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Assessing the water quality of Oued Ain Bayda in Saida region of Algeria.

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ABSTRACT

This study aimed to assess the water quality of Oued Ain bayda (Saida, ALGERIA) and identify the types of pollution present. Monthly sampling was conducted at three stations (S1, S2, S3) to analyze the physicochemical parameters including temperature, pH, electric conductivity, biochemical oxygen demand, dissolved oxygen, nitrite, nitrate, chloride, ammonium, suspended solids, sodium, fatty oils, and turbidity. Results indicated that temperature ranged from 10°C to 19°C, pH ranged between 7.5 and 9, and conductivity ranged from 10 to 23 µs/cm. Biochemical oxygen demand ranged from 8.38 to 15.30 mg/l, while dissolved oxygen ranged from 1.58 to 2.9 mg O2/l. Nitrite ranged between 1.50 and 2.03 mg/l, and nitrate ranged between 46 to 55 mg/l. Chloride ranged between 78 to 81 mg/l, ammonium ranged from 1.68 to 2.36 mg/l, suspended solids ranged from 155 to 195 mg/l, sodium ranged from 7 to 7.60 mg/l, and fatty oils ranged from 96 to 116 mg/l. Turbidity ranged between 8 to 17 NTU, with a significant increase observed in winter (December to January) in 2022 . The summer (especially August) recorded the highest means for all parameters except for turbidity. Pollutants found in Oued ain bayda were of various origins, including industrial, chemical, and agro-food.

INTRODUCTION

Water is a precious resource that sustains life and supports our ecosystems while regulating the climate. However, it is also a scarce resource, with only 0.014% of fresh water available on our planet (Nehme, 2014). Water is vital for human activities such as agriculture, industry, and domestic uses, making it a political, economic, and strategic issue. Unfortunately, the dynamic increase in industrial and agricultural production has led to a rapid deterioration of this essential resource, caused by uncontrolled industrial discharges, the intensive use of chemical fertilizers in agriculture, and the disorderly

exploitation of water resources (Forstner, 1990). This pollution of our environment by industries is a major cause for concern, with waste generated by industries leading to pollution of resources such as air, water, and land. The deterioration of water quality is a threat, with surface waters threatened by silting and eutrophication, and groundwater courses threatened by various sources of pollution (Remi, 2010).

In Algeria, the discharge of urban and industrial wastewater has increased in recent years, posing a threat to the quality and quantity of water resources. The city of SAIDA in Algeria experiences daily aggressions caused by industrial pollution, such as the discharge of untreated wastewater from surface treatment workshops into the environment. The main objective of this work is to diagnose the state of contamination of the waters of the Oued Ain bayda in the Wilaya of SAIDA (west of Algeria) by evaluating and characterizing the degree and origin of the pollution affecting this natural resource through several physicochemical parameters measured upstream, center, and downstream during the year 2022.

MATERIALS AND METHODS

The study area is among the most watered regions of Ain elhdjar (Saida ,Algeria). It is subject to a Mediterranean climate, mild and wet in winter and hot and dry in summer. The average annual rainfall varies between 258.48 mm and 370 mm under an average temperature of about 24°C (ONM, 2022).

This site is characterized by a permanent flow of winter. Its supply is ensured by rainwater, and drainage of Lake ain elhadjar , located in the south west. Its flow can then reach 16 $m3.s^{-1}$. In summer, the inputs are mainly constituted by the outputs of the lake (the flow then oscillate between 1 and 5 $m3.s^{-1}$. it also receives on its course the urban discharges of several villages (Sidi Maamar and Ain el- hdjar)

The lower plain of Oued Ain bayda is characterized by a significant agriculture activity (steel industry, painting, food processing, mechanical, etc.) The aquatic environment receiving the discharges of these different companies is the Oued Ain bayda.

2.1.Experimental design

Sites and sampling and measurement of physicochemical parameters: During this work, targeted sampling was carried out, which consists of taking samples at locations where contamination (pollutant) is suspected (AFNOR,1997). Three points of monitoring of water quality of our site was set up, one is located upstream (S1) of the oued Ain bayda SAIDA region, the second in the center (S2) and the third downstream (S3) of the oued (Fig. 3), they give us the quality of water and discharges all along the Oued.

During the water sample collection campaigns, (monthly sampling), we followed the sampling standards "filtration (filter 0.45 µm), acidification (5 ml of Hcl or HNO_3) and preservation (4 ◦C)" (Mddepq, 2008).

The following physicochemical parameters were performed on the remote water samples the Temperature, Hydrogen potentia l(pH), Electrical conductivity (EC): measured with a conductivity meter, Dissolved oxygen and Biochemical oxygen demand, Nitrate: the analysis was done by the colorimetric method ,Nitrite Chlorides, Sodium (Na): the analysis was done by the volumetric method, Ammonium the analysis was done by the colorimetric method, The turbidity of water (TURB): it is measured with a turbidimeter, the measure is given directly in NTU (Nephelometry Turbidity Unit) (Mddepq, 2008)

2.2.Statistical analysis

Six samples were collected randomly in every month (at the beginning, in the middle and in the end of the month). Results were applied by using ANOVA followed by ORIGIN Software). Results were expressed as mean ±standard deviation. The significant test was considered at $p<0.05$.

RESULTS

3.1.Physico-chemical analysis

The physicochemical attributes parameters for three station tests broke down from the oued Ain bayda (Saida, ALGERIA) area (pH, Temperature, Electrical conductivity, Dissolved Oxygen, Biochemical Oxygen Demand, Nitrate, Chloride and Sodium, Ammonium, Turbidity, Suspended Solids, in the results section. The results of chemical and physical proprities show temperature (Fig 1)electrical conductivity in (Fig. 2), Dissolved Oxygen , (fig. 3), Biochemical Oxygen Demand (Fig. 4),Nitrate (Fig. 5), in Fig. 6.the Nitate variation, Chloride (Cl^-) and Sodium (Na^+) in (Figs 7,8,) the Fig. 9.The Ammonium and Turbidity Fig.10.

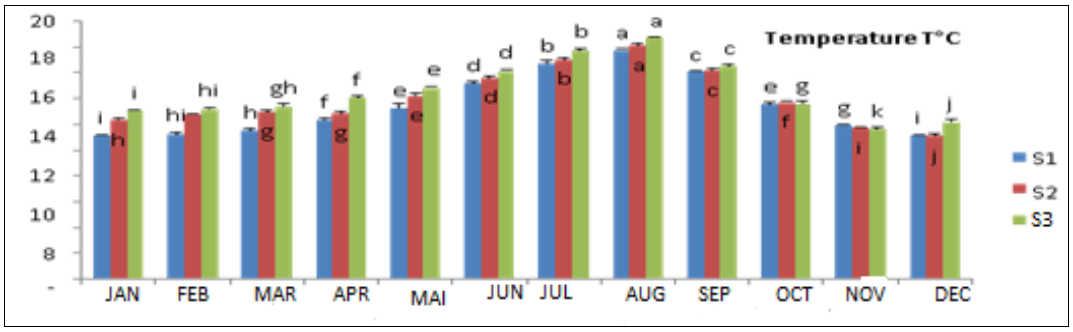

Fig.1. Temperature variation (mean±SD) of three station

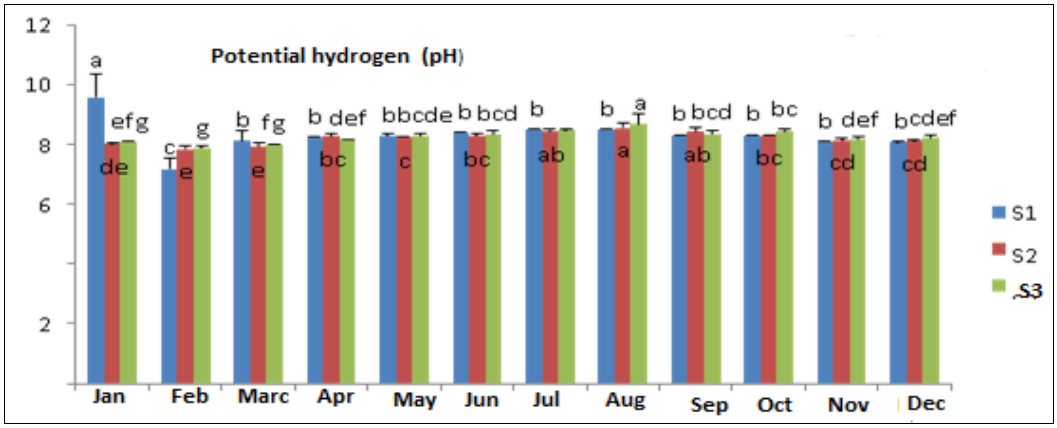

Fig. 2.the potential hydrogen variation of three station.

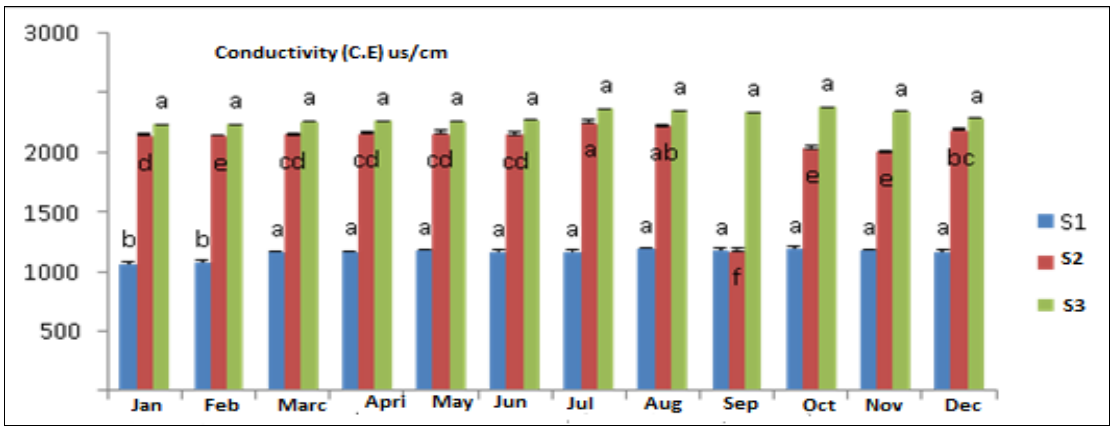

Fig.3. The Conductivity variation of three station.

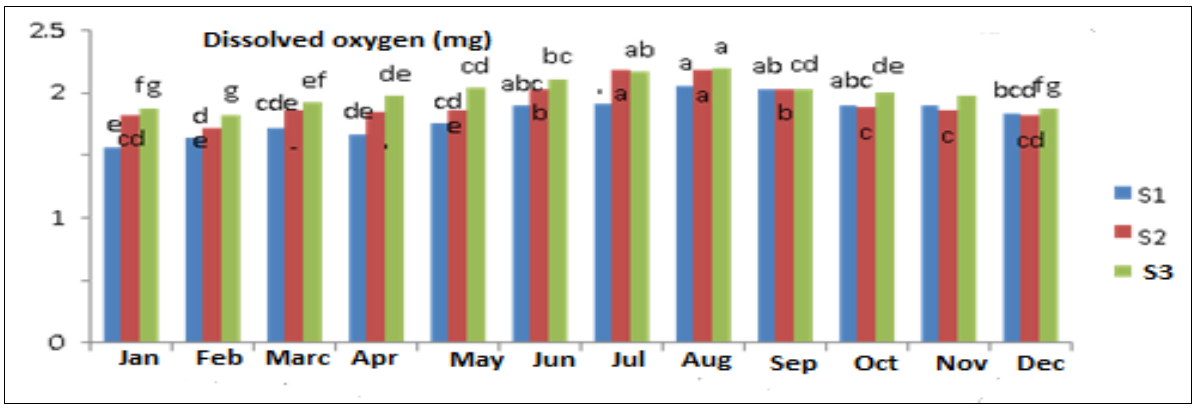

Fig. 4. The Dissolved oxygen variation of three station.

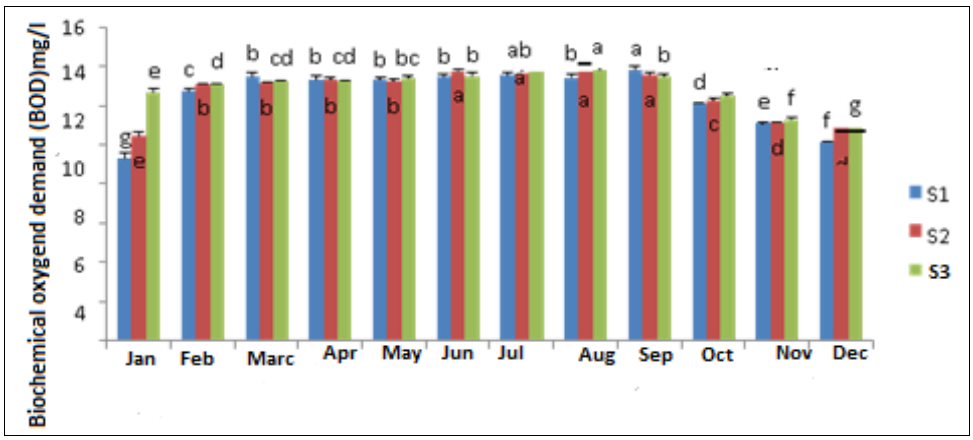

Fig. 5. The Biochemical oxygen demand variation of three station .

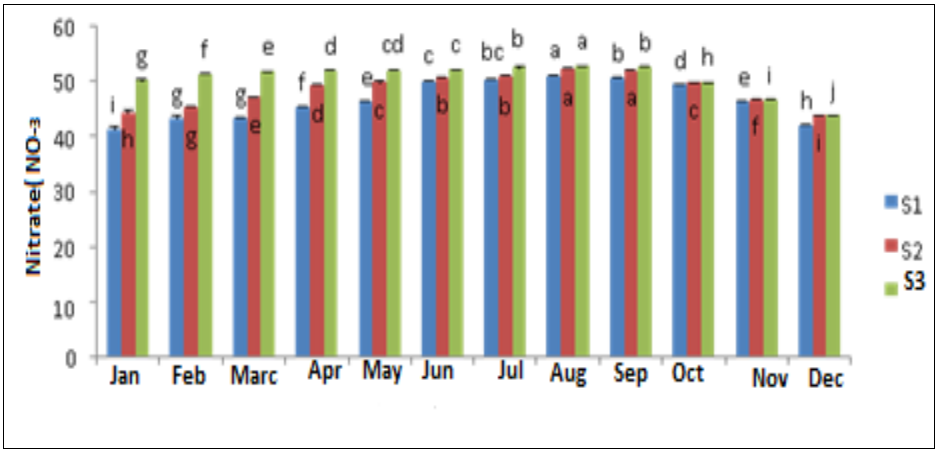

Fig. 6.The Nitate variation of three station.

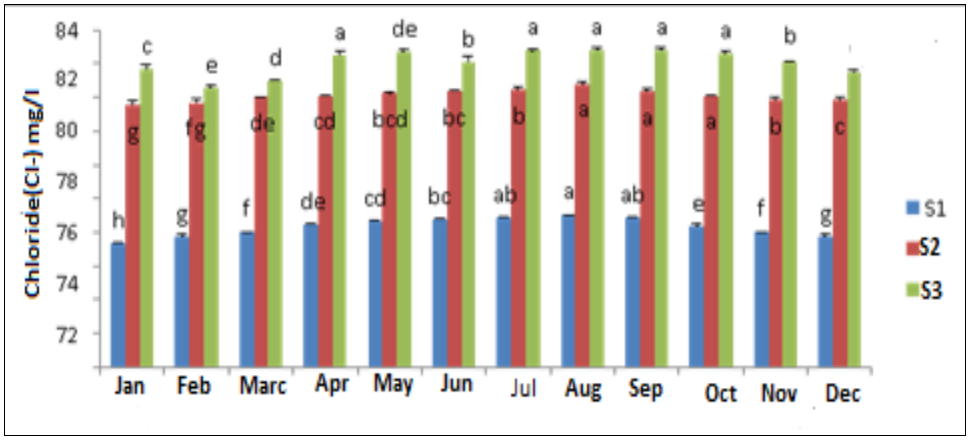

Fig. 7. The Chloride variation of three station.

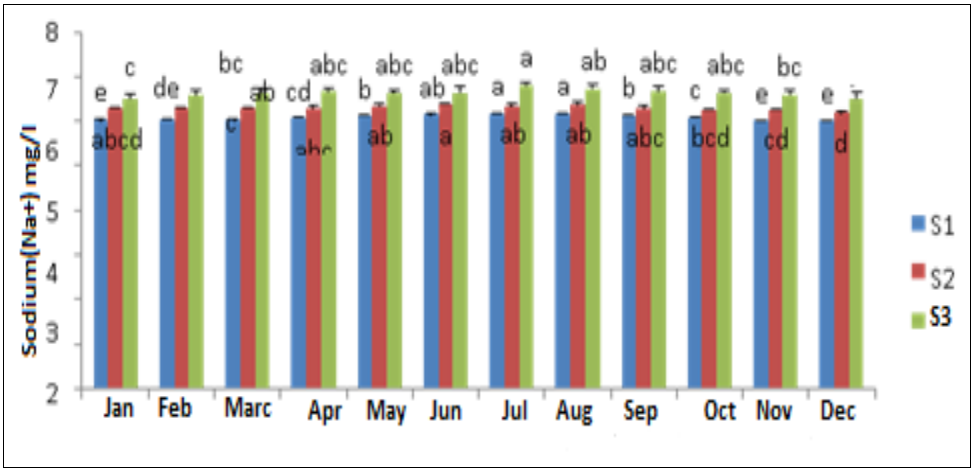

Fig.8. The Sodium variation of three station.

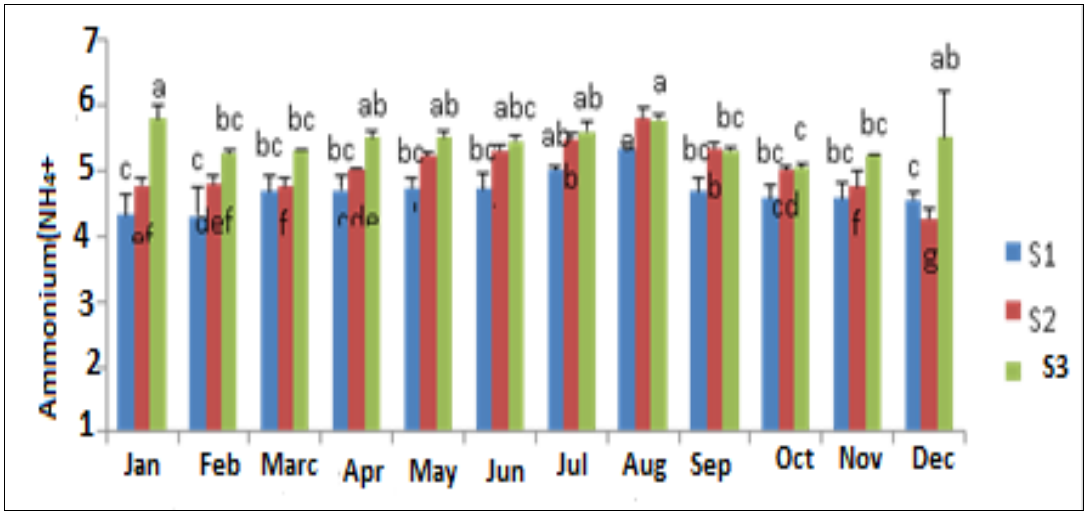

Fig. 9. The Ammonium variation of three station.

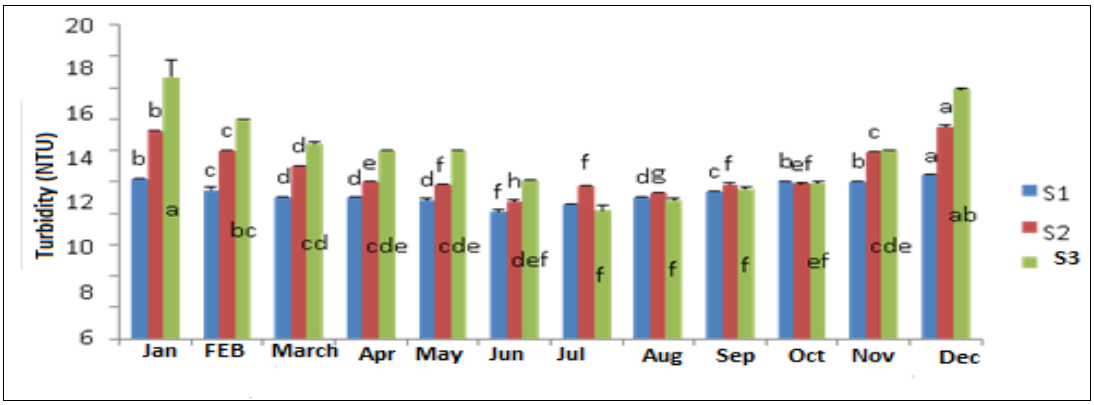

Fig.10. The Turbidity variation of three station.

DISCUSSION

The temperature of water is an essential parameter, and its evolution depends on various local conditions such as regional climate, topography, duration of sunshine, flow rate, and depth. The temperature of a river can also be affected by hot discharges from power plants or factories that use water as a cooling medium. (Fig.1) shows the evolution of the temperature of the Oued of Ain bayda (Saida, ALGERIA).

The Hydrogen Potential (pH) It is a chemical parameter characterizing the acidity or basicity of a medium (Fig.2). It results from the ionic composition of water, and essentially from the presence of carbonates resulting from the exchange of carbon dioxide (CO_2) at the air-water interface, as well as from the dissolution of limestone (Brémaude *et al.*, 2021)

The electrical conductivity in (Fig.3) translates the capacity of an aqueous solution to conduct electric current; it determines the overall content of minerals present in a solution: A soft water will generally show a low conductivity, contrary water known as hard will show a high conductivity (Ruiz, 2000).

The dissolved oxygen, Oxygen is one of the particularly useful parameters for water and is an excellent indicator of its quality (Fig.4). It is one of the most sensitive parameters to pollution. Its value informs us on the degree of pollution and consequently on the degree of self- purification of a watercourse. The quantification of the concentration of dissolved oxygen in water (DO) of a hydro-system is a fairly important factor due to the fact that it participates in the majority of chemical and biological processes in these aquatic environments (Salamon, 2003)

The biochemical oxygen demand (Fig.5) is the quantity of oxygen necessary for the degradation of the biodegradable organic matter of water by the development of micro-organisms, during 5 days at 20°C, we speak then about the BOD5. It is widely used to monitor urban effluents. It is expressed in mg O_2/l (Chapman,1996).

The Nitrate occurs naturally in nature at concentrations of a few milligrams per liter of water because nitrate is a highly soluble pollutant and is the most oxidized form of nitrogen (Ruiz,2000).The values recorded were between 41mg/l and 52 mg/l in (Fig. 6). The increase in nitrate levels in the waters of oued Ain bayda and its presence in surface waters is related to the intensive use of fertilizers (chemical or organic) (Neelly, 1980). Diffuse discharges of agricultural origin on a permeable watershed are mostly involved (Iffat,2020). And in this situation the increase in nitrates and due to the excessive use of fertilizers and agricultural products.

The Chloride and Sodium the origin of these elements is mainly related to the dissolution of salt formations and the effect of marine salinity. The dissolution of

saliferous minerals is done according to the following relationship: $NaCl = Na^{+} + Cl^{-}$ as shown in the (Fig.7, Fig.8) (Belhamra *et al.*, 2016).

The ammonium ion corresponds to the reduced form of nitrogen (Fig.9). This nitrogenous compound is characteristic of wastewater where it is associated with organic nitrogen. It has no appreciable effect on the health of the consumer because it is not the ionized form (NH^{+}_{4}) that is toxic: ammonia is the most toxic form for aquatic organisms. The equilibrium between NH^{+}_{4} and NH_3 is governed by pH and temperature and the oxygen level, but its presence in water is an indicator of pollution Galvez-Cloutier (2002).

Turbidity (Fig.10) is a characteristic that expresses the degree of "cloudiness" of a liquid. It is the opposite of transparency (Légaré, 2000) It is caused by the presence of suspended matter or substances in solution such as mineral substances (sand, clay or silt), organic matter (dead organic matter or decaying plants, suspended plankton) or other microscopic matter that forms an obstacle to the passage of light in water (ONAR , 2006).

CONCLUSION

This study has revealed that the waters Oued Ain bayda are contaminated with pollution from various sources, including natural and anthropogenic factors. Industrial and urban discharges, along with intensive agriculture in the lower valley of the Oued Ain bayda, contribute to the pollution. Statistical analysis of the physicochemical parameters has demonstrated that the physicochemical levels of the Oued Ain bayda region of Saida (ALGERIA) vary depending on temperature, with the highest levels observed in August and an increase in turbidity during the winter. To combat this pollution, it is recommended to conduct individual characterization of the various wastewater produced within the industry and explore the possibility of isolating the polluted water. It is also suggested to install purification pilots in each industrial plant and to sensitize farmers to eliminate the excessive use of fertilizers and chemical fertilizers, which can serve as a significant solution.

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