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Abstract. The analytical parameters of wastewater gathered from ten stations have been studied by standard methods. The unpleasant odor was observed in all stations, in addition, the pH of the wastewater was measured to be in the range of 6.3-8, meanwhile, the electrical conductivity of the water was in the range of 2030-6450 μscm^{-1}. The values of 3225, 406, (144-604), 5.84 and 130 ppm corresponded to maximum total dissolved solids, maximum biological oxygen demand, range of the chemical oxygen demand of the selected sites, maximum nitrate content and maximum sulfate content, respectively. The obtained analytical data showed variables in all used parameters in all stations, and most all of the studied parameters were higher in comparison with the permissible limit reported by World Health Organization or the Libyan National Center for Standardization and Metrology.

Keywords. Wastewater, Sewage. analytical parameters, maximum total dissolved solids, maximum biological oxygen demand, maximum chemical oxygen demand, nitrate and sulfate contents.

1 . Introduction

It is known that pollutants in sewage are harmful to public health and the environment as well. Sewage treatment helps to remove pollutants from water [1]. Water is polluted through natural processes that occur in the environment but most pollution is the result of human activities [2]. Water after use is called wastewater and the wastewater is usually not treated before discharge into waterways, causing pollution in the surrounding environment [3]. Previous studies have been conducted by various researchers on different effluents where it has emerged to them that human activities strongly affect the water's nomenclature [4-6]. Water quality can be measured and evaluated by analysing data for some water components and knowing their physical and chemical properties [7-8].

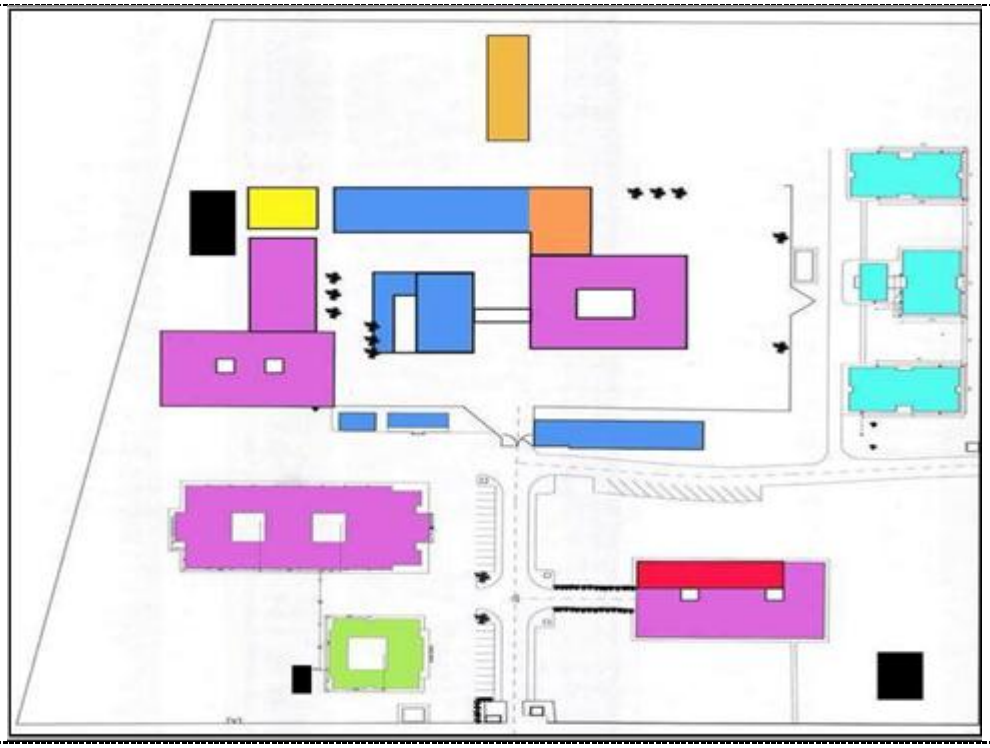

Figure 1. Location of the study area.

The study was conducted at the Koueifieh Hospital for Chest Diseases (figure 1), which is located in the north-east of Libya, about 7 km from the eastern city of Benghazi at the intersection of the "11.2 '02 ° 32" latitude and longitude "48.1 '10 20 ° The total area of the hospital is 57.449.40 m2 and includes the following facilities:

- Outpatient clinic.
- Laboratory analysis.
- Administrative building.
- Washing machine.
- The Holocaust.
- Accommodation sections number four.
- Radiology Department.
- Residential building for doctors.
- kitchen.
- Main drainage tanks for water collection.

The samples collected were taken from the disposal of sewage which presents in ten collection tanks drainage (figure 2) because the area of the collection does not have an infrastructure. This work aims to evaluate the properties of waste water discharged at Koueifieh Hospital, and also to study the quality of wastewater disposed of in the environment.

The rest of this article is organized as follows. Materials and methods are given in section 2. In section 3, the results of the color and odor of wastewater, pH, electrical conductivity, total dissolved solids, biological oxygen demand, chemical oxygen demand, nitrate ion, and sulfate ion are discussed. The spatial representations of analytical parameters and stations based on information regarding the dissimilarity relationships existing between the parameters or stations are shown in section 4. Finally, the conclusion is given in section 5.

2 . Materials and methods

In this study, laboratory analyzes were performed to determine the physiochemical properties of wastewater, such as color, odor, pH, electrical conductivity (EC), total dissolved solids (TDS), biological oxygen demand (BOD), chemical oxygen demand (COD), nitrate and sulfate, samples were collected from the Koueifieh Hospital for Chest Diseases-Koueifieh area in Benghazi, eastern Libya.

Using clean plastic bottles. The samples were transported and their tests performed on the same day. pH determination was done by using the Hach Sension ™ 3 pH Meter.
The analysis of the other chemical properties was carried out using a spectrophotometer (HACH DR2800) method in the ultraviolet spectrum method and comparing the results with the Libyan National Center for Standardization and Metrology. LNS 773: 2013 Libya [9] .

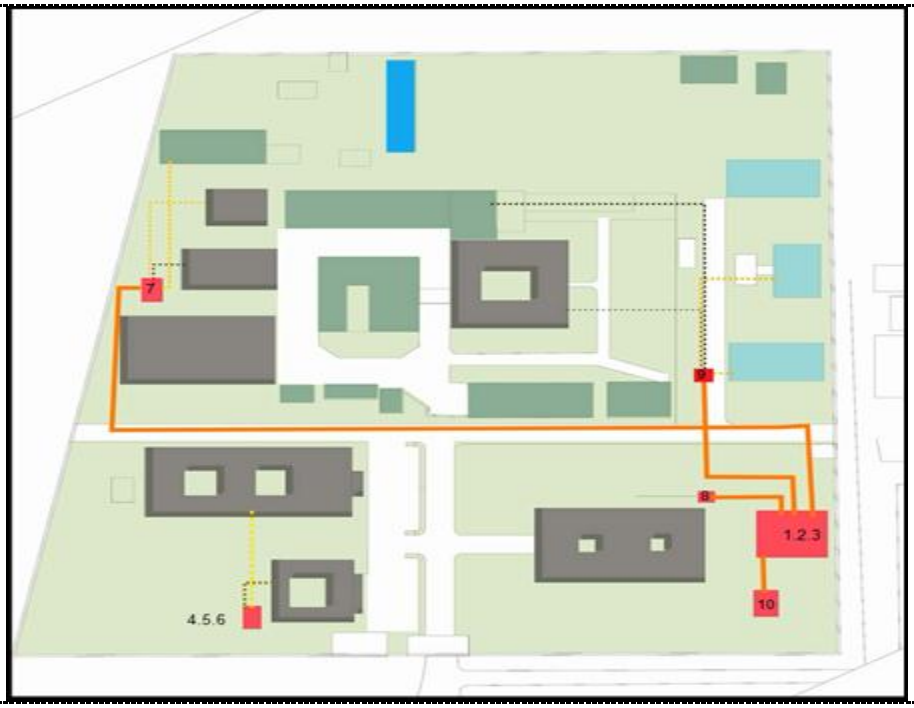

Figure 2. The area of the samples collection.

3. Results and discussion

It was observed that the experimental values (figure 3 to figure 9) are varied where the change in these properties is an indicator of the level of environmental pollution.

3.1. Color and odor of wastewater

Color affects the entry of light into the water medium and the color of the water in the drainage as a result of the solubility of the organic substances and plankton in it [10]. In this study, all samples were almost transparent only in samples 8,9 where the appearance of violet color in the sample 8 results from the use of a special dye in the laboratory of tuberculosis analysis, except sample no.9 which has a dark color, this color comes from the reservoir collection housing drainage for the Koueifieh hospital. In this study, the unpleasant odor was observed in all stations.

3.2. pH

Hydrogen ion concentration is an important indicator of wastewater and its importance lies in the difficulty of biological treatment if it exceeds the permissible range [11]. Figure 3 shows that the pH values in the sewage samples were found to be mostly around 7, except for samples 9 and 10 which were 6.3 and 8.0, respectively, indicating that the water is not acidic or alkaline. It falls within the limits allowed locally according to the specifications and standards of the Libyan state (Table 1).

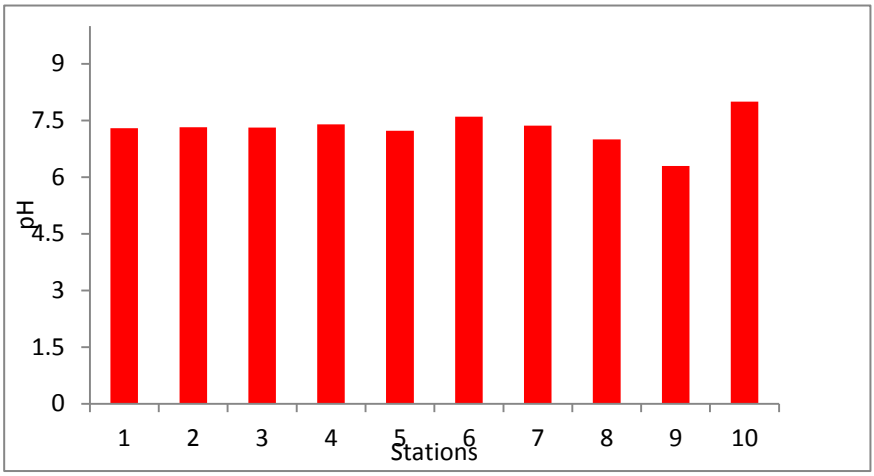

Figure 3. Variation of pH of all stations under investigation.

3.3. Electrical conductivity (EC)

As a result of the presence of ionic compounds represented in the salts of some chemical elements (sodium, potassium, calcium, magnesium) and others lead water to conduct the electrical current [12]. The results in figure 4 show that the EC values of the sewage samples ranged from 3160 to 6450 µs/cm in all samples except sample 8 where its conductivity was 2030 due to the existence of suspended solids and high turbidity, which reduces the movement of ions. The results of all samples exceeded the locally allowed limits and limit allowed by the World Health Organization (WHO) (Table 2). The EC in station 10 was found to be maximum value.

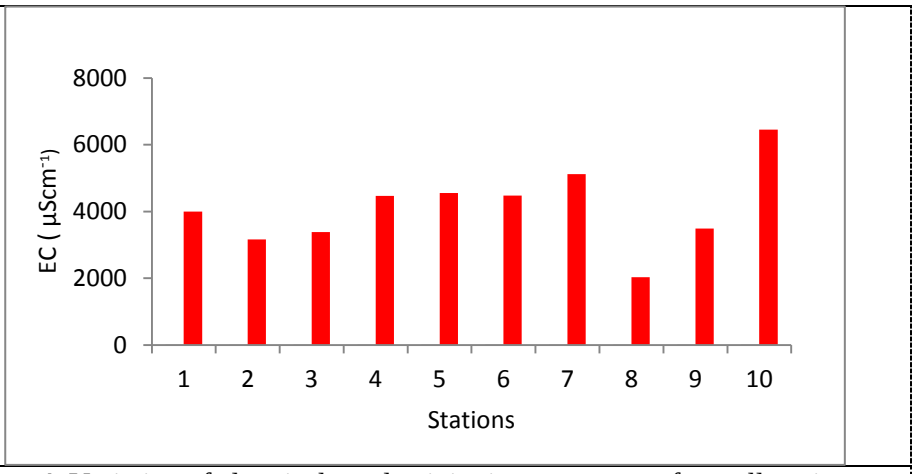

Figure 4. Variation of electrical conductivity in swage water from all stations under investigation.

3.4. Total dissolved solids (TDS)

It means impurities that remain or volatilize when evaporating a known amount of water [13]. Figure 5 shows the presence of suspended solids that ranged from 1015 to 3225 µs/cm in all samples. The lower limit (1015) is associated with station 8 while the upper limit (3225), which is very higher than the internationally and locally allowed limits, is associated with station 10. All values of TDS are far higher than the permissible limits. This is due to the stagnation of the wastewater of the study area.

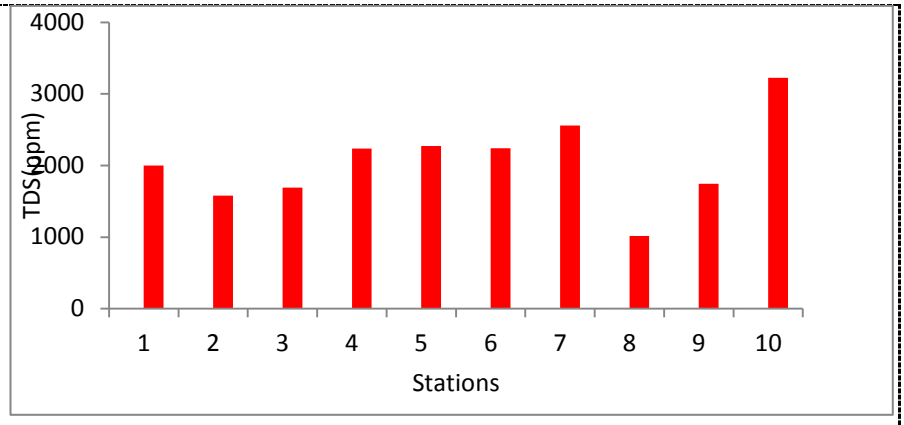

Figure 5. TDS (ppm) in all station under investigation.

3.5 Biological oxygen demand (BOD)

The amount of oxygen consumed by microorganisms is expressed at a constant temperature and within a specified period of time. It is an indicator of the existence of organic pollution. The higher amount of oxygen consumed, the higher the water is polluted [14]. COD = 11.3 + BOD 1.46 , COD represents the chemical oxygen consumed. Physically consumed oxygen. 11.3 Quantity of nitrates per milligram in drinking water according to the WHO. 1.46 is the amount of oxidized carbon after 20 days [15]. The range of oxygen values consumed between (91-406) mg /L in figure 6 was found to be within the allowed limits of the Libyan standards.

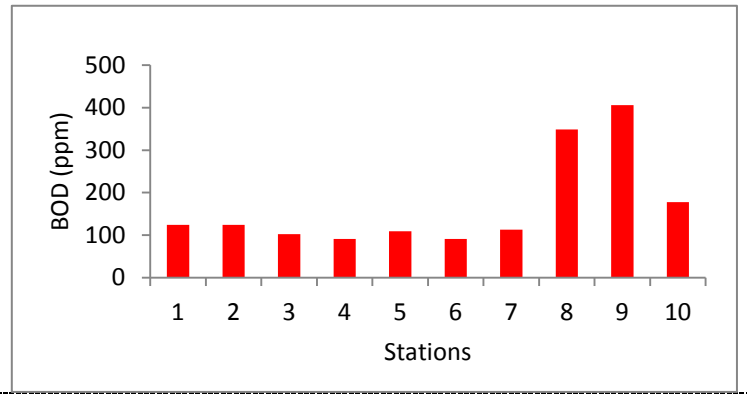

Figure 6. BOD (ppm) in all stations under investigation.

3.6. Chemical oxygen demand (COD)

The used chemical oxygen test is a measure of the organic matter found in wastewater containing toxic compounds. The chemical oxygen content (COD) of the wastewater should be higher than the value of BOD (bio-oxygen) because due to the chemical oxidation destroys of the inorganic matter Biodegradability [16]. The analytical results of samples show that the values of chemical oxygen consumed within the locally allowed limits ranged between 144 - 604 mg/L (figure 7).

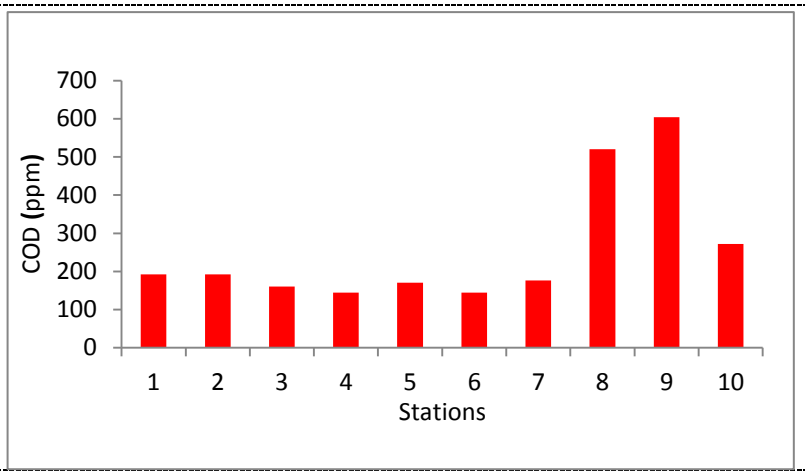

Figure 7. COD (ppm) in all stations under investigation.

3.7. Nitrate ion

N-NO3 is shown in the evidence that the risk does not come from the nitrate, but from its transformation into nitrite within the human body [17]. The results obtained from the wastewater assessment at Koueifieh hospital show that the nitrate ion concentration is between 1.17-5.84 mg/L as shown in figure 8; all nitrate ion concentrations in all samples under investigation are within the internationally and locally allowed limits, in accordance with Libyan standards and standards.

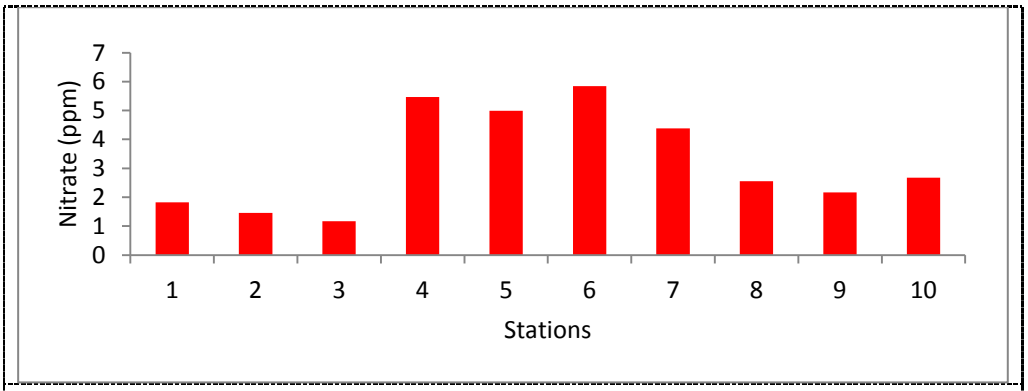

Figure 8. Variation of nitrate ion (ppm) in swage water from all stations under investigation.

3.8. Sulfate ion

The Sulfates are formed due to the decomposition of various sulfur-containing substances present in water bodies [18]. The results reveal that the highest value of sulfate ion concentration in wastewater during the period of the study was 130 ppm and the minimum value was 12 ppm, which is far higher than the locally allowed limits. This is due to the stagnation of the wastewater of the study area.

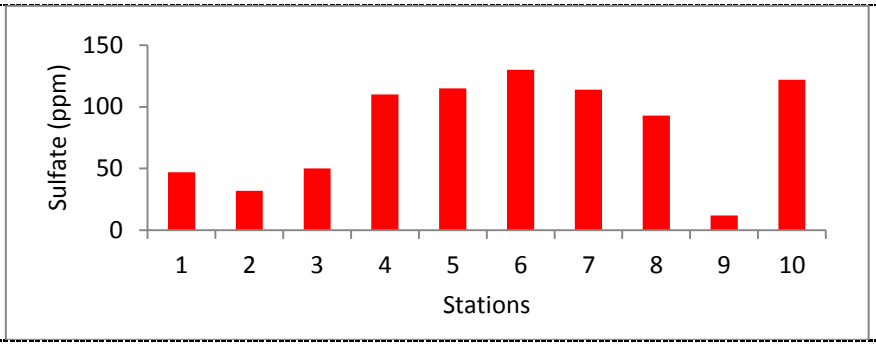

Figure 9. Variation of sulfate ion (ppm) in swage water from all stations under Investigation.

Table 1. Libyan standards limits for the concentration of wastewater.

Constituent	Unit	Libyan limits
pH	---	6.8 - 7
EC	µs/cm	700 - 900
TDS	mg/L	1200 - 1350
BOD	mg/L	550
COD	mg/L	900
Nitrate ion (as N)	mg/L	20 - 35
Sulfate ion	mg/L	60

Table 2. WHO standards limits for the concentration of wastewater.

Constituent	Unit	WHO limits
pH	---	6.5 – 9.20
EC	µs/cm	750
TDS	mg/L	1000
BOD	mg/L	80
COD	mg/L	150
Nitrate ion (as N)	mg/L	34
Sulfate ion	mg/L	400

4. Spatial representations

Here we use the multi-dimensional scaling (MDS) as a statistical technique to generate spatial representations of analytical parameters or stations based on information regarding the dissimilarity relationships existing between the parameters or stations. The MDS [19][20] refers to any procedure that creates a multi-dimensional geometric representation of data where qualitative or quantitative data relationships are made to match the geometric representation relationships. The MDS begins with information about some sort of similarity or dissimilarity between the elements of a data set, and from this information creates its geometric representation. The spatial representations (two-dimensional configurations) of analytical parameters and stations are given respectively in figure 10 and figure 11. It appears that the values of electrical conductivity and total dissolved solids were the most influencing parameters affecting the wastewater of the ten stations and this was reflected in the distance of stations 8 and 10 away from the rest of the stations. Also, we can conclude the same results mentioned above.

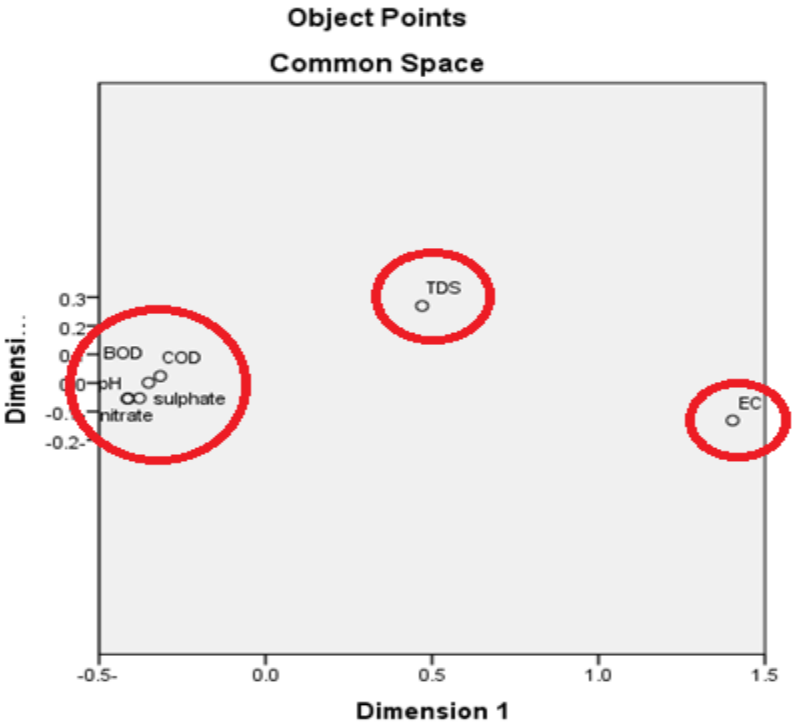

Figure 10. Spatial representation of analytical parameters.

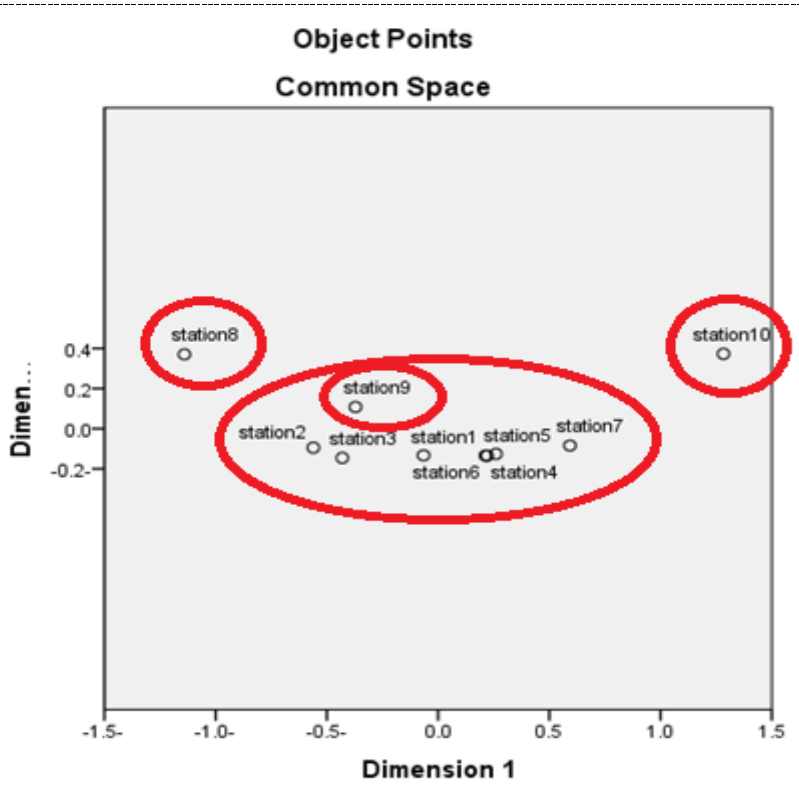

Figure 11. Spatial representation of ten stations.

5. Conclusion

In the present study, the analytical parameters of wastewater gathered from ten stations have been studied by standard methods. The pH of the wastewater was measured to be in the range of 6.3-8, meanwhile, the electrical conductivity of the water was in the range of 2030-6450 and the total dissolved solids were in the range of 1015-3225. The minimum values of electrical conductivity and total dissolved solids are associated with station 8 while the maximum values are associated with station 10. The values of 406, 604, 5.84 and 130 corresponded to maximum biological oxygen demand, the chemical oxygen demand of the selected sites in station 9, the nitrate content and the sulfate content in station 6, respectively. The obtained analytical data showed variables in all used parameters, and most all of the studied parameters were higher in comparison with the permissible limit reported by World Health Organization or the Libyan National Center for Standardization and Metrology. High values of some parameters are signs of the deterioration of the water quality.

According to the above, we recommended to conduct further studies of the sewage water of the Koueifia area and the other areas of Libya, which do not contain infrastructure, to evaluate, develop, and protect groundwater from all types of pollution.

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