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Pollution of domestic and industrial water in Tlemcen (Algeria)

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ABSTRACT

Pollution of rivers by has become one of the major problems of environment; it results in environmental enrichment on nutrient and algae blooms. The current situation in the region of Tlemcen shows a very serious pollution of effluent, either by industrial effluent or by domestic effluent. This study, based on water pollution and discharges of domestic and industrial waste with a physic-chemical analysis shows high values for the parameters analyzed between 64.1 mg/l and 447.2 mg/l for BOD5, 42 mg/l and 809 mg/l for COD and between 11 mg/l and 283 mg/l for suspended solids and bacteriological analysis confirms the previous analysis shows bacterial pollution from domestic sources. The effluent is used for irrigation and is a threat to the environment, must install sewage treatment plants.

KEYWORDS

Pollution;
Waste discharges;
Domestic and industrial;
Environmental;
Physic-chemical;
Bacteriological analysis.

INTRODUCTION

With the development of urbanization and industrialization, and changing patterns of consumption, wastewater discharges have evolved considerably in quantity and quality, so they are a global threat to human health and the environment[1].

Pollution of rivers by chemicals has become one of the major problems of the environment. This chemical pollution has two origins either directly which is completely understandable when it comes from factories, refineries and pipe leaks, or indirect, which has no known specific source and propagates in runoff from fields or mine workings, seepage from septic tanks or sewers[1].

Most rivers in industrialized countries are already more or less polluted. These rivers are the last refuge for many plant and animal species, and the water they provide is the best support the development of many nations. The hydro-biological research has mainly focused on the use of living organisms as biological indicators (algae, invertebrates, fish)[2,3] but little on the physical chemistry.

This work aims to analyze the physic-chemical parameters determination of major water pollution and industrial waste household in the city of Tlemcen, and identify bacterial germs that pollute the effluent that threatens the environment as these waters are used for irrigation.

EXPERIMENTAL

Description of the study area

The Station study lies in the region of Tlemcen, in northwestern Algeria between 34 ° and 35 ° 30 'north latitude and 1 ° 20' and 2 ° 30 'west longitude. It is semi-arid bioclimatic atmosphere less cool winter.

The wastewater discharged by urban and industrial city of Tlemcen, were evacuated in the rough in both rivers El hora and Saf-Saf. The court of El hora water is the receiving domestic wastewater is located north of this city. The main collector of industrial wastewater is Saf-Saf (both rivers are used for irrigation as they pass through small villages).

For our present study, we chose these two collectors at the end of obtaining a representative measure of the total wastewater drained by the population and industries of the town of Tlemcen.

Physic-chemical analysis

At each station three samples of wastewater were performed to measure the physic-chemical and bacteriological analysis during the year 2006 (June, December and February). The measurements of temperature, salinity and dissolved oxygen were made in situ. The water for microbiological analysis was collected in glass bottles of 250 ml sterilized for half an hour at 170 ° C in an oven. Samples are transported in a cooler for it is advisable to keep samples at 4 ° C and that for slow bacterial activity[4]. The analysis is performed on the same day in no case beyond 24 hours.

Knowledge of some physic-chemical gives a preliminary assessment of the quality and degree of pollution of water. The parameters studied are:

Temperature, pH, conductivity, dissolved oxygen were determined using a multi-parameter analysis CONSORT Type-Model 835.

Salinity: The salinity was measured using a brand salinometer Wissenschaftlish Technische Werkstatten "WTW".

Conductivity: is measured by a conductivity meter (MPT) WTW-LF330.

Turbidity: Turbidity is measured by nephelometry using a turbidity meter laboratory and expressed in NTU (Nephelometric Turbidity Unit).

The biological oxygen demand (BOD5): The BOD5 is determined by the method respirator with a BOD metremarque WTW, model 1020T using the technique described by[5].

Chemical oxygen demand (COD): COD is determined by the oxidation environment acid by the excess of potassium dichromate at a temperature of 148 ° C, oxidizable materials in test conditions in the presence sulfate of silver and sulfate of mercury[6].

Chlorides: These are drawn by the method of Mohr. This method is to measure the chlorides with silver nitrate and potassium chromate. In the presence of silver nitrate, Cl-ions are mobilized to form silver chloride. When all the chloride ions were precipitated as AgCl, silver nitrate reacts with chromate potassium and a brick red precipitate appears[7].

The suspended solids (TSS): The measurement principle of the TSS is the vacuum filtration or pressure of the sample. The sample is filtered through a fiberglass vacuum or pressure and dried in an oven at 105 ° C. The residue deposited on the filter is weighed.

The dry residue: is made by drying and weighing a known volume of sample. The sample is 4 hours in an oven at 105 ° C and weighed.

Nitrates and nitrites: Nitrates are determined by the photometric method with 2,6 -dimethylphenol according[8] and finally the determination of nitrite was carried out by the photometric method according[9].

Ammonia: In alkaline medium (8 <pH <11.5), the dissolved ammonium reacts with hypochlorite to form monochloramine. This compound, in the presence of phenol and an excess of hypochlorite (oxidizing medium) results in the formation of a blue indophenol. The reaction is catalyzed by sodium nitroprusside. The absorption maximum is at a wavelength of 630 nm.

Phosphates: the method used for analysis of phosphate based on the mineralization of samples by adding ammonium sulfate and acidifying the medium.

Calcium: by measuring volumetric (titrimetric) by addition of dilute solutions of acid (sulfuric acid, hydrochloric or nitric) in the presence of colored indicators, necessary to neutralize the amount of water to be analyzed.

The determination of heavy metals (Zinc, Lead, Iron, Copper, Chromium, Cadmium, Nickel, Magnesium)

was performed, according to the ISO 11 885 on samples filtered at 0.45 um, treated with pure nitric acid (pH <2) and passed to the ICP-AES (Inductively Coupled Plasma-Atom Emission Spectroscopy).

Sodium, potassium, sulfate and silica are determined by colorimetric on a Palintest photometer type.

Bacteriological analysis

This search for pathogens in a sample of water[10]. Germs are sought coliforms, total bacteria, Escherichia coli, sulfite-reducing clostridia and fecal streptococci. These germs are few or non-pathogenic; they are indicative of fecal contamination and lead by their abundance of suspicion of contamination more dangerous[11].

Searchers coliform: The standard method of[12], is to make a presumptive test that is reserved for total coliforms, performed on lactose broth, the fermentation is manifested by a disorder and a release of gas observed in the bell of Durham. After incubation for 48 h at 37C °, it appears a shift from purple to yellow + gas in the bell that is to say the presence of coliform.

The confirmatory test performed for the detection of fecal coliforms and *Escherichia coli*. From the positive test tubes before, six drops in a tube of medium indole Mannitol + Erlich Kovacs, after incubation for 24 h at 44C °, add two drops of reagent Erlich Kovacs, observed in a reddish ring indicates the presence *Escherichia coli*.

-Detection and enumeration of total germs: The culture medium that is used is TGEA agar (tryptone glucose yeast extract), we take two Petri dishes for the first box 1ml of sample is run over the agar until closure of the surface of the box. The second box, 1ml of the sample in the box and poured the agar, incubation is for 48 hours at 37C °.

-Detection and enumeration of sulphite-reducing clostridium: is to seek the vegetative form and spore shape. Two tubes for each form containing 10ml of sample in each tube then add the beef liver agar. After the destruction of vegetative form by heating at 80C ° for 10 minutes then incubated for 48 h at 46 C ° y 'it a black color that shows the presence of colonies of Clostridium sulfite-reducers.

Searchers streptococci: The technique used that of[12], is to make a presumptive test on the middle of Rothe and incubation at 37C ° for 48 h. A confirmatory test for each tube of medium Rothe positive is seeded two to three drops in a tube of medium Litsky. After an overnight incubation at 37C °, it appears a growing yellow with a purple patch at the bottom of the tube this confirms the presence of streptococci.

RESULTS

The analysis of the chemical quality of water shows that most values recorded are not compliant Algerian. The degree of pollution varies from one sample to another. The main sources of pollution in our study area

TABLE 1 : Results of physic-chemical properties of water courses.

Station→	Saf-Saf			El hora			Algerian standards
Samples→ Parameters↓	1	2	3	1	2	3	
Temperature (C°)	23,0	16,3	12,0	24,6	20,0	12,4	30
pH	7,3	7,5	7,9	7,6	7,7	8,3	07
DBO_5 (mg/l)	302,3	447,2	298,1	190,8	90,3	64,1	40
DCO (mg/l)	700,0	809,0	699,3	120,2	60,0	42,0	120
Dissolved oxygen (%)	19,2	14,5	53,2	20,1	13,3	62,1	5-8
Phosphate (mg/l)	12,2	2,9	2,4	3,8	4,9	1,3	02
Nitrites (mg/l)	2,3	4,2	3,25	0,18	0,09	0,27	0,1
Ammoniac (mg/l)	33,0	11,8	9,8	8,1	0,5	0,3	0,5
Organic matter (mg/l)	49,0	55,0	70,0	31,0	22,0	9,0	05
Suspended matter (mg/l)	228,0	50,0	11,0	250,0	283,0	200,0	30
Mineralization (mg/l)	1801,0	903,0	1103,0	890,0	728,0	701,0	500
Conductivity (µs/cm)	2699,0	1548,0	1920,0	1423,0	1277,0	1150,0	250
Turbidity (NTU)	152,0	198,0	163,0	84,0	40,5	16,2	05
Dry residue (mg)	2034,0	1328,0	1396,0	1135,0	901,0	875,0	200

TABLE 2 : Results of physic-chemical (heavy metals) properties of water courses.

Station	Saf-Saf			El hora			Algerian standards
Samples→ parameters↓	1	2	3	1	2	3	
Zinc (mg/l)	0,2	0,08	0,073	0,34	0,29	0,98	5
Plomb (mg/l)	-	0,33	0,20	-	0,22	0,29	1
Cadmium (mg/l)	0,031	0,085	0,052	0,059	0,030	0,032	0,2
Iron (mg/l)	0,98	0,51	0,39	0,87	1,59	0,70	5
Copper (mg/l)	0,023	0,012	0,009	0,059	0,049	0,079	3
Chrome (mg/l)	-	-	0,009	-	-	-	0,05
Nickel (mg/l)	0,019	0,017	0,016	0,12	-	0,04	5
Magnesium (mg/l)	0,16	0,17	0,11	0,040	0,098	0,040	1
Calcium (mg/l)	60,0	12,1	136,0	70,0	132,0	140,0	200
Sodium (mg/l)	90,0	71,0	189,0	125,0	164,0	190,0	20
Potassium (mg/l)	40,0	35,0	42,0	46,0	31,0	40,5	20
Chloride (mg/l)	105,2	192,0	290,0	116,2	223,0	270,0	200
Sulfate (mg/l)	111,0	102,0	245,0	79,0	213,0	189,0	250
Nitrate (mg/l)	4,5	12,5	8,0	4,0	4,5	7,5	50
Silica (mg/l)	16,1	17,0	24,0	15,0	19,2	20,5	20

are industrial effluents, domestic effluents and runoff water laden fertilizer and many municipal wastes which are driven by rain and showers.

The bacteriological analysis revealed the presence of a large number of total bacteria, coliforms represented by *Escherichia coli*, spores of Streptococcus and Clostridium (TABLE 3).

TABLE 3 : Results of bacteriological analysis of water courses.

Station→ Flora sought↓	El hora	Saf-Saf
Total bacteria/100 ml	332.10^5	340.10^5
Coliformes/100 ml	320.10^5	333.10^5
Escherichia Coli/100ml	32.10^5	51.10^2
Streptococcus/100ml	201.10^3	100.10^3
Clostridium/100ml	40.10^3	23.10^2

DISCUSSION

Measures the temperature of each station, range from 12 ° C and 24.6 ° C, with referring to the maximum values of the parameters of discharges (TABLE 1), we note that these values are less than the standard releases that Algeria is 30 ° C. The temperature variation is explained by the change in air temperature.

The pH is one of the most important factors affecting the biological activity of the microflora of the water. The vast majority of microorganisms growing in an area of 4.5 to 8.0 and the optimum range between 5.5 and 7.5[13,14]. pH values between 7.3 and 8.3 for the two stations, this would probably be due to the nature of the load of waste water and the biological activity of microorganisms. The pH was not a direct ecological impact between 5 and 9[15].

The recorded values of BOD5 in rivers are very high; they are included between 298.1 mg / l and 447.2 mg / l for industrial wastewater and exceed the standards of allowable discharges limited to 40 mg / l. This result confirms that wastewater is polluted by inorganic pollution strong enough and this is due to the excessive load of organic matter. The values of domestic wastewater are BOD5 ranging from 64.1 mg / l and 190.8 mg / l. These values are compared with the amount of organic matter.

From the results obtained, we note that the values of chemical oxygen demand (COD) are higher than maximum discharge parameters where the value of COD is equal to 120 mg / l. The most important value for both streams is 809 mg / l.

The value of electrical conductivity is probably one of the simplest and most important for quality control of wastewater[16]. The results (TABLE 1) show high values in conductivity with the highest value of 2699 S / cm. Conductivity is large and strong, this is related not only to chlorides but also to increasing process of mineralization[17]. These values found in wastewater dis-

charges of these are comparable to those encountered in wastewater[16] in Morocco. The recorded values reveal that the majority of stations have a high electrical conductivity due to the organic load[18].

The determination of suspended solids is important because it allows to assess the pollution load, this measure is in colloidal mineral or organic[19]. The results of suspended solids (TSS), showed levels exceeded the permissible values, limited to 30 mg / l. These results show the poor quality of domestic and industrial sewage due to the high organic load generated by the population of the city and factories.

The analysis of results of dissolved oxygen (TABLE 1) shows that the extreme minimum and maximum values recorded are 13.3% and 62.1%. Comparing the values of dissolved oxygen in the effluent with the permissible value (TABLE 1) can be deduced that the wastewater quality is very bad. The significance of this parameter is very clear since the presence of dissolved oxygen determines the degradation reactions of organic matter and more generally the biological balance of aquatic ecosystems. In networks of wastewater, its complete disappearance is usually accompanied by the appearance of H2S in the air, from the reduction of sulfur compound present in waste, and correspondingly the phenomenon of acid attack concrete pipes[20].

The values of nitrate are substandard. For nitrite values are above the norm especially for industrial wastewater. There is an enrichment of water in phosphates, is a maximum of 12.2 mg / l greater than standard 2 mg / l. Phosphates are mainly fertilizers and detergents and their presence in stagnant water causing excessive growth of algae[21].

For sulfate, the maximum value recorded is 245 mg / l. The sudden increase in the concentration of sulfate in water can be an indication of industrial pollution[22].

Among the pollutants of industrial effluents, heavy metals present in the same trace are persistent in the receiving environments, and prone to accumulate in organisms through the food chain[23].

Rainfall is the main factor in the dilution and precipitation of several ions and metals. Their concentrations are related to contributions by washing the alluvial soils and changes thereafter, physic-chemical conditions that would have freed the ions stored in sediments[24].

Bacteriological results show the presence of *Escherichia coli*, coliforms, clostridia and streptococci of whose studies correlate with the presence of high organic load. Thus, there is a predominance of coliforms on streptococci attesting that the contamination is of human origin In general, the concentrations of streptococci are in natural settings other than those[25] specifically polluted by livestock, lower than those of fecal coliforms[12].

Sulfite-reducing clostridia are present at both effluent is evidence of an ancient fecal pollution[10]. Through these results the two effluents are of poor bacteriological quality and represent a danger for irrigation.

This result was used to assess the risk from pathogenic microorganisms may be found in waters used by humans and thus cause water-borne diseases. In Algeria, the water-borne infections are the leading cause of morbidity among the notifiable diseases or placed under surveillance[26].

CONCLUSION

Our work focuses on updating the parameters of pollution with a physic-chemical and bacteriological two industrial effluents and domestic. The results obtained show that these waters are heavily polluted by industrial and domestic wastes. These waters are highly contaminated and may impact on the environment and represent a danger for irrigation due to the presence of certain pathogens.

To improve the quality of these waters and for good preservation of the receiver must install a treatment plant before the effluent used for irrigation.

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