Evaluation of the water quality Before and after the Al-Diwaniyah Textile Factory in Iraq

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Abstract The study aimed to evaluate the quality of entering and leaving water to the textile factory in Diwaniyah and water of AL-Diwaniyah River for the period October 2017 to January 2018, Thirteen sites were selected (three sites) on AL-Diwaniyah River and (ten sites) within AL-Diwaniyah textile factory.

The evaluation of water quality includes 14 parameters as confirmed on spatial and temporal changes of these parameters in Thirteen sites (S1,S2,S3 ,S4,S5, S6,S7,S8,S9,S10,S11,S12 and S13). These Thirteen sites are divided into four groups, the first group (water of AL-Diwaniyah river), includes (site 1,site12 and site 13). The second group (Water prepared for textile industries), includes (site 2 and site 3 ). The third group (industrial processing water), included (site 4 , site 5 and site 6). The fourth group is the treatment unit (Outflow water) that includes (site 7 ,site 8 ,site 9, site 10 , site 11 and site 12). site 1 (AL-Diwaniyah river water), site 2 (soft water), site 3 (boilers water ), site 4 (Water for textile preparations), site 5 (completion water), site 6 (water of printing and dyeing), site 7 (water of primary collection basin), site 8 (Waters of the sedimentation Basin), site 9 (chemical treatment water), site 10 (Biological Treatment Ventilated Water), site 11 (water of Filters), site 12 (Final assembly basin (river basin) and site 13 (AL-Diwaniyah river water after distance from the dumping of textile industrial waste). The study includes physical tests, which include Electrical Conductivity (EC), Total Dissolved Solids(TDS), and conducting chemical tests that included pH, Total Hardness (T.H), Calcium (Ca), Magnesium (Mg), Total Alkalinity (T.A), Chlorides(Cl), Sulphates (SO4), Phosphates(PO4) and Nitrates (NO3), as well as heavy metals Chromium (Cr), Nickel (Ni) and Cobalt (Co). For 13 sites inside and outside AL-Diwaniyah textile factory and AL-Diwaniyah River.

The results of physical and chemical analysis show the following means of: Electrical Conductivity (2277.75 μs/cm in site 13 to 3991.75 μs/cm in site 11), Total Dissolved Solids (759.75 mg/l in site 2 to 1790.75 mg/l in site 11), pH (7.94 at site 2 to 9.29 at site 4). Total Hardness (313.25 mg/L at site 1 to 574 mg/L at site 9), Calcium (166.25 mg/L at site 1 to 375 mg/L at site 9), Magnesium (21.23 mg/L at site 11 to 70.63 mg/L at site 8), Total Alkalinity (288.75 mg/L at site 5 to 596.25 mg/L at site 10), Chlorides (174.75 mg/L at site 2 to 483.5 mg/L at site 4), Sulphate (363 mg/L at site 2 to 521.75 mg/L at site 1), Phosphate (0.29 μg/l at site 3 to 1.315 μg/l at site 6). Nitrates (21.6 μg/l at site 3 to 37.05 μg/l at site 11). The highest mean of Cr, Ni and Co were (0.145, 0.1745, 0.043 mg/L) at site 9 and the lowest mean of Cr, Ni and Co were (0.00125, 0.061475 mg/L) at site 2 and 13 respectively but CO were (N.D) at site 1, 2 and 3.

The water quality index values of the water inside and outgoing water from AL-Diwaniyah textile factory generally ranged from (fair to marginal), where the sites located on AL-Diwaniyah River (group 1), the site 1 and site 13 got on (fair) were (69.20,67.93), respectively while site 12 got on (marginal) was (51.41). While sites within the factory (group 2, 3 and 4) from (site 2 to site 12) lowest value was (47.82) at site 4 and the highest value was (64.47) at site 2 so the water quality in these sites were (marginal).

Keywords: CCME WQI; AL-Diwaniyah River; AL-Diwaniyah Textile Factory; textile industries
1. Introduction

The industries in which cotton, wool and nylon fibers are transformed into textile products are called the textile industry [1]. The spinning and weaving industry is one of the oldest industries which is human knew and Mesopotamia is the first home of this industry [2]. The textile industry is one of the most important industries for humans, and the interest in it has increased as the population advances in the demand for textile products around the world [3]. Textile industries are a large part of the industries in Iraq [4]. The second basic needs of ‘cloth’ are supplied by processing of natural and man-made fibres in the textile industries. Increasing population and modernized civilization trend gave rise to booming of textile sectors in Iraq. Including in the province of AL-Diwaniyah which generates voluminous quantities of wastewaters which are thrown into AL-Diwaniyah River and in turn causes environmental degradation in the river. These effluents consist of high TDS, chloride, sulphate, hardness and carcinogenic dye ingredients and Toxicants [5,6]. As the increase in the volume of human activities in the field of industry and the presence of industrial Installations that pose many pollutants in industrial wastewater to natural water lead to pollution of water, as water plays an important role in the industry and these industries differ in the quality of water they need, some of them require untreated water and some of them need of treated water [7].

This requires the conduct of chemical, physical and biological tests to determine the characteristics of these natural waters and to indicate their suitability for the industry so that they are free of contaminated materials. For example, the hardness water working on Basal Dyes deposition and reduces the melting of acid dyes so that the process of dyeing is become irregular, and the organic matter causes the emission of unacceptable odors from the tissues so the water used in the textile industry must be of high purity [8]. The spinning and weaving industry uses water in a large way as it enters in the production stages such as washing, dyeing and printing as used in boilers units to generate steam [9]. The quantity of water used in the factory depends on the quantity of the product from the factory and the type of raw material used in the textile industry [10]. Therefore, construction of factories requires the provision of water treatment units before use in the factory and after leaving the factory when put into the rivers [11]. Water is one of the most important requirements for life. A large rate of water is not suitable for human consumption. It is Salty, while a small rate is suitable for human consumption is the Fresh water especially rivers, should be protected from general pollution problems, whereas The technological progress, the growing population, the increase in water consumption and the increase in waste disposal from factories to the aquatic environment (rivers and others) Has led to pollution of this relatively low percentage of water [12,13].

The types of pollutants vary according to the type of raw material used in the factory and in the units that produce cotton fabric or woolen fabric some of them are in dyeing processes and other in printing and washing, which causes the diversity of liquid pollutants put into the rivers [14,15]. The industrial water that emerges from a textile factory differ from one factory to another [4,16], when he studied the water of the Hilla River, he noticed that the industrial wastes of the Hilla textile factory led to the pollution of the river by heavy elements, especially the lead. As mentioned [17] that industrial water that is discharged to rivers without treatment leads to pollution of the rivers with hazardous substances. Where Freshwater is one of the most important natural sources for sustaining life on Earth, with these resources becoming endangered and will become scarce in the future thus, the water quality control Programme has become necessary to protect these water sources of pollution [18].

The process of determining water quality for any water body depends on the traditional assessment of reliance on physical, chemical and environmental factors compared to recognized domestic and international standards but as a deficient process that does not provide us with accurate information [19]. So the need to develop New techniques such as the Water Quality index (CCME QWI) is a mathematical tool that collects a large number of data for water quality resulting from the process frequent checks of a range of physical and chemical factors of a given water surface and its transformation into a quantitative speech in an excellent and simple way and from In the meantime, the beneficiary can be identified and for what purpose [20].
2. Materials and methods

Hilla river is the branch of Euphrates river which is ramified into two branches (Daghara and Al-Diwaniyah Rivers) before passing Daghara city. Daghara river is eastern branch, Al-Diwaniyah River is western branch (location of study) passing connects at AL-Diwaniyah city (Al-Diwaniyah province), the length of the river (123 km) and width (45 - 50 m) also passing near AL-Diwaniyah Textile Factory, which is located south of Diwaniyah city (location of study)[21].

The current study included the study of some physical, chemical and heavy metals properties in 13 sites, three of which are located on AL-Diwaniyah River, including the site 1 (AL-Diwaniyah River at the site of water with drawal From before the Liquidation Station at AL-Diwaniyah Textile Factory), site 12 (Final assembly basin (river basin)) Final collection basin (AL-Diwaniyah River Basin, Which receives liquid waste for textile industries) and site 13 the AL-Diwaniyah river, about 3 km away from the site 12. The other sites are located within AL-Diwaniyah Textile Factory includes site 2 (the soft water), site 3 the (boilers water), site 4 (the water of the textile preparations), site 5 (completion water), site 6 (water of printing and dyeing), site 7 (water of primary collection basin), Site 8 (Waters of the sedimentation Basin), site 9 (chemical treatment water), Site 10 (Biological Treatment Ventilated Water) and Site 11(Water Filters).

These sites 13 divided to four groups, The group 1 (the water of AL-Diwaniyah river), includes (site 1, site 12 and site 13). The group 2 (Water prepared for textile industries), includes (site 2 and site 3). The group 3 (industrial process water), includes (site 4, site 5 and site 6). The group 4 the treatment unit (Outflow water), includes (site 7, site 8, site 9, site 10, site 11 and site 12), (Figure 1).

The Monthly sampling from the sites 13 during the period from October 2017, to January 2018, (Figure 1). For measuring the physical-chemical and heavy metals, by taken sample each month from each site. The samples (water sample) taken from mid of the sites about 30 cm under water surface, for purpose of physical-chemical and heavy metals analysis, that collected in polyethylene containers a volume 5 litters. All physico-chemical parameters and Heavy elements were analyzed following methods outlined in the standard method for examination of water wastewater [22], Nitrate, Phosphate Depending on [23]. The calculation Of (CCME WQI) Depending on [24], And it identified the water quality of AL-Diwaniyah River and the water used in textile factory in Diwaniyah depending on the following categories in (table 1).
Table 1. Categorization of water quality

| Rank      | WQI Value |
|-----------|-----------|
| Excellent | 95-100    |
| Good      | 80-94     |
| Fair      | 65-79     |
| Marginal  | 45-64     |
| Poor      | 0-44      |

**Figure 1**: The planner explain the locations of study before and after and inside the textile factory in AL- Diwaniyah.
3. Results and discussion

The (Table 2) presents the results obtained during the current study, which are measurements of physical and chemical factors: (Electrical conductivity (EC), Total Dissolved Solids(TDS), pH, Total Hardness (T.H), Calcium (Ca), Magnesium (Mg), Total Alkalinity (T.A), Chlorides(Cl), Sulphates (SO4), Phosphates (PO4) and Nitrates (NO3)) and heavy metals (Chromium (Cr), Nickel(Ni) and Cobalt(CO)) at the water at sites Before and after its departure from the textile factory in Diwaniyah and sites inside the factory.

Electrical Conductivity(EC) is an indicator of the amount of salts found in water and soluble materials, It was noticed during the study that the Electrical Conductivity (EC) in the group 1 (the water of AL-Diwaniyah river) was the lowest value (1800 μs/cm) at site 1 (AL- Diwaniyah River water) in October 2017 and the highest value was (4053 μs/cm) in December 2017 at the site 12 (Final assembly basin (river basin)). While the Electrical Conductivity (EC) in Water prepared for textile industries (the group2) was the lowest value (2953 μs/cm) in site 2 (the soft water) in October 2017, and the highest value was (3971μs/cm) in December 2017, in site 3 ( boilers water ). In the group 3 (industrial process water) was the lowest value of electrical conductivity (EC) was (2070 μs/cm) in site 6 ( the water of printing and dyeing ) in October 2017 and the highest value was (4144 μs/cm) in November 2017 , at site 4 ( Water for textile preparations). While the group 4 (water treatment units) the site 10 (Biological Treatment Ventilated Water) get on the lowest value for electrical conductivity was (1919 μs/cm) in January 2018 and highest value was (4437 μs/cm) in November 2017,. The mean values of electrical conductivity were ranged from (2277.75 μ/cm in site 13 to 3991.75 μ/cm in site 11), (Figure 2A).

This variation in the values of the electrical conductivity may be due to the addition of different chemicals during production processes, including the addition of alum [25], or the increase of salts and conductive materials, evaporation in the boilers and the degradation of the substances in biological treatment [26]. As well depending on the nature of the water entering the industrial processes that occur in each of the study sites in the factory [27]. The electrical connectivity values in the current study were higher than the environmental determinants [28]

Total Dissolved Solids(TDS) is defined as the total dissolved solids in water, whether ionized or not ionized [29]. in the group 1 (the water of AL- Diwaniyah river) was the lowest value (796 mg / L) at site 1 (AL- Diwaniyah River water) in October 2017 , and the highest value was (2026 mg /L) in December 2017 , at site 12 (Final assembly basin (river basin)). While The highest value of the Total Dissolved Solids(TDS)during the study was in the water group2 ( Water prepared for textile industries ) at site 3 (boiler water) in October 2017 was (974 mg / L) and the lowest values was (500 mg / L) at site 2 ( the soft water) in January 2018 . While the lowest values for the TDS was (880 mg /L) in October 2017 at site 5 (completion water) and the highest value was (2859 mg / L) at same site in November 2017, for the group of industrial process water (The group 3). While the values ranged between (830-2218 mg /L) in the group 4 (water treatment units) at site 8 (Waters of the sedimentation Basin ) and at site 10 (Biological Treatment Ventilated Water) in October 2017 and November 2017 respectively, While The mean values of TDS were ranged from (759.75 mg /l) in site 2 to (1790.75 mg / l) in site 11 (Figure 2B). The increase in TDS is due to the non-reduction of dissolved solids after the facilitation process and the replacement of calcium and magnesium ions with sodium ions [7,30]. And as well to the efficiency of the work of the sedimentation Basin and the nomination process and as well as use of chemicals for the purpose of sedimentation, which depends mainly on the chemicals added to each of the sites identified for study and increase evaporation [31,32].
The results showed that the pH tends to the basic side of all the study sites. The pH value in the group 1 (the water of AL-Diwaniyah river) was the lowest value (7.72) at site 1 (AL-Diwaniyah River water) in December 2017, and the highest value was (9.4) in October 2017, in site 12 (Final assembly basin (river basin)). While site 13 (the water of the Diwaniyah River after dumping the wastes of AL-Diwaniyah Textile Factory by distance) the pH values ranged between (8.3-9.1). The lowest value in the water group prepared for the textile industries (group 2) was (7.5) in October 2017, and the highest value was (8.7) at site 3 (Boilers water) in November 2017, that the high pH values in boilers due to the concentration conditions and the addition of chemicals with a basic effect such as sodium phosphate. While in the group of industrial process water (Group 3) the highest value of pH obtained in the site 6 (water of dyeing and printing) was (10.2) in October 2017 and the lowest value was in site 5 (completion water) which amounted to (8.1) in the same month. The group 4 (the water of treatment unit) pH values ranged between (7.8-9.5) at site 11 (filter water) and site 9 (chemical treatment water) during the months December and October 2017, respectively. The mean values of pH were ranged from 7.94 at site 2 to 9.29 at site 4 (Figure 2C). The change in the pH values at study sites may be due to the quality of water and additives during dyeing and treatment, and the use of NaoH and Na2CO3, as well as the quality of dyes used in printing and dyeing that increase the base of water [33]. Natural condition due to the presence of salts of carbonates and bicarbonates [34].

![Figure 2](image-url)

**Figure 2.** Average value of the :- A: Electrical Conductivity (μs/cm), B: Total Dissolved Solids (mg/l), C: pH, during the study period.
The Total Hardness (T.H) represents the total concentration of positive ions, especially calcium, magnesium and other positive ions that make water difficult [35], also total hardness is defined as the susceptibility of water to soap deposition [36]. The hard water causes damage and blockage in hot pipes because of the calcification and sediments that are formed by the water hardness on the walls of the pipes. This has an effect on the textile industry, and the salts of the hardness are deposited on the fabric. On the form of deposit a precipitous manner when the heat rises and increase in the total alkalinity, which causes pale color of the fabric and unevenness of the dye [37]. Calcium is one of the most abundant elements in Iraqi waters and is a leading cause of the hardness in water [38]. Magnesium is also a small nutrient needed by organisms in small quantities during its lifetime. Sources of Magnesium is limestone and clay minerals [39,40].

During the current study, concentrations of Total Hardness (T.H) in group 1 (The water of Diwaniyah river) the lowest value was (248 mg/L) in January 2018 at site 1 (AL-Diwaniyah River water) and the highest value was (616 mg/L) at site 12 (Final assembly basin (river basin)) in October 2017. The lowest value of calcium was (150 mg/L) in November 2017 at site 1 and the highest value was (483 mg/L) at site 13 (AL-Diwaniyah river water after distance from the dumping of textile industrial waste) in October 2017. The lowest value of Magnesium was (13.66 mg/L) in January 2018 at site 12 and the highest value was (62.5 mg/L) at site 1 in October 2017. While in the group 2 the total hardness ranged from (148-588 mg/L) at the site 3 in January 2018 and October 2017 respectively, while the calcium ranged between (75 - 428 mg/L) as well as magnesium between (16.8 - 55.5 mg/L) at same sites and months in the group 2 (the water group prepared for the textile industries). While the values of the total hardness in the group 3 (industrial process water) ranged from (244-724 mg/L) at site 4 (the water of textile preparations) in January 2018 and October 2017 respectively. Magnesium values ranged between (5.12-88.6 mg/L) in the same sites and months. While calcium was the lowest in this group (181 mg/L) at site 1 in December 2017 and the highest value (504 mg/L) at site 5 (complements water) in November 2017. The water sites of the treatment units (Group 4) were recorded at the highest values of total hardness, calcium and magnesium (780, 535 and 101 mg/L) at sites 7 and 9 (primary collection basin water and chemical treatment water) in November, October and December 2017 respectively, and the lowest values of total hardness, calcium and magnesium (240, 182 and 13.5 mg/L) at site 10 (biological treatment water and ventilation) during January 2018 and the site 8 (Waters of the sedimentation Basin) in December 2017 and site 11 (candidate water) in January 2018, respectively. The mean values of total hardness were ranged from (313.25 mg/L at site 1 to 574mg/L at site 9 (Figure 3 A) and the mean values of calcium were ranged from (166.25 mg/L at site 1 to 70.63 mg/L at site 8 (Figure 3 C). The increase and rise of total hardness, magnesium and calcium due to the evaporation process and to the quality of pure water and efficiency of the sedimentation Basin and the quality of chemical substances such as the use of ion exchangers and high temperature and increase the use of alum and sedimentation processes and chemical treatment and filters and the impact of the river water which is the source of industrial water as well as monthly changes Of the high and low level of water in AL-Diwaniya River and the Irrigation process of agricultural lands surrounding the river [41,42].

The industrial drainage also increases the levels of salts causing hardness, especially calcium and magnesium [43]. Calcium sulphate also affects the internal walls of the boilers, causing serious deposits [44]. The geological nature of the soil surrounding the watercourse and the slope of the earth leads to an increase Calcium and magnesium in river, and hard water also affects water treatment units [45,46]. In general, the values of total hardness, calcium and magnesium in the present study were evaluated within the determinants of sanitation [47,48].
The (Table 2) shows the total alkalinity (T.A) values in the sites (group 1): The site 1, site 12, and site 13 the lowest value of the total alkalinity was (252 mg/l) in October 2017 at site 1, the site 12 and 13 obtained the highest value was (700, 660 mg/L), respectively, was in January 2018. The site 2 (soft water) and site 3 (boiler water), which they considered as the "Water prepared for textile industries" (the group 2) where the site 2 obtained the lowest value of the total alkalinity was (200 mg/l) in October 2017 and site 3 obtained the highest value was (522 mg/L) but was in January 2018. The sites of the Water Group for Textile Industries (Group 3) Water for textile preparations (Site 4), Supplementary Water (site 5) and Printing and Dyeing Water (site 6) have values of the total alkalinity ranging from (207 - 596 mg/L) at site 5 in October 2017 and at site 6 in January 2018, in the group 4 (the water of treatment unit) from sites (7 to 12), the highest value was (752 mg/L) at the site 9 (chemical treatment water) in December 2017, but the lowest value was (343 mg/l) at site 11 (filter water) in October 2017. The mean values of total alkalinity were ranged from 288.75 mg/l to 596.25 mg/L at site 10 (Figure 3 D). Where total alkalinity is known as the ability of water to offset the acids and bases and are classified into three types are the base of hydroxides, carbonates and bicarbonate and most of the base of water is due to calcium bicarbonate [49].

Where the industrial water contains bicarbonate at different rates depending on the source of this water, but it contains a small amount of carbonate and the reason for the rise of basal in the site 3 (boiler water) is due to the exit of CO2 with water vapor [50], While in other sites increased as a result of the addition of basal chemicals or because of the presence of algae that consume CO2 [51,25]. The height of total alkalinity in the site 13 and in the ventilation basin the site 10 to the high temperature and the decomposition of organic matter by living organisms, also Increased the Alkalinity in treatment sites as results of addition the molasses in treatment process for the purpose of growth of germs to analyze organic substances [52,53].

![Figure 3.](image-url) Average value of the:- A: Total Hardness (mg/l), B: Calcium (mg/l), C: Magnesium (mg/l), D: total alkalinity(mg/l), during the study period.
Chloride is found in all natural waters in different concentrations, with a concentration of more than 2000 mg/L in the sea [54]. The presence of chloride in water is a salty taste and is a sign of water pollution with sewage [28]. The results showed that the concentrations of chloride in group 1 (the water of Diwaniyah river) the lowest value was (139.5 mg/l) in October 2017 2010 at site 1 (AL-Diwaniyah River water) and the highest value was (300 mg/L) at site 12 (Final assembly basin (river basin)) in January 2018. But the water group prepared for the textile industries (Group 2) got the site 3 (boiler water) at the highest value of (420 mg/l) during January 2018. While the site 2 (soft water) got the lowest value of chloride was (135 mg/l) in October 2017. The rise of chloride in boiler water may be due to the concentration conditions in the steam boiler. The Industrial Process Water Group (Group 3) the value of chlorides (536 mg/L) as the highest value during the month of November 2017 in the Site 4 (Textile Preparation Water), while the lowest value was in the site 6 (water of printing and dyeing) and amounted (131 mg/L) during the month of October 2017.

Geted in water of the treatment units (Group 4) was highest value of chlorides were (319 mg/L) at the site 7 (water of primary collection basin), in December 2017, The lowest value was (145 mg/L) in the site 11(filter water) in October 2017, The mean values of chlorides were ranged from (174.75 mg/L at site 2 to 483.5 mg/L at site 4) (Figure 4 A). This is due to the addition of CLO4 to the treatment unit or chlorine for the purpose of purification or for the purpose of sterilization and reducing the amount of sulphate [31]. The chloride concentrations in the present study are within the determinants of sewage and less than the maintenance of rivers from pollution [55]. Also Coloring of hosiery fabric takes place in the presence of high concentration of sodium sulphate or sodium chloride [56].

Sulfur is found in the natural waters in The highest levels of oxidation, a stable composite component known as sulphates ions, It is believed to be the cause of increase sulphates in water is Sedimentary rocks in arid and semi-arid regions are also a source of sulfur [40,57]. The Concentration of sulphates in the group 1 (the water of Diwaniyah River) the lowest value was (277 mg/L) at site 13 (Diwaniyah river water after distance from the dumping of textile industrial waste) during October 2017 and the highest value was (672 mg/L) at site 1 (Diwaniyah River water) in January 2018, while The sulphates concentrations in the water group for the textile industries (Group 2) ranged from (260 mg/L) at the site 2 (soft water) as the lowest concentration during October 2017 and the highest Concentration was in the site 3 (boilers water) during December 2017 so The presence of sulphates at high levels in the wastewater causes erosion of the pipes, while in The increased concentration of sulphates in the river water is due to the increase in the diversion of sulphates from agricultural land and the addition of industrial waste to the river water [58]. The group 3 represented by the industrial process water group had the highest concentration of sulphate (572 mg/L) in the site 4 (textile preparations) and the site 6 (dyeing and printing water) but during the month of November 2017 and December 2017, respectively and the lowest concentration (240 mg/l) in the site 5 (complements water) was during December 2017. The lowest concentration of sulphate was (280 mg/l) at the site 7 (primary collection basin water) in October 2017 and the highest concentration (792 mg/L) at the site 8 (Waters of the sedimentation Basin) in December 2017 in the group 4 (water of the treatment units), The mean values of sulphates were ranged from (363 mg/L at site 2 to 521.75 mg/L at site 1) (Figure 4 B).

The sulphate concentrations in industrial waste water from the AL-Diwaniyah textile factory are higher than the environmental determinants of the river maintenance system from pollution and wastewater. The reason is that some chemicals containing sulphates are used in its composition such as sodium sulphate and sulfuric acid during fabric preparation and use of sulfur dyes In the dyeing and printing unit. This is evident in the site 4 and 6 of the present study. The rise is also due to the use of aluminum sulphate [59,15,33].
While phosphate is exist in natural and industrial water in a soluble or suspended form and more stable is orthophosphate [60]. The concentrations of phosphates were different at the sites of the study. The highest concentrations (1.66, 0.95, 0.87, 1.75 μg/l) at sites 1, 2, 11 during December 2017 and site 6 in November 2017 in group 1, 2, 4 and 3 respectively. While the lowest concentrations of phosphate were (0.13 μg/l) at the site 1 (AL-Diwanyah river water) in October 2017 and in site 2 (soft water) reached (0.123 μg/l) during November 2017 and in site 5 (complements water) was (0.14 μg/l) during October 2017 and the site 7 (0.135 μg/l) in December 2017 2010 in group 1, 2, 3 and 4 respectively. The mean values of phosphate were ranged from (0.29 μg/l at site 3 to 1.315 μg/l at site 6 (Figure 4C). It is known that concentrations vary from one factory to another depending on the nature and quantity of industrial waste put into the river or the use of phosphate fertilizers for agricultural lands adjacent to the river, detergents and washing powders. The concentration of phosphate in AL-Diwaniyah River was increased before the Diwaniya Textile Factory [61]. The increase in phosphate concentrations in the sites within the textile factory is due to the addition of sodium phosphate to the treatment sites [62].

The high concentration of phosphate in the water entering the factory leads to the process of enriching algae food, thus affecting the filter stations [63]. The concentration of phosphate in the current study is higher than the environmental determinants. Increased the phosphate may be the result of the use of detergents and washing powders and used sodium phosphate in steam boilers and this is consistent with [64].

The Nitrate contamination in the water comes from sources such as the transformation of part of the atmospheric nitrogen by lightning and precipitation into water bodies, as well as the use of nitrogen fertilizers [65]. Nitrate is the predominant form of inorganic nitrogen in the aquatic environment [35]. The variation in nitrogen compounds is due to increased human activity in agriculture and industry and the resulting residues of a container of nitrogen compounds [66]. The results of the study showed the mean values of Nitrate were ranged from (21.6 μg/l at site 3 to 37.05 μg/l at site 11 (Figure 4D) and the high concentration of nitrate during December 2017 2010 at the site 7 (the water of the first collection basin) (54 μg/l) of group 4 and the lowest value was in the site 3 (boiler water) (13.2 μg/l) during November 2017 of group 2, the concentration of nitrates in other sites and groups falls within these two values because the concentration of nitrates depends on the type of water coming from the river to the factory and the quality of the additives on the nitrate compounds during the manufacturing processes as well as on the many physical and chemical processes that occur within each site also Increased the nitrate because of the use container pigments of nitrate and nitrite in the productive processes [15]. The concentration of nitrates in this study falls within the parameters of the river maintenance system from pollution [67].
Figure 4. Average value of the :- A: Chlorides (mg/l), B: Sulphate (mg/l), C: Phosphate (μg/l), D: Nitrate (μg/l), during the study period.

The study of the heavy elements in the current study sites is important to determine the validity of water for textile industrial processes and the impact of the industrial processes on these elements and the effect of the heavy elements in the water to which the elements are put so that they should be within the permissible limits. The ratio of heavy elements and their applications and the toxicity thereof vary depending on the water conditions. Are subtracted and some of them are absorbed and deposited with the sediments and thus less than their concentration [ 68]. The main source of heavy elements is industrial drainage, which leads to water pollution and heavy elements are considered hazardous because they are not rapidly decomposed [69]. This is what was proved by the study [70] on the impact of waste from the 14 Ramadan factory for spinning and weaving and its effect on the waters of the Tigris. In the present study, chromium, nickel and cobalt are present in the industrial wastewater of the textile industries for the textile factories due to the processes of lubrication and oxidation of dyes due to the use of heavy metals in the industry [71]. It is known that chromium is not free in nature and the most important of its minerals is chromite and in different waters of industrial processes, which include tanning electroplating. As well as in the remnants of the ceramic industry and chromium is used to prevent corrosion in the towers while nickel is found in basalt igneous rocks while the cobalt is in the Silicia rocks [72]. While the water is contaminated with compounds of industrial waste, which is included in the composition of the cobalt, while the water is contaminated with nickel compounds when the coating of pipes used in water transport is degraded [73].
The highest values for chromium, nickel and cobalt were in the site 12 (Final assembly basin (river basin)) of group1, which reached the concentration of these elements (0.115, 0.173 and 0.042 mg / L) chromium, nickel and cobalt respectively during November 2017 and the lowest concentration of Cr and Co was (N.D) at site 1 in January 2018 and all the months, respectively. While the values of Cr ranged between (N.D -0.13 mg / L) site 2 and 3, Ni was (0.108 – 0.13) at site 2 and 3 while Co (N.D) at all months and sites in group 2. The Lowest of chromium (Cr) concentration in group 3 was (0.107 mg / L) at site 4 in January 2018, nickel (Ni) was (0.004 mg / L) at site 6 in January 2018 while cobalt (Co) concentration was (0.017 mg / L) at site 4 in October 2017 and the highest values of Cr, Ni and Co were (0.14 mg / L) at site 6 in October 2017, (0.12 mg / L) at site 5 and 6 in some months, (0.48 mg / L) at site 6 in November 2017 respectively. While the lowest value of chromium was (0.01 mg / L) at site 11 in January 2018 and the highest value was (0.15 mg /L) at site 9 in October 2017, so the lowest value of nickel was (0.102 mg / L) at site 11 in January 2018 and the highest value was (0.177 mg /L) at site 9 in October 2017 while the lowest value of cobalt was (0.034 mg /L) at site 7 and 10 in October 2017 and the highest value was (0.042 mg /L) at site 9 in January 2018 in sites of group 4. The highest mean of Cr, Ni and Co were (0.145 , 0.1745 , 0.48 mg /L) at site 9 and the lowest mean of Cr, Ni and Co were (0.00125 , 0.061475) at site 2 and 13, respectively but CO were (N.D) at site 1, 2 and 3 (Figure 5, A,B,C).

The reason for the decrease and rise in the concentration of heavy elements was due to increased water hardness, increased dilution and heavy adsorption of suspended substances [74,75]. And the concentration of these heavy elements of chromium, nickel and cobalt is less than the limit allowed for sewage and the parameters of the system of river maintenance from pollution during the current study we conclude that the physical and chemical tests and heavy elements studied match many studies [76,77]. Where the results indicate that huge quantities of pollutants are being removed from the Diwaniyah fabric factory to the Diwaniyah River. The elevated values identified for Cr, Ni and Co are probably a result of anthropogenic activities in the AL-Diwaniyah River. These sources mainly include the effluent of wastewater plants which released large amounts of Cr, Ni and Co compounds into the river, and the water released of factory. The industrial activities around water bodies were the most important agents for releasing heavy metals in the area under study, this finding was in agreement with [78,79]. The heavy elements Ni, Cr, Co and Ni were likely to result to the deleterious effect on bottom-dwelling organisms. Multivariate analyses revealed that Cr and Ni had common origin or geochemical behaviour and were associated with anthropogenic activities that were near of river and industrial process in AL-Diwaniyah textile industry. The elevated concentration of Cr and Ni in water could be attributed to vehicular emissions and commercial and industrial discharges so The identified major anthropogenic sources of Ni are nickel wood, fuel combustion, agricultural wastes, and domestic sludge [80,81,82,83].
Figure 5. Average value of: A: Chromium (mg/l), B: Nickel (mg/l), C: Cobalt (mg/l), during the study period.

The water quality index values of the water inside and outgoing water from the Diwaniya textile factory generally ranged from (fair to marginal) where the sites located on the Diwaniya River (group 1), the site 1 and site 13 got on (fair) were (69.20, 67.93), respectively while site 12 got on (marginal) was (51.41) because it is the site of receive the industrial waste water direct of factory (Final assembly basin (river basin)), while sites within the factory (group 2, 3 and 4) from (site 2 to site 12) lowest value was (47.82) at site 4 and the highest value was (64.47) at site 2. The change in water quality of these sites is due to substances added to water during industrial processes, leading to change in Water quality to become (marginal) (which is the water that is affected by the pollution and tends to be far from ideal. (Table 3; Figure 6), the reason for the natural of the river may be that it has the ability to handle the changes that occur by way of what is known as self-purification so the decrease in CWQI value in the AL-Diwaniyah River stations (site 1, 12 and 13) is a reflection of different types of pollutants entering its due to natural reasons and various anthropogenic activities such as discharge of untreated domestic sewage from the houses of residential areas, also the runoff water from agricultural lands near of the River and The Industrial Processes Water of Al-Diwaniyah Textile Factory [84,85], perhaps Another reason is the decrease in water quality levels that promote water seepage from ground water into the river water [86].
The river can’t achieve the self purification from the disposal of pollutants that entering its because of the low level of water and shortage caused by lack of rains in the area and the water quotas because of the many dams which had been built in Turkey and Syria besides the bad planning with the old methods used in irrigation the agricultural lands around the river [87]. The river is often polluted by domestic waste and industrial effluents, its means that the river is lightly polluted, This is consistent with what [88] found during the study of the Garang river. Water pollution occurs at different time-periods of the months and sites: pollution is highest in site 4, but least (fair) in site 1 while moderate (marginal) in others sites, the pollution levels increase from site 1 to site 13.

In the diwaniyah River, the main pollutants that decline water quality in the river were and in the Diwaniya textile factory sites accounted by EC, TDS, SO4, PO4 the remaining pollutants were accounted by TA and T.H.[89]. the variation of the results of physical-chemical were too large to show the degree of water pollution in the sites so the result is generally diverent. The integrated water quality index can not only determine the water quality classification but also evaluate the degree of pollution and judge whether the water is Affect the nature and quality of the water in the water body as rivers when throw it to river, As can be seen from the above assessment, the pollution was more serious in the sites in factory. The possible reasons being Due to increased materials that add praise to manufacturing processes, weak biological activity and the slower absorption and decomposition of pollutants. so that the water quality began deteriorating more seriously. [90,91,92]

The water quality was evaluated by the Water Quality Index (CCME WQI) depending on in-situ and laboratory analysis. Water quality variables are selected for the quality assessment in AL-Diwanyah river. The result indicated that, when the effluent domestic waste and industrial effluents of factory mixed with the river water, the water quality decreased gradually and was found to be lower at a site 12 so that the water quality in AL-Diwaniya River ranges between 51.41 to 69.20. Similar with The water quality of Sembilang River of Water Quality Index with ranges between 68.03 to 43.46 to 68.03 to 43.56. It is revealed that the present scenario of water quality of Sembilang River is due to the effect of effluent from the landfill [93].

![Figure 6. The values of water quality index (CCME WQI) during the study period.](image-url)
Using SPSS program the statistical analysis of the results showed a negative correlation between water quality index (CCME WQI) and some environmental factors: electrical conductivity (EC) \( R = -0.52 \), total dissolved solids (TDS) \( R = -0.65 \), calcium (Ca+2) \( R = -0.50 \), chloride (Cl-1) \( R = -0.57 \), chromium (Cr) \( R = -0.73 \), nickel (Ni) \( R = -0.53 \) and cobalt (Co) \( R = -0.62 \). The highest correlation between water quality index was recorded with total dissolved solids and chromium \( R = -0.65 \) and chromium \( R = -0.73 \) respectively, and lowest values of water quality index correlation was recorded with calcium \( R = 0.50 \). The highest positive correlation between nitrate (NO3) with cobalt (Co) and chromium (Cr) \( R = 0.80 \) and \( R = -0.76 \). The statistical analysis of the results showed a positive correlation between TDS with \( \text{pH}, \text{Ca}+2, \text{NO}_3, \text{Cr} \) and Co \( R = 0.51, R = 0.65, R = 0.59 \) and \( R = 0.79 \), also the total hardness (T.H) correlation with calcium \( R = 0.64 \), magnesium (Mg) \( R = 0.63 \), the total alkalinity (T.A) \( R = 0.57 \), respectively (Figure 7, Table 4).

![Figure 7](image_url)

**Figure 7.** The correlations between water quality index (CCME WQI) with some environmental factors (EC, TDS, Ca, CL, Cr, Ni and Co), Total Dissolved Solids (TDS) with \( \text{pH}, \text{Ca}, \text{NO}_3, \text{Cr}, \text{Co} \), Total Hardness (T.H) with (Ca, Mg, T.A, NO3, Cr, Co) and between Calcium (Ca) with (T.A, NO3, Cr, Co).
| Parameters | S1  | S2  | S3  | S4  | Mean |
|------------|-----|-----|-----|-----|------|
| site       | mont | site | mont | site | mont |
| Pre | Oct | 2953 | 3496 | 3424 | 3619 |
| Pre | Nove | 3443 | 931 | 783 | 3944 |
| Pre | Dec | 3471 | 815 | 815 | 3066 |
| Pre | Janu | 2831 | 1113 | 500 | 2833 |
| Pre | Oct | 1800 | 2953 | 3424 | 3617 |
| Pre | Nove | 3418 | 924 | 1112 | 3617 |
| Pre | Dec | 3291 | 1083 | 1497 | 3579 |
| Pre | Janu | 2831 | 1113 | 500 | 2833 |
| EC (μS/cm) | 796 | 815 | 815 | 815 | 808.75 |
| TDS (mg/l) | 428 | 552 | 536 | 2360 | 1712.5 |
| pH | 8.4 | 7.9 | 8.3 | 8.8 | 8.03 |
| T.H (mg/l) | 172 | 364 | 400 | 724 | 271.75 |
| Ca (mg/l) | 62.5 | 30.2 | 33.2 | 88.6 | 293.25 |
| Mg (mg/l) | 252 | 200 | 272 | 226 | 207.5 |
| T.A (mg/l) | 139.5 | 135 | 141.5 | 478 | 278.25 |
| Cl (mg/l) | 336 | 260 | 384 | 380 | 363.75 |
| SO4 (μg/l) | 0.13 | 0.14 | 0.18 | 0.212 | 0.21 |
| PO4 (μg/l) | 21 | 20 | 22 | 30 | 21.5 |
| NO3 (μg/l) | 0.004 | 0.142 | 0.123 | 0.212 | 0.21 |
| Cr (mg/l) | 0.123 | 0 | 0.13 | 0.12 | 0.123 |
| Ni (mg/l) | 0 | 0 | 0 | 0 | 0 |
| Co (mg/l) | 0 | 0 | 0 | 0 | 0 |

Table 2. The values of physical and chemical factors which are measuring during the current study.
| Month | Octo | Nove | Dece | Janu |
|-------|------|------|------|------|
| S5    | 3054 | 3487 | 3690 | 2475 |
|       | 880  | 2859 | 1760 | 1224 |
|       | 8.1  | 8.3  | 8.58 | 8.6  |
|       | 600  | 620  | 300  | 312  |
|       | 466  | 504  | 232  | 252  |
|       | 32.7 | 28.3 | 1.66 | 14.6 |
|       | 207  | 248  | 285  | 415  |
|       | 184  | 158  | 206  | 205  |
|       | 384  | 480  | 240  | 379  |
|       | 0.14 | 0.23 | 0.77 | 0.5  |
|       | 27.5 | 15.5 | 46.7 | 39.5 |
|       | 0.12 | 0.12 | 0.13 | 0.13 |
|       | 0.03 | 0.12 | 0.12 | 0.03 |
|       |       |       |       |       |
| mean  | 3176.5 | 1680.75 | 363.5 | 23.05 |
|       | 23.05 | 370.75 | 188.25 | 188.75 |
|       | 0.41 |       | 0.13 |       |
|       |       | 0.175 | 0.12 |       |
|       |       |       | 0.034 |       |
| S6    | 2070 | 2436 | 2668 | 2435 |
|       | 1305 | 1218 | 1334 | 1417 |
|       | 10.2 | 8.5  | 8.17 | 8.6  |
|       | 616  | 660  | 308  | 332  |
|       | 377  | 430  | 188  | 215  |
|       | 58.3 | 56   | 29.3 | 28.5 |
|       | 257  | 332  | 418  | 596  |
|       | 131  | 175  | 189  | 234  |
|       | 432  | 244  | 572  | 432  |
|       | 1.3  | 1.75 | 1.08 | 1.13 |
|       | 39.6 | 24.9 | 46   | 37.5 |
|       | 0.14 | 0.11 | 0.12 | 0.13 |
|       | 0.12 | 0.48 | 0.03 |       |
|       |       |       |       |       |
| mean  | 2402.25 | 1318.5 | 479 | 302.5 |
|       | 43.025 | 363.5 | 280 | 234 |
|       | 188.75 | 737 | 572 | 432 |
|       | 0.13 | 17 | 0.13 |
|       |       |       | 0.04 |       |
| S7    | 2252 | 2995 | 2602 | 2433 |
|       | 1469 | 1497 | 1301 | 1316 |
|       | 8.1 | 8.32 | 9.2 | 8.6 |
|       | 680 | 780 | 340 | 332 |
|       | 385 | 465 | 192 | 215 |
|       | 77.7 | 76.9 | 36.11 | 28.5 |
|       | 400 | 484 | 737 | 596 |
|       | 200 | 166 | 319 | 234 |
|       | 280 | 432 | 450 | 432 |
|       | 0.42 | 1.357 | 0.135 | 1.13 |
|       | 33 | 17 | 54 | 37.5 |
|       | 0.13 | 0.127 | 0.125 | 0.13 |
|       | 0.117 | 0.118 | 0.118 | 0.13 |
|       | 0.034 | 0.035 | 0.037 |       |
| mean  | 2620.5 | 1395.75 | 547 | 319 |
|       | 43.025 | 737 | 572 | 432 |
|       | 188.75 | 319 | 572 | 432 |
|       | 0.5305 | 668 | 624 | 624 |
|       | 33 | 28 | 54 | 28 |
|       | 0.13 | 0.126 | 0.125 | 0.13 |
|       | 0.117 | 0.118 | 0.118 | 0.13 |
|       | 0.034 | 0.035 | 0.037 |       |
| S8    | 3932 | 2995 | 2898 | 2680 |
|       | 830 | 1497 | 1449 | 1340 |
|       | 8.5 | 8.4 | 8.9 | 8.9 |
|       | 600 | 700 | 600 | 352 |
|       | 386 | 368 | 182 | 184 |
|       | 52.2 | 81 | 99.3 | 50 |
|       | 348 | 504 | 697 | 744 |
|       | 207 | 180 | 242 | 233 |
|       | 336 | 290 | 792 | 400 |
|       | 0.67 | 0.78 | 0.67 | 0.75 |
|       | 28.5 | 33 | 24.5 | 139 |
|       | 0.12 | 0.115 | 0.102 | 40 |
|       | 0.165 | 0.163 | 0.161 | 0.15 |
|       | 0.037 | 0.04 | 0.038 | 0.04 |
| mean  | 3126.25 | 1279 | 352 | 184 |
|       | 70.625 | 535 | 184 | 50 |
|       | 573.25 | 373 | 233 | 200 |
|       | 400 | 432 | 432 | 400 |
|       | 1.39 | 1.28 | 1.02 | 1.39 |
|       | 40 | 33.5 | 24.5 | 40 |
|       | 0.15 | 0.145 | 0.141 | 0.15 |
|       | 0.177 | 0.175 | 0.175 | 0.16 |
|       | 0.04 | 0.041 | 0.041 | 0.04 |
|       |       |       |       |       |
| S9    | 3557 | 3587 | 3193 | 2728 |
|       | 910 | 1793 | 1596 | 1364 |
|       | 9.5 | 8.2 | 8 | 7.9 |
|       | 684 | 466 | 680 | 312 |
|       | 535 | 29.5 | 266 | 233 |
|       | 36.4 | 487 | 101 | 19.27 |
|       | 373 | 196 | 707 | 752 |
|       | 217 | 432 | 243 | 309 |
|       | 282 | 46.7 | 692 | 576 |
|       | 0.75 | 0.13 | 1.28 | 1.44 |
|       | 30 | 35.5 | 33.5 | 28.5 |
|       | 0.15 | 0.148 | 0.145 | 0.137 |
|       | 0.177 | 0.175 | 0.171 | 0.171 |
|       | 0.04 | 0.041 | 0.042 |       |
|     | mean  | 3266.25 | 1415.75 | 8.4  | 574  | 375  | 46.5425 | 579.75 | 241.25 | 495.5 | 1.0775 | 31.875 | 0.145 | 0.1745 | 0.041 |
|-----|-------|---------|---------|------|------|------|---------|--------|--------|-------|---------|--------|------|-------|-------|
| S10 | Octo  | 3856    | 975     | 8.3  | 656  | 462  | 47.3    | 370    | 199    | 408   | 0.8     | 32     | 0.12 | 0.16   | 0.034 |
|     | Nove  | 4437    | 2218    | 8.4  | 480  | 368  | 27.3    | 595    | 240    | 288   | 0.9     | 37.5   | 0.12 | 0.16   | 0.036 |
|     | Dec   | 3839    | 1919    | 8.2  | 300  | 230  | 17.1    | 687    | 238    | 696   | 1.5     | 37.5   | 0.12 | 0.16   | 0.04  |
|     | Janu  | 1919    | 960     | 8.11 | 240  | 184  | 13.6    | 733    | 282    | 528   | 1.6     | 40.9   | 0.102| 0.16   | 0.041 |
|     | mean  | 3512.75 | 1518    | 8.25 | 419  | 311  | 26.325  | 596.25 | 239.75 | 480   | 1.2     | 36.975 | 0.1155| 0.16   | 0.03775|
| S11 | Octo  | 3594    | 977     | 8.4  | 576  | 490  | 20.9    | 343    | 145    | 380   | 0.62    | 39     | 0.13 | 0.113  | 0.036 |
|     | Nove  | 4240    | 2120    | 8.5  | 508  | 396  | 27.3    | 474    | 177    | 336   | 0.86    | 37.2   | 0.11 | 0.111  | 0.039 |
|     | Dec   | 4281    | 2140    | 7.8  | 340  | 245  | 23.2    | 536    | 237    | 684   | 0.87    | 30     | 0.1  | 0.109  | 0.04  |
|     | Janu  | 3852    | 1926    | 8.3  | 256  | 200  | 13.5    | 740    | 278    | 520   | 1.59    | 42     | 0.01 | 0.102  | 0.04  |
|     | mean  | 3991.75 | 1790.75 | 8.25 | 420  | 332.75| 21.225  | 523.25 | 209.25 | 480   | 1.2     | 36.975 | 0.087 | 0.10875| 0.03875|
| S12 | Octo  | 3347    | 955     | 8.2  | 616  | 476  | 34.2    | 205    | 80     | 480   | 0.56    | 28.5   | 0.11 | 0.17   | 0.038 |
|     | Nove  | 3720    | 1860    | 9.4  | 494  | 367  | 30.9    | 490    | 208    | 312   | 0.68    | 36.5   | 0.115| 0.173  | 0.042 |
|     | Dec   | 4053    | 2026    | 8.8  | 320  | 238  | 20      | 520    | 240    | 615   | 0.94    | 29.5   | 0.105| 0.167  | 0.04  |
|     | Janu  | 3212    | 1606    | 8.6  | 264  | 192  | 13.66   | 700    | 300    | 580   | 1.47    | 22     | 0.11 | 0.162  | 0.039 |
|     | mean  | 3583    | 1611.75 | 8.75 | 419.5| 318.25| 24.69   | 522.5  | 238.25 | 496.75| 0.9125  | 29.125 | 0.11 | 0.168  | 0.03975|
| S13 | Octo  | 2400    | 1150    | 9.1  | 586  | 483  | 27.6    | 359    | 250    | 277   | 0.59    | 32.5   | 0.005| 0.11   | 0.001 |
|     | Nove  | 2420    | 1210    | 8.9  | 500  | 382  | 28.8    | 430    | 260    | 288   | 0.357   | 24.5   | 0.008| 0.107  | 0.003 |
|     | Dec   | 2491    | 1095    | 8.3  | 330  | 242  | 21.5    | 540    | 200    | 500   | 0.58    | 29     | 0.003| 0.099  | 0.002 |
|     | Janu  | 2375    | 900     | 8.5  | 252  | 196  | 13.66   | 660    | 270    | 590   | 1.47    | 30     | 0.003| 0.019  | 0.001 |
|     | mean  | 2277.75 | 1088.75 | 8.7  | 417  | 325.75| 22.89   | 497.25 | 245    | 413.75| 0.74925 | 29     | 0.0045| 0.0615 | 0.0018 |
Table 3. The water quality Index values (CCME WQI), during the study period:

| Sites  | WQI value |
|--------|-----------|
| site 1 | 69.2      |
| Site 2 | 64.47     |
| Site 3 | 57.58     |
| Site 4 | 47.82     |
| Site 5 | 60.74     |
| Site 6 | 61.35     |
| Site 7 | 52.39     |
| Site 8 | 62.49     |
| Site 9 | 49.76     |
| Site 10| 56.32     |
| Site 11| 55.12     |
| Site 12| 51.41     |
| Site 13| 67.93     |
Table 4: The correlation Coefficient between environmental factors With each other and with the water quality index.

| Parameters | CCME | WQI | EC | TDS | pH | T.H | Ca | Mg | T.A | Cl | SO4 | PO4 | NO3 | Cr | Ni | Co |
|------------|------|-----|----|-----|----|-----|----|----|-----|----|-----|-----|-----|----|----|----|
| CCME       | 1    |     | 1  | -0.52 | 0.34 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| WQI        | 1    | 1   | 0.57 | 0.26 | 0.39 | 0.67 | 0.09 | 0.12 | 0.00 | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| EC         | -0.52 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| TDS        | 0.34 | 1   | 0.57 | 0.26 | 0.39 | 0.67 | 0.09 | 0.12 | 0.00 | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| pH         | -0.38 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| T.H        | -0.44 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| Ca         | -0.04 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| Mg         | -0.36 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| T.A        | -0.36 | 1   | -0.38 | -0.28 | 0.34 | 0.41 | 1   | -0.38 | 0.51 | 1   | -0.44 | 0.34 | 0.41 | 1   | -0.04 | 0.65 | 0.32 | 0.64 |
| Cl          | 0.57 | 1   | -0.08 | 0.44 | 0.33 | 0.32 | 0.37 | 0.07 | 0.63 | 0.00 | 0.31 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| SO4         | -0.08 | 0.37 | 0.44 | 0.33 | 0.32 | 0.37 | 0.07 | 0.63 | 0.00 | 0.31 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| NO3         | -0.21 | 0.38 | 0.20 | 0.08 | -0.14 | -0.30 | 0.16 | 0.33 | 0.3  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| PO4         | 0.21 | 0.38 | 0.20 | 0.08 | -0.14 | -0.30 | 0.16 | 0.33 | 0.3  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| Cr          | -0.73 | 0.44 | 0.20 | 0.08 | -0.14 | -0.30 | 0.16 | 0.33 | 0.3  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| Ni          | -0.73 | 0.44 | 0.20 | 0.08 | -0.14 | -0.30 | 0.16 | 0.33 | 0.3  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| Co          | -0.53 | 0.51 | 0.25 | 0.11 | 0.33 | 0.29 | 0.29 | 0.43 | 0.4  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| Ni          | -0.53 | 0.51 | 0.25 | 0.11 | 0.33 | 0.29 | 0.29 | 0.43 | 0.4  | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
| Co          | -0.62 | 0.17 | 0.79 | 0.38 | 0.69 | 0.67 | 0.24 | 0.67 | 0.67 | 1   | 0.00 | 0.03 | 1   | -0.36 | 0.37 | 0.19 | 0.57 |
4. Conclusion

The results of the water quality index values of the water inside and outgoing water from the Diwaniyah textile factory generally ranged from (fair to marginal), where the sites located on the Diwaniya River (group 1), the site 1 and site 13 got on (fair), while site 12 got on (marginal). While sites within the factory (group 2,3 and 4) from (site 2 to site 12) the water quality in these sites were (marginal), so that The combination of physical-chemical measures of the comprehensive pollution index identification method meant it could evaluate the degree of water pollution as well as determine that the river or chosen sites was pollution ranged between (Moderate Pollution to Heavy Pollution) and the water quality was (fair to marginal).

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