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Physicochemical characterization of wastewater from the Niamey National Hospital (NNH) (Niger) and assessment of its impact on the environment

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Abstract

The Niamey National Hospital (NNH) is among the reference hospital in the Niamey region (Niger) to after the quality of care it offers to the population. However, these activities have a negative impact on the quality of the water of the river constituting one of the main sources of water supply for the population of Niamey and gardening activities. This study aims to determine the physicochemical quality of wastewater from the NNH activated sludge treatment plant and its impact on the environment. To carry out this study, twenty (20) wastewater samples were taken at the outlet of the NNH treatment station. The sampling lasted five (5) weeks to take into count fluctuations. The results obtained indicate that the average values of physicochemical parameters such as: the pH (6,91), temperature (27.825°C), conductivity (574.80 µS/cm) and certain heavy metals of this hospital are compliance with national and international standards for wastewater discharge. However, it was noted that the average values obtained at the HNN for copper (1.982 mg/L); zinc (1.077 mg/L); in phosphorus (18.065 mg/L); DCO (808 mgO_2/L) and DBO_5 (442.5 mgO2/L) do not comply with national and international wastewater discharge standards. These abnormal levels must be treated before being released into the river.

Keywords: NNH; Wastewater; Wastewater treatment plant; Environment

1. Introduction

Water is an essential element of life and is used in all daily activities [1,2]. With demographic change, the volume of wastewater continues to grow. These are often released into the environment without prior or adequate treatment. This causes the suffering of hundreds of millions of people around the world generate to diseases such as schistosomiasis, cholera, typhoid fever [3]. The city of Niamey is experiencing an accelerated increase in its population, going between 2011 and 2018, from 1,303,000 to 1,802,910 inhabitants [4]. This rapid increase in population has considerably affected the environment and sanitation of the city through the increase in liquid waste. However, access to sanitation is of capital importance, in the sense that it improves the food security of populations, their nutritional and health status and also their production capacities [5]. Therefore, cleaning up water before its discharge into nature is a necessity given that the discharge of untreated wastewater negatively affects the soil, the subsoil through infiltration, surface water and gardening activities.

Among the different types of wastewater, hospital liquid waste deserves particular attention [6]. The latter are often loaded with heavy metals, the concentration of which regularly increases in soil and water. This exposes plants to high concentrations of heavy metals and also presents a toxic risk to humans, because cultivated plants are the entry point into the food chain [7]. This study aims to determine the impact of wastewater from the wastewater treatment plant (WWTP) of the National Hospital of Niamey (NNH-Niger) on the environment.

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2. Material and methods

2.1. Geographical presentation of the study site

The study site is the National Hospital of Niamey (Niger) (figure n°. 1). It was inaugurated on November 22, 1922 and is located on the parallels 02° 06' 06" North and 13° 62' 30" East in the Niamey region. This hospital has an area of 5.41 hectares. It is limited to the east by Avenue François Mitterrand, to the west by the administrative district, the Institute of Public Health (IPH) and part of the National School of Public Health (NSPH), to the north by the 2nd part of the NSPH and to the South by the Kombo district. The Niamey National Hospital wastewater treatment plant (WWTP) was built in 1989. This wastewater treatment plant is supplied by a unitary network which collects all wastewater from the hospital.

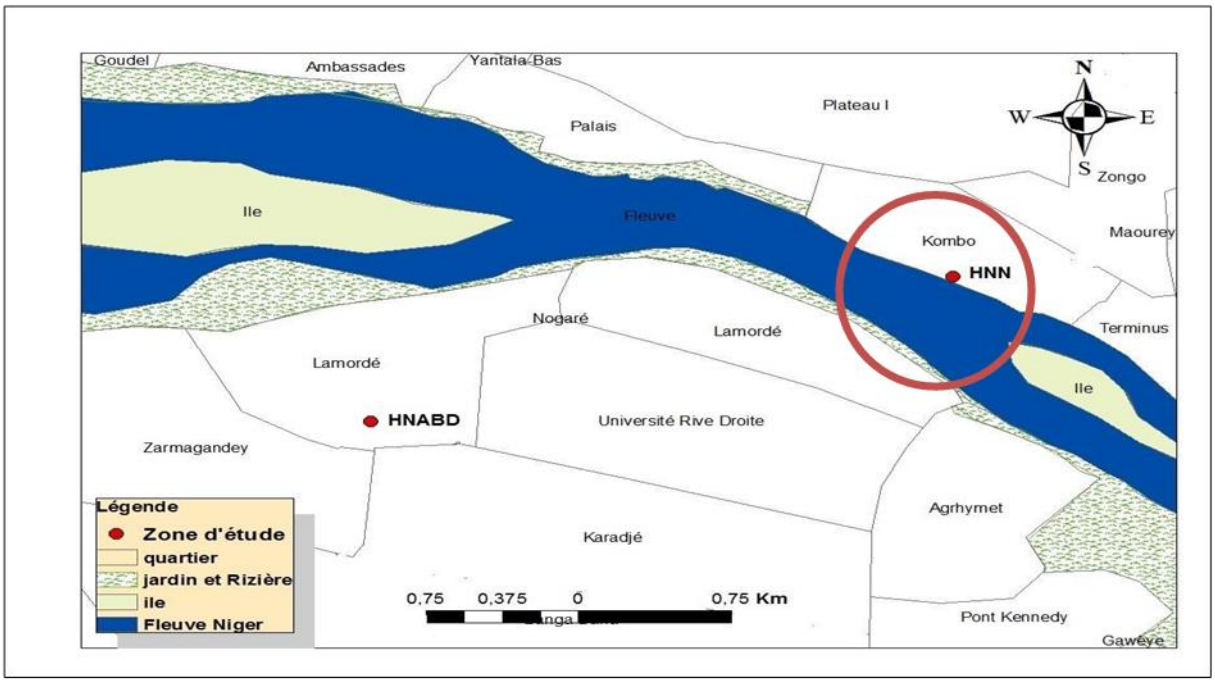

Figure 1 Presentation of the study site

2.2. Sampling

Wastewater samples were collected at the HNN in 500 mL polyethylene plastic bottles previously washed with water then rinsed with distilled water before being filled with water. Before each sample, the bottle was first rinsed with waste water.

2.3. Analysis

Electrical conductivity (EC, µS/cm), pH and temperature (°C), these three physical parameters were measured in situ using a HANNA brand multivariate pH meter [8,9]. The turbidity was measured with a HANNA HI 98713 brand turbidimeter. The nitrite ion contents; in nitrate; in zinc, copper; in cobalt; in chrome; in aluminium; nickel and phosphorus were measured using a DR3800 spectrophometer.

3. Results and discussion

The average values of the physicochemical parameters at the outlet of the NNH (WWTP) and the national and international discharge standard are presented in table I.

For each parameter, several measurements were carried out. The value used for interpretation is the average value of the different measurements.

Table 1 Average values of physicochemical parameters obtained at the outlet of the HNN wastewater treatment.

Paramètres physico-chimiques	**Average value**	**National standard of denial**	**International standard of denial**
pH	6.91	6.5< pH< 9.5	5.5 <pH<8.5
Temperature (°C)	27.825	<50	<30 (EU)
Conductivity (µS/cm)	574.8	-	≤ 2000 (WHO)
Turbidity (NTU)	446.1	-	≤ 50 (WHO)
Nitrite (mg/L)	0.2805	-	≤ 10 (WHO)
Nitrate (mg/L)	121.315	-	≤ 60 (WHO)
Phosphorus (mg/L)	18.065	-	≤ 10 (WHO)
Zinc (mg/L)	1.077	≤ 1.0	-
Copper (mg/L)	1.982	≤ 1.0	-
Aluminium (mg/L)	0.126	-	-
Nickel (mg/L)	0.0458	≤ 1.0	-
Cobalt (mg/L)	0.2715	-	-
DCO (mg O_2/L)	808	≤ 200	≤ 150 (EU)
DBO_5 (mg O_2/L)	442.5	≤ 50	≤ 30 (EU)

The results in Table 1 show that the wastewater from the NNH (WWTP) has an average temperature of 27.825 °C and an average pH of 6.91. These average values of temperature and hydrogen potential are within the range of national and international standards.

An average value of electrical conductivity obtained at the outlet of the wastewater treatment plant is 574.8 µS/cm. This value meets the standard recommended by the World Health Organization (WHO). This result also shows that the average turbidity value obtained at the outlet of the treatment plant is equal to 446.1 NTU. This value is significantly higher than the guideline value recommended by the World Health Organization for the discharge of wastewater. This could be due to the presence of suspended organic matter and other undissolved substances in the wastewater. This average turbidity value could lead to adsorption and retention of chemical contaminants (heavy metals; pesticides) by suspended particles. The latter reduce the effectiveness of wastewater disinfection [10]. This turbidity explains poor clarification of this wastewater. And this can have a direct impact on living beings in this place.

Likewise, the result in Table I shows that the average nitrite contents obtained are 0.2805 mg/L. This value is lower than the WHO guideline value which is 10 mg/L. The average nitrate value obtained is 121.315 mg/L, higher than the guideline value recommended by the WHO. This high nitrate value indicates that wastewater is very loaded with biodegradable nitrogenous materials. Also, the average phosphorus value obtained for this wastewater is equal to 18.065 mg/L. This value is higher than the standard recommended by the World Health Organization. These high nitrate and phosphorus contents can induce the phenomenon of eutrophication. They can also promote the proliferation of algae and photosynthetic microorganisms which reduce the penetration of light into deep water layers of these algae and photosynthetic microorganisms produce oxygen during the day, they consume it at night and these variations in oxygen concentration could be fatal to aquatic fauna [10]. This could have a harmful impact on living beings and the environment.

The average values for copper and zinc are 1.982 mg/L and 1.077 mg/L respectively. These values are higher than the national standard. These average copper and zinc values could have acute or chronic toxic effects on aquatic life [11]. The average values of DCO and DBO_5 are respectively equal to 808 mgO2 /L and 442.5 mgO2 /L. These values far exceed the international and Nigerien guide values.

These results show that this wastewater is very rich in organic and mineral matter. They can explain the high nitrate values following their mineralization. This high BOD5 value explains the harmful consequences that this wastewater

can have when it is discharged into the aquatic environment. They use a large quantity of dissolved oxygen from the environment, which can cause asphyxiation in aquatic fauna. Also, these discharges expose the receiving environment to very high organic pollution with the consequence of a reduction in its capacity to self-purify [12].

4. Conclusion

The objective of this work is to study the impact of wastewater from the National Hospital of Niamey (Niger) on the environment. The average values of heavy metals obtained at the outlet of the HNN wastewater treatment plant are within the range of the national guideline value. On the other hand, the values obtained at the HNN for copper, zinc and phosphorus are higher than the national and international standards. Also, regarding DCO and DBO_5, the average values obtained at the outlet of the HNN wastewater treatment plant (WWTP) are higher than national and international standards. Discharge of this wastewater into the river could contribute to pollution, contamination and eutrophication at the point of discharge into the river. They can also constitute a serious risk of spreading water-borne diseases for the local population and aquatic fauna.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare no conflict of interest.

References

[1] Fatimaezzahrae I. 2016. The stages of water treatment and quality control. Project graduation. Degree in chemical engineering. SIDI MOHAMED BEN ABDELLAH University. Faculty of Sciences and technology.28 pages.

[2] World Resources Institute. 1999. World Resources Database CD-rom 1998-99. A Guide to the Global Environment Change and Human Health.

[3] Chevalier P. 2002. Summary sheets on drinking water and human health: Enterococcus et streptococcus fecal. National institute of public health, Québec. 5 p.

[4] National Institute of Statistics of Niger (INSN). Population evolution. [Online]. Available on <*https:// fr.m.wikipedia.org>wiki> Niamey>* (Consulted 05/06/2021).

[5] ADAMOU Z .2017. Contribution to improving wastewater management on the industrial site: Case of the China National Petroleum Corporation Niger Petroleum S.A (CNPCNP S.A) on the block Agadem. Thesis for obtaining the Master's degree in engineering of water and environment. International Institute of Engineering of water and Environment(2ie). Ouagadougou .77pages.

[6] Harence FF. 2012. Management of domestic effluent in a hospital environment: Case of the National Hospital Center: Hubert Koutoukou Maga of Cotonou (Bénin). Thesis for obtaining the Master's degree in engineering of water and environment. International Institute of Engineering of water and environment (2ie). Ouagadougou .82 pages.

[7] Walid Z. 2011. Research and characterization of determinants controlling cadmium accumulation in lettuce "Lactuca sativa". Doctoral thesis at the University of TUNIS EL MANAR

[8] Chapman D, KIMSTACH V. 1996. Selection of water quality variables. Water quality assessments: a guide to the use of biota, sediments and water in environment monitoring, *Capman edition, 2nd ed. E & FN Spon, London, pp. 59 -126.*

[9] Rodier J. 1996. Water Analysis; Natural water, waste water , sea water, 8ème édition, Ed. Dunod, Paris.

[10] Garba HB. 2018. Quality control of water supplied by traditional sellers "Garouas" in the city of Niamey: Characterization physicochemical and bacteriological parameters. Thesis for obtaining the Master's in Chemical at the Faculty of Sciences and Technology of Abdou Moumouni University of Niamey (FAST/UAM). 83 pages

[11] Brussels Institute for Environmental Management / Environmental Data Observatory. 2005. Physicochemical and chemical quality of surface water: general framework.

[12] Alhou B. 2007. Impact of discharges from the city of Niamey on the quality of river water (Niger). Thesis to obtain the degree of faculty doctor. Notre Dame of peace University, Namur; 300p.