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Short communication

Turbidity monitoring as a critical parameter for water supply safety and quality

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Introduction

Turbidity (TUR) reflects the reduction in water transparency caused by suspended particles including colloidal, mineral, and organic matter, or by microorganisms. It is an important parameter for evaluating water quality and its suitability for human consumption. While not necessarily harmful on its own, high TUR can indicate the presence of contaminants that may affect taste, odor, and appearance. TUR can also serve as an indicator of potential microbial contamination in water (Sahoo and Anandhi, 2023; Szpak et al., 2020).

Threats to the water supply may occur at any stage of the production of water intended for consumption: in the water source, at the stage of the treatment and storage, as well as in the water distribution system (WDS). TUR measurements are used to assess water sources, monitor treatment processes, and ensure regulatory compliance (Reza et al., 2026; Szpak et al., 2020). Consequently, understanding and monitoring this parameter is imperative for maintaining water quality (Jung et al., 2014; Zhang et al., 2019).

The aim of this study was to monitor and analyze TUR variations throughout the water supply chain in Stip, from the raw surface water of the Hydrosystem Zletovica, through the filtration and ultrafiltration (UF) stages, to the final WDS.

Materials and methods

The raw surface water at the water treatment plant was subjected to pretreatment in order to remove suspended particles aimed to protect the UF membrane. The pretreatment consisted of addition of 1% $Ca(OH)_2$ solution (pH correction) which was followed by coagulation, sedimentation, and then pre-filtration. Afterwards, the water was ultra-filtrated and then released in the WDS. Four types of samples were collected, raw surface water, samples from the filter station before UF and after UF, and samples from the WDS. A total of 80 water samples were collected in 2024.

TUR was measured according to the MKC EN ISO 7027-2017 method and expressed as nephelometric turbidity units (NTU). TUR of raw surface water was measured using HACH 1720 E turbidimeter, TUR before and after UF was measured by a TU5300 HACH LANGE process turbidimeter, and TUR in WDS was measured by a Lovibond TB 300 IR (IR LED source 860 nm) turbidimeter (Tintometer, Ltd., Germany). All data were processed to obtain descriptive statistics,

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minimums and maximums in order to get an overview of the data collected and their variability.

Results and discussion

The existing practices for water quality monitoring of raw surface water entering a treatment plant include TUR as well as several other physicochemical parameters. At this stage TUR monitoring is essential as it may influence the proper selection of treatment (Matos et al., 2024).

The results from TUR measurements for raw surface water in our study ranged from 2.23-17.53 NTU. The analysis revealed a marked seasonality. Values higher than 10 NTU were noted in May, June, and August probably due to intense rainfall. The highest TUR value was observed in August. After the raw water pretreatment, the TUR values dropped, ranging from 0.94-7.05 NTU. After the UF, there was a significant decline in TUR ranging from 0.02-0.07 NTU. This due to the UF process. The values were constant throughout the entire year, which implies the effectiveness of the process. According to the WHO's standards, the TUR of drinking water should be below 1 NTU before disinfection, otherwise, the effectiveness of chlorination significantly decreases. In areas where fewer resources are available, the turbidity should be below 5 NTU (Matos et al., 2024). Compliance with these standards is essential for water facilities to ensure the delivery of safe drinking water to the public. Also, TUR values after UF serve as critical indicators for protecting infrastructure, minimizing downtime, and maintenance costs for the UF, and fortifying the resilience of operations in the face of dynamic environmental conditions (Matos et al., 2024). The TUR in the WDS was in the ranges of 0.35-0.56 NTU. The slightly elevated values compared to the values obtained after UF is a common phenomenon, probably due to particles that can be re-suspended, corrosion, or chemical reaction in the pipes (Álvarez-Arroyo et al., 2023). However, the obtained values are acceptable and comply with the national drinking water quality standards (Official Gazette 184/2018).

Conclusion

The TUR monitoring results showed that, following appropriate, the water intended for consumption meets national and international safety standards. The reduction of turbidity was very efficient, with turbidity below 0.1 NTU underscoring the importance of UF for obtaining safe drinking water. This is an emerging issue in order to meet the growing demands for clean and safe water. In addition, continuing research and investment in innovative water treatment technologies and continuous quality monitoring is very challenging, but it is of utmost importance for the general wellbeing.

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