Impact of Wastewater on Ditches of Rainwater Drain in Al-Hilla City

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Abstract

In this research, the environmental reality of the ditches to rainwater drain located in the residential neighborhoods of Al-Hilla city in Iraq was studied. The study was conducted on three ditches near schools and health center within three residential neighborhoods. Chemical laboratory tests (BOD, COD, TSS, TN, TP, NO₂⁻, NO₃⁻, SO₄²⁻, Cl⁻, CN⁻, pH, T, DO) were proceeded on this water and it was found that the water is high polluted in sewage water compared to the sewage entering the treatment plant in the city and comparing with samples of water taken from ditches outside the city (as a standard sample). The pollution of this ditches with sewage water is considerable hazard on people health in this urban area, especially on children, students and the people come in to the health center in this areas.

1. Introduction

Water is considered one of the most important natural resources at all, as it is a basic factor on which human life and all the resources on the globe depend [1,2]. Wastewater is used water, comes from daily using for water from many activities such as human personally use, commercial, industrial and agricultural activities. This water contains metals, organic solvents and material, toxic sludge and microorganism. Wastewater also has many pollutants from rainfall carries road salts, clay, oil, grease, inorganic and organic chemical materials [3-6]. Sewage water, whether domestic, industrial or rainwater, it causes numerous hazards that directly effect on the environment and human, especially when it is in direct contact with the environment and people, this sewage water have greater harm in terms of odors, unwanted looks, diseases. Microorganisms and insects (especially mosquitoes and flies) that live in it cause many diseases, and these microorganisms may cause pollution of drinking water in this area [7-10]. In many countries water pollution is a major problem lead to death, according to the World Health Organization more than 1 in 4 deaths of children under 5 years of age are unsafe water, lack of sanitation, and inadequate hygiene [11,12].

Given the seriousness of wastewater and the health and environmental problems that result from it, it is necessary to assess the extent of pollution it causes in some residential neighborhoods in Al-Hilla city, where this research conducted to study the possibility of contamination of rivers water in these
neighborhoods with sewage water and the extent of potential harm to the people of these areas and the surrounding environment.

2. Experimental section
2.1. Materials and instruments
The chemical were purchased from CDH and Fluka companies, chemical tests were made by Hach spectrophotometer (DR 2800) with DRB200 reactor, pH value was determined by using Hach HQD portable meter, dissolved oxygen (DO) was determined by Hach HQ30D.

2.2 Estimation of chemical oxygen demand (COD)
COD was measured by using high-range ampoules (Hach chemical kit) with spectrophotometer (Hach DR2800) and reactor (Hach DRB200) according to specific method of Hach company.

2.3 Estimation of biochemical oxygen demand (BOD) [13]
First a known amount of wastewater sample was placed on the airtight BOD bottle (volume = 300 mL), then bottle was filled with dilution water contains the nutrients required for organisms growth and saturated with oxygen. The dissolved oxygen was measured for solution by Hach HQD dissolved oxygen meter, the bottle was incubated for five days at 20 °C, after five days the dissolved oxygen concentration was measured again, the BOD value of sample is the difference between the initial value of dissolved oxygen before incubation and dissolved oxygen value after incubation divided by decimal fraction of sample used.

2.4 Estimation of total nitrogen (TN) and total phosphor (TP)
Total nitrogen and total phosphor were measured by using ampoules of (Hach chemical kit) with spectrophotometer (Hach DR2800) and reactor (Hach DRB200) according to specific methods of Hach Company.

2.5 Estimation of dissolved oxygen (DO) and temperature (T)
Dissolved oxygen (DO) and temperature (T) were measured by using Hach HQD dissolved oxygen meter immediately after bringing samples.

2.6 Estimation of nitrite (NO$_2^-$), nitrate (NO$_3^-$), cyanide (CN$^-$) and total suspended solid (TSS)
The nitrite, nitrate and cyanide ions were measured by using ampoules of (Hach chemical kit) with spectrophotometer (Hach DR2800) according to specific methods of Hach company.

2.7 Estimation of chloride ion (Cl$^-$) [14]
Determination of chloride concentration in waste water done by using Mohr method, first step is taking 25 mL from collected sample into conical flask, then added 2-3 drops from indicator (potassium chromate), the color of solution was turn into light yellow. The solution was titrated against silver nitrate solution until reach the end point when light yellow color was in turn to permanent brownish-red color. The volume of silver nitrate added was noted then concentration of chloride was calculated.

2.8 Estimation of sulfate ion (SO$_4^{2-}$) [15]
Sulfate ion was measuring by using gravimetric method, 100 mL of sample was placed into beaker then added 100 mL distilled water then added 4 mL of 6 M HCl, the solution was heated nearly to boiling. For the warm solution 10 mL of barium chloride was added with string. The solution was lifted to 24 h for digestion, and then the precipitate was filter with ashless filter paper and rinsed with distilled water.
The precipitate with filter paper putted into crucible (the crucible was rinsed and dried in furnace then weighted after cooling in desiccator), then the crucible with sample was heated on Bunsen burner to burning the filter paper. After that the crucible was dried at 800 °C in a furnace for 1 h then cooled, weighed and calculations were done.
3. Result and discussion

Pollution is one of the serious problems and has a direct impact on human life, animals and plants. One of great importance pollution problems is water pollution, especially its contamination with sewage water. Therefore, we notice in all developed countries of the world attaching great importance to this aspect and wastewater treatment is one of the priorities for them to reduce the possibility of contamination of surface or ground water with wastewater. But in developing countries and third world countries that suffer from poverty and economic problems, we notice that there is a great lack of interest in this aspect due to ignorance and lack of awareness of the hazards generated by this issue. In the city of Al-Hilla, as an example of this side, there is a great insufficiency of sewage networks and the lack of areas served by these networks. In addition, the flood of most neighborhoods during the winter season has induced the local government and the people to replace the sewage networks by drilling a ditch to rainwater drain. These ditches have become a focal point of pollution instead of being a solution to this problem. In this research, the pollution of accumulation rainwater in these ditches with sewage water was studied in addition to studying the presence of chemical pollutants. This study was conducted in three areas in the city center of Al-Hilla, and samples were collected from the ditches in them.

The results of the chemical analysis of the samples were taken from these areas are shown in Table (1) these results were compared with samples taken from ditch located outside the city and far from residential areas (as a standard sample), as well as compared with heavy water in water treatment plant in the city.

During studied the results in table (1), the research found ditches inside the city have bad quality comparing with another ditches outside city (that is usually used for rainwater drainage, surface water drain, land reclamation, and soil salinity reduction) in this water the research found that the percentage of salts is high, especially sulfates and chlorides, and in contrast, a decrease in the value of the chemical oxygen demand and the biological oxygen demand, or even its nonappearance, due to the absence of organic pollutants in the water, as well as for biological pollutants. On the contrary, the research found that the water in the drains under study has a high percentage of pollution with organic materials and chemicals, where we notice the high percentage of the chemical requirement for oxygen and the biological requirement and this is a clear indication of its great pollution of organic materials and its values are close to the values of wastewater offered from the city to the station Sewage. In addition to increase in the value of total nitrogen and total phosphorous, which is one of the important elements in the process of food enrichment, and this causes a problem in the growth of suspended organisms and filamentous algae as noted in the microscopic examination of the water samples and as seen in the images (1-3). The surface algae cover and its decomposition, as well as the emission of unpleasant odors that are not desirable, and this was clearly noticeable when collecting samples and a decrease in the value of the oxygen absorbed in the water in comparison with the natural state found in rivers and non-polluted waters.

Also, by examining these samples under the microscope, it was found that these samples contain a large number of microorganisms from parasites, as well as eggs of worms, filamentous algae and many other types as shown in images (4).

By comparing three samples found the first location is more pollution and has high odor and more turbidity and dark color where the third location is less pollution and there is an empty space and a pond of water with the reed plant on the site also, the soil present high salinity.

The results appeared this type of drain is contaminated directly with sewage water, and this constitutes an environmental disaster, especially in the rainy season, because the capacity of these rivers is little and the speed of their drainage depends on the slope of these rivers and sometimes on water pumps installed on these rivers and this is not sufficient for the purpose drainage of water in it and rainfall leads to flooding of these rivers on the neighboring streets, and in the event of heavy rain, the entire areas will be pools of water contaminated with sewage water, and this constitutes an environmental disaster, especially most of these areas do not contain public sewage networks or contain a rainwater network that will take this water is transferred to the main rivers in the city, and this means pollution of water sources and thus pollution of drinking water as well. In normal times, most of the time the water of these drainages reaches the street, and here the pollution will be
transmitted through the cars that drive on it, and the pollution will spread in a larger way, and it can also be transmitted through the dust after the streets dry up and the traffic of cars spread this dust, which is contaminated with secondary pollutants that They exist in these waters.

Table 1. Chemical tests of samples, standard sample and sewage water.

| Test | Sample 1 | Sample 2 | Sample 3 | Standard\* | Sewage water average for one month |
|------|----------|----------|----------|------------|-----------------------------------|
| BOD  | 70       | 70       | 18       | Zero       | 181                               |
| COD  | 198      | 135      | 117      | Zero       | 328                               |
| TSS  | 345      | 116      | 48       | 9          | 344                               |
| TN   | 42       | 34       | 27       | 0.39       | 17.04                             |
| TP   | 9.67     | 8.69     | 3.79     | 0.9        | 7.46                              |
| NO₃⁻ | 0.9      | 1.6      | 1.3      | 1.2        | 2.45                              |
| NO₂⁻ | 0.005    | 0.01     | 0.001    | 0.006      |                                   |
| Cl⁻  | 360      | 470      | 1159     | 90         | 434                               |
| CN⁻  | Zero     | Zero     | 0.032    | Zero       | 0.034                             |
| SO₄²⁻| 820      | 977      | 1760     | 91         | 1039                              |
| pH   | 7.15     | 7.38     | 7.14     | 8.49       | 7.48                              |
| T    | 15       | 15       | 17       | 14         | 19                                |
| DO   | 0.16     | 0.37     | 4.41     | 9.22       | -                                 |

*standard; the sample from river outside the city.

Figure 1. The position of sample (1).
Figure 2. The position of sample (2).

Figure 3. The position of sample (3)
4. Conclusion
- Through the results of the tests, it was found that the ditches waters polluted with high percentage of sewage water, which represents a major environmental problem that affects the residents of the areas where these ditches pass.
- The pollution increase in the rainy season because of the flood of polluted ditches waters to streets and near places.
- The banks of these ditches have become a dumping ground, and even inside these ditches noticed that there are a lot of waste which causes the clogging of the drainage water and lead to the crossing of this water on the streets and increasing pollution. In addition these ditches have become a shelter for many animals and rodents.
- It is possible to treat this phenomenon by burying these ditches and replacing them with an underground network of pipes, as well as by establishing a sewage network for the areas insulated from drainage networks for rainwater to reduce the pollution in rivers where the ditches pour.

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**Acknowledgment**

The research team presents to Mr. Ali Najah with thanks and appreciation for the assistance in completing this research. In addition, appreciation to the Babil Sewerage Directorate, Laboratory and Environment department.