuated into the environment, which are calculated in table IX.

TABLE IX  
THE AMOUNTS OF THE AIR CONTAMINANTS CAUSED BY MOBARAKEH STEEL  
ACTIVITY (KILOGRAM PER DAY)

TSM	NOX	SO <sub>2</sub>	HC	CO	The Consumption Amount Per Day	Fuel Kind
1080	43200	43	72	1215	450000 cube meters	Gas

Zobe Ahan Factory: This factory is located in 37 kilometers Southwest of Esfahan. Its primary consumption materials are ironstone, collier, limestone, and ironstone quartzite which their total amounts are 5477000 tons per year. This factory contains different departments as a) lump making, b) coke and chemical materials production department, c) the long blast furnace, and d) steel making departments; the air contaminants in lump making department (according to the removal and accumulation method of the materials in this department) include about 250 tons of ingredients and dust per day. In coke and chemical materials production department, a large amount of different steams caused by the evaporation of the produced materials and SO<sub>2</sub> gas evacuate into the environment for about 700000 cube meters per year. In steel making department, in addition to 83 tons of produced ingredients during the production process and by considering the kind and content of the manufactured product, about 500000 cube meters of SO<sub>2</sub> gas enter the environment. Meanwhile, according to the consumption of 1850000 cube meters of daily gases, a large amount of contaminant gases enter into the air.

#### IV. CONCLUSION

The environmental sources contamination which in this domain and study the water sources display itself more than the other sources, are considered as the most primary and specific problems not only in the agricultural department but also it has directly and indirectly endangered the human being's life seriously. In Zayanderood basin area, for the centralization and the establishment of the lighter and danger less industries, it is started to make and establish 19 industrial towns. These towns have specified and monopolized about 26 percents of the entire industrial towns of the country. Considering the domain level which is about 2 percents of the entire country, this fact represents that Zayanderood basin is industrial. About half of these towns are located at the margin of the river or in a distance that can affect dominantly on Zayanderood River. The dominant problems of these towns are the inexistence appropriate and licensed distance between the industrial towns and the neighboring cities and the inexistence regard to the occupancy level of the installation to the lands applicable for the industrial towns. The industries by different and sometimes dangerous sewage and residuum productions create the primary environmental contaminants. The dominant industries such as Zobe Ahan factory of Esfahan, Mobarakeh Steel Complex, Poli Akiril factory of Esfahan, etc, which all of them have been expected the efficiency and exploitation of Zayanderood, are situated around this river.

About the contamination of the industries sewage it should be stated that in general the inexistence application of the appropriate refining technology or lack of the knowledge and the sufficient and suitable human power for the correct and accurate utilization of them have led some non organizations. The results of these defects are observable as the entrance of a vast content of the contaminants into the natural and environmental sources such as subterranean and surface water sources.

One of the most important factors stated and considered as the deletion of the disadvantages caused by the industrial contaminants evacuation is surveying of the renewed usage.

The recycling of the materials and energy from the industrial wastes and redundant materials alongside the provision of the local facilities and the renewed exploitation of their power and energy causes the environment health preservation, too. The recycling of the industrial wastes and redundant materials can be applied as a national controlling system about the management of the industrial wastes and redundant materials.

In Zayanderood basin area more than 330 thousand hectares of water lands are used for the agricultural utilizations. From the view point of the living environmental dangers, the consumption of two main factors which are pestilence killers and chemical fertilizers has the prominent effects. According to the cultivation level and the consumption amount in hectare (about 2 liters) which are extracted from the provincial studies of the toxicants consumption, in Zayanderood basin area about 660 thousand liters of pestilence killers are consumed annually. The passage of these pestilence killers into the sources such as the subterranean water sources and the rivers cause of some pestilence killers' accumulation like chloride toxicants are very dangerous and debatable.

The accumulation of the chloride toxicants in living tissues perishes the small living beings in the beneath levels of the nutrition pyramid and finally it causes serious hurt to the upper levels living beings especially human beings. About the existence of the pestilence killers' remains in the environment, there are no statistics but different studies from around and about this subject state the presence and remains of the toxicants in the living tissues.

In this study, 25 numbers of pestilence killers which their consumption in this domain has been reported more than 10 thousand liters a year were selected; in toxicants features' survey, it was observed that some of them have a very long living length. Among these long lasting pestilence killers which their removal and expansion strength in natural environment by the fluent water have been reported a lot, include: Paraquate with the living length of 1000 days, Lindin with 400 days, Diazinon with 40 days, Mankoozab with 70 days, Randap with 67 days, and Tarfalan with 60 days. These pestilence killers from the view point of permanency in the environment and expansion and transference by the fluent water have been considered dangerous. According to the stated factors, the probability of these pestilence killers' presence in the flowing water is excessive. The agricultural lands accumulation around Zayanderood River can emphasize the presence of these toxicants in Zayanderood water.

The toxicants studies in a vast controlling and stabilization network of the toxicants can present the sufficient information about the existence or inexistence of the special pestilence killers in the water sources. Making decision about and survey of the toxicants studies with this information will be improved. On the other hand, the chemical fertilizers are vastly consumed in Zayanderood basin area. The annual consumption of 132560 tons of different fertilizers in this domain states the presence of the large content of phosphate and nitrate in the environment. Nitrate enters the rivers by the flowing water and also by water worn reaches the subterranean water beds. But, phosphate cause of less solvability mainly moves by flowing water and transfers into the surface water. Therefore, the remained result of the two mentioned combinations can be observed in sewages and swamps. In this case, the presence of these materials in the river and in the subterranean water sources (dominantly nitrate which in some cities has been reported more than the licensable amount) can be trouble making. The outlook of the harmful effects from the view point of urbanistic, industrial and agricultural domains of Zayanderood according to the environmental biology sources contamination has been surveyed. Their contaminations which at the first look remind Zayanderood contamination in the mind have been studied entirely by gathering various samples. Most of the industries across Zayanderood River will enter their wastewater directly into Zayanderood River; among all we can name: Poli Akiril factory, Simin and Tejarat looms, Esfahan Leather making, etc. Through this sewage, organic Senetic materials, weighted metals and lots of other contaminants will enter into the river. In addition, the water wastes of about 800 thousand persons of Esfahan residential after a semi refining will evacuate into the river. Afterwards the Esfahan city region, the agricultural water wastes just will enter into the river which contains large amounts of salts. The river salinity will increase gradually towards its movement to the lower parts; in addition, the evacuation of Esfahan urban water wastes and the industrial departments alongside of Zayanderood River entirely transforms the water quality. In the lower parts of the river, the quality of water reduces a lot which has been compared with the sewage brook. The experiments represent the existence of a large amount of EC (3040-3820 milligram in each liter) and the considerable content of inseparable organic materials in the lower parts of the river. The BOD and also COD amounts which primarily relate to the organic load of the canals is excessive in Zayanderood river water after the passage of Esfahan city. The amount of the weighted metals has been experimented, too; which the amounts of Mercury, Cadmium, Nickel, Antimovan, and Bur were not specified as dangerous metals, but a few amounts of lead was observed in the river; in addition, a few amounts of tungsten can be existent in it, however the experiments do not present it but cause of the its productive sources presence on its route, it can be probable. In general, the most polluted point of the river is Denart station which is a little far from the evacuation place of the refining water wastes

of Esfahan city into the river. The subterranean water bed cause of its drinkable water provision of the most cities has a special importance. In the northern and the northeast of the domain, the underground water level is very low; but in some parts of the domain such as the marginal lands of Zayanderood, especially in the lower parts of the river, the water bed level is very high. The chemical fertilizers specifically the nitrogenous ones and the chemical toxicants have the dominant role in the water contamination. The annual consumption of 132560 tons chemical fertilizers and 621510 liters of pestilence killers have entered excessive contents of contaminants into the domain water sources. In hydrologic departments of Barkhar-Koohpayeh, Sagzee- Margh descriptively 40 and 70 thousand hectares of the lands are sub cultivation of the agricultural crops. These lands encompass the considerable levels of their sub cultivation lands from their domain. According to this fact that in the lower parts of the river, just the agricultural water wastes emphasize the river contamination, and the river has relation with the underground water sources, therefore, the agricultural activities role in the contamination of these parts represent itself more.

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