

Identification of the Water Pollutant Industries in Khuzestan Province

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ABSTRACT

The purpose of this study was to build up a logic ranked pattern between the most important industrial activities with respect the type of water pollution and the discharge ways or managing the wastewaters in these units. For this purpose all of the statistical data have been gathered by referring to the responsible organizations. After that, by using the desk study, field work and selecting some of the industrial units as studied cases and by referring to their production processes and obtaining the curtailed analytical results, the industries have been separated to several groups including Food ,Textile , Pulp & Paper/, Chemical, Non-metallic mineral, Metal and Electricity & electronics Comparing the number of active industrial plants within the boundaries of Khuzestan province at 5 catchments area, indicates that Karun, Dez and Jarrahi basins with 1044. 324 and 290 active plants, respectively, are crowded with a lot of industries. Nature of the examined parameters has been selected in view of the production process type and includes pH, turbidity, electrical conductivity, chloride, sulfate, BOD, COD, TSS, iron. Results indicates that Dez river basin, being compared with the other two basins, impose the most degradable organic, nutrient substances and suspended particle loads to Dez River , and the metal pollution load at Karun basin is more than the other two basins , caused by the steel industries concentrated in Ahvaz city.

Keyword: *Industries, Pollutant parameter, Khuzestan, Iran*

INTRODUCTION

Water is considered as one of the foremost levers of today's world development; therefore, studying the issues concerning its pollution sources and environment pollution and their management under the present development conditions are an urgent and unavoidable affair. At present setting forth the development issue in the various social-economic-cultural and industrial dimensions and knowing their qualita-

tive and quantitative effects and disadvantageous consequences in the developed and/or developing world, among them our country, is important. Our nation's industrial development too, is not excluded from this urgency and familiarization, precise and multilateral knowledge of all-important and various dimensions of the industrial development in the framework of the scientific studies and examinations are indispensable and compulsory.

In Khuzestan province, due to its much potential in various expansion dimensions, industrial development is confronted with the ever-increasing pollution of the water sources. Thus

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for the reason of importance and effective role of industry in the environmental pollutions of Khuzestan province and quick and simple access to the existing conditions in the environment, examination of the water pollutant industries has been taken under advisement.

The pollutant industries in Khuzestan province have been somehow examined in the various researches conducted by the State Head Office of Khuzestan Environment Protection and the other bodies, which are used in the present research (Rostami et al., 1997).

A study conducted on Rasht Zarchub River in 1979-80 revealed that river pollution in the spring reached to its maximum and that also the pollution had shown incensement from the first station towards the river's last station which the cause had been known to be arising from emergence of the pollutants caused by agro industries and city sources (Binaye Motlagh, 1981).

The studies conducted on Fars Kor and Sivand Rivers (Sofel Environmental Engineers, 1981), Isfahan Zayandehrud (Jamab Consultants, 1997) and Gillan Sefidrud (Parsvista Consultants, 1996) rivers indicate that presence of metals in the various river environments is resulted from deposition of the industrial, agricultural and urban wastewaters.

The studies conducted on the effluents of Steel Industries indicate that these companies wastewater quality in connection with the biochemical and chemical oxygen demands, oil and grease, cadmium, lead and zinc is below the standard limit (Khuzestan Steel Cooperation, 1999).

The study conducted on the wastewater of Mobarakeh Steel Company indicates that biochemical and chemical oxygen demands, oil and grease, cadmium, lead and zinc is below the standard limits of environment protection agency (Mobarakeh Steel Industry, 1998).

The present study has been conducted as an inventory research on the industries existing in Khuzestan province and on the basis of the letter of instructions of the Mines & Industry Organization, the Industrial complex Company

and the Rural Industries Committee of the Ministry of Jahad Keshvarzi, determination of dispersion and distribution of the industrial pollutant sources regarding the industrial group, the polluted site and type of pollution, preparation of a suitable information bank, transfer of data and finding out the technical and management priorities (Rostami, 2002).

MATERIALS AND METHODS

To achieve the intended objectives, the phases of the present study have been executed at 5 basins of Karun, Dez, Jarahi, Karkheh and Zohreh Rivers, identifying the active industrial plants, including cities of Khuzestan province and based on the standardized classification, statistics and information provided by the concerned bodies. In the next stage, the water pollutant industries at 5 basins of Khuzestan province were compared and classified from the paid of view of their importance.

Then discharge conditions of the wastewater of these sources, to the surface waters and groundwater were examined due to importance of the surface waters in Khuzestan province and since the majority of wastewater plants which discharge their wastewaters into the surface waters belong to the large industrial plants group (employing more than 50 persons), this group of industries (including 28 large industries) has been examined.

This study includes the industries situation regarding their position, type and quantity of raw materials and products, amount of water drawing and wastewater discharge, production process and situation of the wastewater treatment systems. Based on the manpower, equipment, the frequency of sampling from the industries in question, it was decided to be effected once within each 3 months and during one year interval of 2001-2. The wastewater sampling has been affected through grab sampling and based on the Standard Methods (Karajca Jaromi, 1989). Nature of the examined parameters was selected based on the production process type

include pH, turbidity, electrical conductivity, chloriding, sulfate, BOD, COD, TSS and Iron. The measurements have been made based on the Standard Methods for the Examinations of Water and Wastewater (APHA, AWWA, WEF, 1999). Upon sampling and conducting the required tests, amount of the pollution load was calculated and based on the definite criteria; pollution of each industry was classified. At the end of this study regarding the area conditions and based on the treatment technical feasibility, financial feasibility aspects and im-

portance of the receiving source, pollutants significance and intensification, the industries in question were classified and the most important management control priorities were determined.

RESULTS

There are a total of 1710 active industrial plants at the 5 basins; the most of them are situated at Karun, Dez and Jarrahi basins, respectively. These data are shown in Table 1.

Table 1: Number of the active plants separated by industrial group and basin

Industrial group	Basin					Total
	Karoon	Dez	Jarahi	Karkheh	Zohreh	
Food	234	53	65	9	3	364
Textile	52	11	5	8	-	76
Cellulose Industry	47	9	6	1	-	63
Chemical	152	54	19	2	-	227
Non-metallic mineral	293	141	162	22	-	618
Metal Industry	247	53	31	4	3	338
Electricity & electronics	19	3	2	-	-	24
Total	1044	324	290	46	6	1710

The majority of the water pollutant industries are located at Karun River basin followed by Jarrahi, Dez and Zohreh basins respectively. Thus, there was no significant industry regarding, the water pollution at Karkheh basin. Due to importance of the surface waters at

Khuzestan Province and as the majority of wastewater discharges are related to the big industries (having more than 50 employees), this group in basins of Karun, Dez and Jarrahi Rivers were placed in the first priority of the study. The characteristics of these industries are stated in Tables 2 and 3.

Table 2: Wastewater discharge of the studied industries based on basin and industrial group

Basin	Industrial Group	Wastewater Discharge (m ³ /d)
Dez	Pulp & Paper industries	40700
	Food	21600
	Food	179300
Karoon	Electricity & electronics	11000
	Metal industry	44670
	Non-metallic mineral	350
Jarahi	Chemical	235710
	Chemical	33500

Table 3: Percentage of the industries having an effluent of wastewater above the discharge standard limit prescribed

Basin	Parameter	pH	Turbidity	BOD	COD	Chloride	Sulfate	Tss	Iron
% Industry	Dez	20	80	20	80	-	20	60	20
	Karun	25	75	35	75	50	60	75	5
	Jarahi	-	-	-	66.6	33.3	33.3	66.6	-

In Table 4 the results of the industries pollution load for some of the studied parameters are stated and in Table 5 the results of this exami-

nation for 3 basins of Karun, Dez and Jarrahi rivers are indicated regarding the two aspects of discharge in the surface and ground waters.

Table 4: Amounts of the wastewater pollution load of the examined industries, based on some of the measured factors

Industry's Name	Pollution Load (ton / y)						
	BOD	COD	Nitrate	Phosphate	Lead	TDS	TSS
Pars Pulp & Paper	4161	23847	279	1.76	0.13	12613	12551
Hafttapeh Suger Cane Industry	3781	50137	833	1.8	-	45309	14558
Karun Suger Cane	5589	23506	438.5	0.93	-	37590	11171.7
Ahvaz cubic suger & suger Refining	350.4	637.3	9.2	0.26	-	1734.5	4546.7
Ahvaz Zamzam Co.	12.97	65.7	1.2	0.01	-	147.8	30.9
Khormshahr Khoramnoosh Co	18.3	73	2.4	0.03	-	456.6	115.9
Ramin thermal power plant	18.6	83.2	50.1	0.068	0.26	5853.9	614.7
Khozestan Steel Co.	-	1686	113.7	5.8	3.18	49974.7	2325.8
Steel National Group	353.7	1470.6	31.5	1.26	0.034	7431	1090
Farcit Co.	1.91	14.8	0.84	0.01	0.035	732	17.5
Abadan Petrochemical	62.1	186.2	10.9	-	0.036	6734.3	158.2
Abadan Oil Refinery Co	4592.4	14287.6	164.9	0.77	0.77	117872.4	-
Bandar-e emam Petrochemical Complex	-	154.8	1.34	0.13	-	-	163.8
Farabi Petrochemical	-	14235	150.8	3.4	-	288897.5	16247.9

Table 5: Amount of the mineral and organic pollution loads of the studied industries at Karun, Dez and Jarrahi Rivers basins (ton/y)

Pollution load	Basin	Karun		Dez		Jarrahi	
		Surface water	Ground water	Surface water	Ground water	Surface water	Ground water
Organic	Biodegradable	56441	61	87652	64	14390	-
	Salts	237436	536	63410	776	288898	-
	Nutrients	881	1.7	1178	2.9	152	-
Mineral	Metals	5.4	-	0.2	-	-	-
	Suspended solids	21308	7.5	27923	92	16412	-

The metals are not measured in the case of Jarrahi River's basin.

DISCUSSION

Comparing the number of active industrial plants within the boundaries of Khuzestan province at 5 basins indicates that Karun, Dez and Jarrahi basins with 1044, 324 and 290 active plants, respectively, are crowded the highest number of industries. This study also indicates that Karkheh and Zohreh basins are situated in the next positions with significant difference.

The results indicate that with considering of the water pollutant industries, among the 5 basins of Khuzestan province, Karun, Dez and Jarrahi, hold priority in the study. Making a comparison on the pollution load of the industries located at these 3 basins, indicates that a quantity of 56502 ton/y organic load and 260186 ton/y mineral load from various industries are discharged into Karun River. In addition to this categorization, the total pollution load of the examined industry group at this basin, based on the total organic and inorganic pollution loads, is the highest in connection with the chemical industries and the food, metal, electrical, electronic and non-metal industries, respectively.

The results for Dez river basin indicate that an annual quantity of 87716 tons of organic and 93380 tons of inorganic loads from the industries under the examination, are discharged into Dez River. In addition to this categorization, total mineral and organic pollution loads in the industry group under examination indicate that the food industry causes the most pollution load and the Pulp & Paper industries are the next category.

At Jarrahi River's basin an annual organic load of 14390 tons and a mineral load of 305461 tons per year are discharged in Khourmusa water way.

Examining of the figures presented in Table 5 indicates that at the three basins, the most mineral and organic pollution loads are discharged into the surface waters (rivers, streams and estuaries). At Karun River basin, 99.8% of the

pollution load is discharged in the surface waters and only 0.4% is discharged into the ground waters. At Dez River basin, 99.5% of the total mineral and organic pollution loads is discharged into the surface waters and only 0.2% is discharged into the ground waters. And as it is observed all the industries at Jarrahi River basin, discharge their wastewaters into the surface waters (Musa estuary).

Categorization of Karun, Dez and Jarrahi Rivers basins for pollution load of the degradable substances, salts, nutrients, metals and suspended particles indicate that most of the degradable pollution load is discharged at Dez River basin and Karun and Jarrahi Rivers basins are in the next categories. As for the pollution load of salts, Jarrahi River's basin holds the most loads and after it Karun and Dez Rivers basins belong to the 2nd and 3rd categories, respectively. The most load on the nutrients, join the surface waters of Dez River basin and Karun with 881 tons and Jarrahi with 152 tons per year belong to the next category. A comparison of metal pollution load at two basins of Karun and Dez Rivers indicate that Karun basin with an annual load of 5.4 tons, takes the most heavy metals pollution load. Comparing the suspended particles pollution load at Karun, Dez and Jarrahi Rivers basins indicate that Dez basin with an annual pollution load of 27923 tons takes the most load and after it Karun and Jarrahi basins are in the next categories. Finally, the industries under examination are evaluated on the basis of the technical feasibility of treatment, financial feasibility, and importance and intensity of the pollutants and thus ranking of the industries based on management issues were determined. Selected criterion is shown in Table 6.

Table 6: Type of classification and evaluation of the criteria selected for examination of the industries status regarding production and wastewater management

Criterion		Classification & rating			
Treatment Technical Feasibility	Class	Very Easy	Easy	Relativly difficult	Difficult
	Value	4	3	2	1
Financial Feasibility	Class	Completely cost-effective	Cost-effective	Relativly Cost-effective	Low justification
	Value	4	3	2	1
Importance of source receiving wastewater	Class	Karoon	Dez	Jarahi	Zohreh
	Value	4	3	2	1
Importance & pollutant severity	Class	High organic load or toxic compounds	Medium organic load or salinity increaser		Low organic load
	Value	3	2		1

Upon evaluation of the examined industries based on contents of Table 6 and summing up the obtained values, prioritization of the said industries is effected at Karun, Dez and Jarrahi Rivers basins.

Study of the obtained results indicates that 5 big industries (2 Cellulose and 3 Foodstuff plants), being compared with the other two basins, impose the most degradable organic, nutrient substances and suspended particle loads to Dez River basin and this is while only pollution of one of these plants is controlled and is under a relatively good wastewater treatment system. Therefore, it is evident that pollution control of each of these plants may have a significant share in the improvement of Dez River's water quality, and as the causes of the most organic, nutrient substances and suspended particles loads imposed to Dez River are Pars Paper and Haft Tappeh Sugar Cane factories, thus pollution control of these two factories (execution of wastewater treatment systems), have the highest priority.

Study of amounts of pollution loads into the three basins indicates that at Karun River basin only the metal pollution load is more than the other two basins and a major part of this pollution is caused by the metal industries concentrated within the Ahvaz city limits and exami-

nation of this issue, gives priority to decreasing of metal pollution loads of these industries.

This study also indicates that although amounts of pollution of the degradable organic substances, nutrients and suspended particle loads, as compared with Dez basin and the salts pollution load with respect to Jarrahi River basin are somehow lower at this basin, but neverthe due to its importance as the drinking water supply source, pollution control of the industries examined in connection with each of the mentioned cases how specific importance nature.

ACKNONLEDGEMENTS

This research has been supported by Khuzestan Department of the Environment. The Authors would like to express their special appreciation to Mr. Sepehrfar the General Director of KDOE.

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