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EXTENDED ABSTRACT

Evaluation of Treatment Processes; Recovery and Recycling of Water from Human Wastewater in Tall Towers Using Automation Methods; A Case Study of The Project in the Sepehr Tower, Tehran

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1. Introduction

Considering the rapid population growth and increasing demand for clean and reliable water, wastewater treatment plants play a significant role in providing a reliable water source. Therefore, the use of unconventional water sources has rapidly grown in recent decades (Taheriyoun, et al, 2014). Discharging wastewater requires treatment and alternative evaluation for proper environmental monitoring and protection of our natural water resources. Assessing the reliability of treatment processes and treatment facilities should be an important part of the planning and design process for water resource projects, wastewater treatment, and especially wastewater reuse projects. Wastewater should be treated before disposal or reuse in order to comply with regulations and guidelines at various national levels. Generally, complete wastewater treatment consists of three main stages: primary treatment (removal of suspended and floating solids), secondary treatment (biological decomposition of organic matter) and tertiary treatment (removal of nutrients and toxic compounds) (Jones, 2021).

2. Methodology

The study location in this research is the administrative tower of Sepah Bank in Tehran. The mentioned building is a 32-story tower with an area of approximately 32,500 square meters, located at the intersection of Semeia Street and Malek al-Shoara Bahar Street. It houses around 1,400 administrative personnel and serves over 400 visitors daily. The tower has approximately 3,500 square meters of green space surrounding it and consumes an average of 76 cubic meters of water per day throughout the year. At the beginning of the project, the wastewater treatment plant in this building used the chlorination method to treat the incoming wastewater and discharged it into the surrounding water stream after settling. In this section, while collecting statistics and information on the water consumption of green spaces and facilities, and determining the parameters of the study's water quality, relevant standards were established. By making structural changes in the layout and design of the space, such as eliminating chlorination and replacing it with ozonation, and incorporating a biological treatment pond, the results of the studied wastewater treatment methods were evaluated. Initially, by obtaining information on the raw wastewater and recording statistical data on pollution load, pH, COD, and

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temperature using relevant sensors, the experiences of previous implemented projects were evaluated. The activated sludge method was used due to the potential physical space available and the possibility of extending the retention time. Two different scenarios were defined for ozonation, considering constant air supply, ozone injection dosage, and pH of the wastewater in the inlet pond, and initial raw test results were obtained through automation sensors.

3. Results and discussion

The obtained results on different scenarios showed that when ozonation is performed in the inlet ponds, a greater reduction in COD and BOD_5 pollution load is achieved compared to when it is done in the outlet ponds. Additionally, the results indicated that initial ozonation, along with an increase in the retention time of wastewater in the biological pond, yielded better results compared to other studies conducted in this area. Furthermore, the results of the second scenario were compared with the standards of green spaces and facilities. The results showed that despite the reduction in the desired parameters' pollution load, the system's reliability for 50% operation was calculated. Therefore, in the subsequent treatment stages, secondary ozonation, filtration, and reverse osmosis were utilized. It was determined that the parameters of egg parasites, BOD_5, pH, and TSS were fully compliant with the standards after secondary ozonation and filtration. However, there was a slight difference in EC and TDS beyond the standard limit. Additionally, in the facilities section, the reliability coefficient of the reclaimed water did not change despite the reduction in pollution load. Therefore, by passing the wastewater through the reverse osmosis system, the water was tested and the results indicated complete treatment and 100% reliability for facility use. Furthermore, by determining the required water quantity for the facilities, it was found that not only all the needs of the green spaces were met before reverse osmosis, but there was also water stress for the months of Khordad, Tir, Mordad, Shahrivar, and Mehr.

4. Conclusions

Based on the uniformity and lack of significant changes in the pollution load produced in the wastewater of the Sepeher Tower, and also the high potential of the physical treatment space and the existence of ponds with considerable volume, the activated sludge wastewater treatment method is considered. Ozone treatment, due to its greater capabilities and high disinfectant power, is a suitable replacement for chlorine treatment, and the results of pre-ozone treatment of wastewater on the raw incoming wastewater have shown better results in reducing pollution load. The results of the experiments on the desired parameters show that wastewater treatment under the following conditions has yielded desirable results for reclaiming water in green spaces and facilities. By implementing this treatment plan in the Sepeher Tower, more than 15,500 cubic meters of water are reclaimed annually and returned to the consumption cycle, resulting in savings of more than 8,300 cubic meters per year from municipal water usage and injection of 7,200 cubic meters annually into groundwater resources.

5. References

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