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DETERMINATION AND INVESTIGATION OF POLLUTION  
OF THE NIR RIVER IN ARDABIL PROVINCE OF IRAN

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The Nir River of Nir City is formed by joining of 5 Bolaughlar springs with high debit: two of these springs provide potable water of Nir City. The river flows from the middle of the city and about 35 tons/day of urban, rural and agriculture waste are offloaded to the river. So, the importance of studying of the conditions of chemical and physical pollution is emerged. Factors like physical and chemical parameters, the amount of anions and cations, turbidity, stiffness, dissolved oxygen, biochemical oxygen density, chemical oxygen density, water temperature, pH, CaCO<sub>3</sub>, fecal and total coliforms were evaluated. Based on the results of this experiment it was concluded that despite the increase of pollutants downstream of the city in comparison to the upstream, studied indices were under the critical limit and were meeting the international standards.

**Keywords:** coliform, chemical oxygen density, biochemical oxygen density, pollution.

**Introduction.** Nir City – with northern latitude of 37°.47' to 38°.9' and eastern altitude of 47°.51' to 48°.21' and with the height of 1687 m above sea level – is one of the highest cities of Iran. This city is located in nearly 35 km from Ardabil and beside the main road Ardabil – East Azerbaijan [1]. The Nir River is originated from Mt. Sabalan and alongside of its direction provides water for the fields of several villages. It has North-South direction up to Fandoghloo Village, after which it nearly turns to West-East direction. The length of its main branch is 37 km. The highest point of this river (4401 m) is located in the heights of Mt. Sabalan and its lowest point (1605 m) is located in the position, where Hydrometric station exists [2].

Wind direction is South, West-North and East during cold months and it has 132 frozen days in a year. Its coldness temperature reaches –28<sup>0</sup>C and it has a relative humidity of 51 to 81% [3]. The Balikloo River is formed by the joining of the Nir River's branches and joins to Gareh soo and the Aras Rivers' valleys and finally pours to the Caspian Sea. Its water is supplied by the springs of mountainous area and melting of snow. Since it flows down from the mountains with stony

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and sandy beds, it has limp water with average electric conductivity [4]. Due to the low density of organic materials, it includes high solved oxygen.

*Hypotheses and primary questions of research were:*

- is the river polluted with domestic and human wastewater?
- are the ecosystem and natural condition of the region intact or not?
- is the river affected by poisons and chemical fertilizers and are their amounts on permissible level or not?
- how can we remove or reduce the visible pollution of the region?
- which factors threaten the natural condition of the Nir River?

**Material and Methods.** Two stations (sampling points) with the observance of required standards, for controlling and specifying of some factors such as the degree of elements, anions and cations as well as physical and chemical parameters were established. Then by means of Nansen, the sampling equipment in eight given months and at two different depths (25 cm and bottom of the river) the sampling was performed.

After sampling some factors like external condition of weather, place, time and hour of sampling, geographical and physical position were controlled. Then for the stabilizing of samples and for the preventing the growth of microorganisms, they were submerged into 65% acid nitric till the pH of the sample reduced to 2.5–3.0 [5].

Water samples were sent to the contracted laboratory in dark containers. We took some photographs from the natural condition of the Nir River and the spring beside it (see, for example, Photo) and then primary and required data were classified and evaluated. In the field operations we used multiparameter instrument of US HACH Inc. with special electrodes [6].



a



b

Photo of the river in winter (a) and summer (b).

**Results and Discussion.** Results of the measuring of the values of anions, cations and insanity parameters are obtained by atomic absorption system.

*pH* values fluctuate between 7.75 and 8.9 during the year and with regard to the fact that pH is one of the main indices of water quality, and that the solubility and density of some gases like carbon dioxide and ammonia is a function of pH, obtained values are very suitable (Table) [7].

*Water temperature* ( $T_w$ ) is one of the properties of surface waters. Temperature affects physical and chemical characteristics of water. It also affects biological activities of aquatic organisms (both animal and plants) and has a direct relationship with electrical conductance. According to the Table, the Nir River water is

classified among the waters of cold and mountainous rivers and its temperature pollution is not visible at present [7].

The *Dissolved Oxygen* (DO) parameter is of importance due to the measurement of pollution loads and biological activity. DO minimum values were observed in summer, and in autumn then it increased up to maximum quantity 10.2 mg/l (Table). We consider that the oxygen volume of the river is also acceptable at present [8].

The required *Biochemical Oxygen Density* (BOD) can show the degree of pollution, and it is always 5 days of oxygen consumption and 20 centigrade. The existence of ample oxygen in river water caused the lower amount of BOD. According to the obtained results, the amount of BOD during the summer is higher than in other seasons (Table) [8].

*Results of chemical and physical analysis from stations*

Station	Date	pH	$T_w$ , °C	DO, mg/l	BO mg/l	COD, mg/l	CaCO <sub>3</sub> , mg/l	Total Coliform, mln./100 ml	Fecal Coliform, mln./100ml
1	05/26/2008	8.30	14	6.4	3	4.1	35	48	3
	07/03/2008	8.50	18	6.3	4	9.0	45	93	15
	09/02/2008	8.30	10	8.5	0	13.5	70	210	100
	10/06/2008	8.35	14	7.2	0	6.3	70	23	20
	11/03/2008	8.90	5	7.8	1	9.1	50	70	9
	12/31/2008	7.85	1	10.2	0	0.9	40	4	4
	01/27/2009	7.80	3	10.0	0	1.5	40	93	93
	02/23/2009	7.75	2	8.7	0	24.3	50	9	9
2	05/26/2008	8.20	17	6.3	2	3.8	60	20	15
	07/03/2008	8.15	17	7.0	4	7.5	150	210	120
	09/02/2008	8.20	16	8.2	4	72.1	145	460	75
	10/06/2008	8.10	16	7.0	0	0.7	165	1100	210
	11/03/2008	8.36	12	7.1	3	5.6	130	9	0
	12/31/2008	7.87	6	8.6	1	3.1	125	93	21
	01/27/2009	7.95	7	9.5	1	2.1	90	9	9
	02/23/2009	7.95	7	9.0	2	42.6	95	460	460

The required *Chemical Oxygen Density* (COD) can be applicable in identifying of pollution degree, and is always more than the amount of BOD. The difference between BOD and COD can show the amount of toxic organic compounds and biological indissoluble materials. The amount of COD during the whole year was lower than 72.1 mg/l, and the optimum amount was observed in summer, which was due to precipitation and flowing of runoffs containing agricultural poisons to the river (Table) [9].

*Carbonate Hardness* (CaCO<sub>3</sub>) is obtained according to calcium bicarbonate and magnesium content. The elevation of pH and temperature decreases the total hardness in aquatic environment. According to the Table, the total hardness was varying between 35 and 165, which places this water among waters with low hardness. However, during the autumn its hardness is higher than in other seasons in both stations, and this places it among very hard waters [10].

The amount of *Total* and *Fecal Coliforms* during autumn in station 2, which is adjacent to residential and cattle breeding area, is higher than in other areas. This

fact is due to the entrance of human and animal waste waters its amount is higher than standards for surface water (Table) [11].

**Conclusions and Suggestions.** Most of the microbial pollution of the Nir River water is reported from April to June each year. Although the amount of nutrients is not high it can be created by temperature variations. There are more bacteria in slimes than in water in general. Sedimentary slimes of this region include Methane and Hydrogen oxidizing bacteria, fermentative non-atmospheric nitrogen stabilizing bacteria etc.

Discharging of corruptible and biological materials to the Nir River causes variation of oxygen density and some other physical, chemical and biological changes. Thus, mentioned processes and their products along with oxygen resource affect significantly the Nir River ecology.

The degree of solved oxygen in all points of the river is above 6.3 mg/l, which counts for the high density of oxygen. Total stiffness of the river before and after reaching to Nir City is quite different and this index is nearly twice higher in the point of its exit. Just in two months only in one station within city limits, the amount of total and fecal coliforms was above the permissible level. In spite of using the region around the Nir River as a tourist and economical area and although there are some threats in this regard, natural condition and ecosystem of mentioned region is intact.

Some factors such as discharging of human and animal waste waters to the river, irregular use of its water, flowing of agricultural poisons and chemical fertilizers to the Nir River, the possibility of decrease of water supply and rainfall as well as the establishment of uncontrolled industries and mines around can create possible threats to the Nir River that could be reduced only by regular and periodic control.

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ԻՐԱՆԻ ԱՐԴԱԲԻԼ ՇՐՋԱՆԻ ՆԻՐ ԳԵՏԻ ԱՂՏՈՏՎԱԾՈՒԹՅԱՆ  
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Նիր գետը ձևավորվում է հինգ աղբյուրներից: Այդ աղբյուրներից երկուսը ապահովում են խմելու ջուր Նիր քաղաքի համար: Սկսած քաղաքի միջնամասից՝ օրվա ընթացքում գետ են լցվում մոտ 35 *m* քաղաքային, գյուղական և գյուղատնտեսական թափոններ, հետևաբար, անհրաժեշտություն է առաջանում ուսումնասիրել գետի աղտոտվածության աստիճանը:

Գետում ուսումնասիրվել են հետևյալ ցուցանիշները՝ քիմիական և ֆիզիկական հատկությունները, հիմնական իոնները, պոտորությունը, կոշտությունը, լուծված թթվածինը, ԹԿՊ-ն, ԹՔՊ-ն, ջրի ջերմաստիճանը, pH-ը, CaCO<sub>3</sub>-ի քանակությունը, կոլիֆորմ բակտերիաները և այլն: Հիմնվելով տվյալ հետազոտության արդյունքների վրա՝ եզրակացություն է արվել, որ թեև գետի ցածրադիր մասում տեղի է ունեցել աղտոտիչների քանակության ավելացում համեմատած բարձրադիր գոտու հետ, հետազոտված ցուցանիշները, այնուամենայնիվ, եղել են թույլատրելի սահմաններում և համապատասխանել են միջազգային ստանդարտներին:

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ОПРЕДЕЛЕНИЕ И ИЗУЧЕНИЕ ЗАГРЯЗНЕНИЯ РЕКИ НИР  
АРДАБИЛСКОЙ ОБЛАСТИ ИРАНА

Резюме

Река Нир формируется из пяти родников, два из которых служат источником питьевой воды для города Нир. Начиная с центральной части города ежедневно в реку сливается около 35 *m* городских, сельских и сельскохозяйственных отходов, следовательно, возникает необходимость изучения степени загрязнения реки.

Исследовались следующие параметры: химические и физические свойства, концентрации основных ионов, CaCO<sub>3</sub>, колиформных бактерий, мутность, жесткость, растворенный кислород, БПК, ХПК, температура воды, pH и т.д. Исходя из полученных результатов было сделано заключение, что, хотя в нижнем течении реки происходило увеличение количества загрязнителей по сравнению с верхним течением, тем не менее, изученные параметры находились в допустимых пределах и соответствовали международным стандартам.