Proceedings of the 8th World Congress on Civil, Structural, and Environmental Engineering (CSEE'23)
Lisbon, Portugal – March 29 – 31, 2023
Paper No. ICEPTP 197
DOI: 10.11159/iceptp23.197

Inhibitory Effect of Chromium Shock Loads on Integrated Fixed-Film Activated Sludge (IFAS)

Abdelsalam Elawwad, Omar Abdelkarim, Minerva Edward
Environmental Engineering Dept., Faculty of Engineering, Cairo University
El-Gamaa St., 12613 Giza, Egypt
elawwad@cu.edu.eg, omar.abdelkarim@hotmail.com, minervaav@cu.edu.eg

Extended Abstract

Several developing counties suffer from inadequate water and sanitation facilities in rural areas [1]. In addition, the disposal of wastewater in these areas without treatment of water streams is one of the significant environmental problems, where it causes eutrophication and affects public health [2]. Exploring cheap and simple treatment systems in these rural areas has been one of the challenges in the last decades [3]. Many pollutants, such as heavy metals, are causing problems in conventional wastewater treatment systems as the heavy metals have an inhibitory effect on the microorganism [4]. In developing countries, discharge regulations for sewer systems are not restricted, which may result in shock loads of heavy metals to local treatment facilities from surrounding local industries. The existence of such inhibitory pollutants in wastewater can cause instability in the operation of biological treatment systems [2], [5]. Integrated Fixed Film Activated Sludge system (IFAS) is a hybrid system, which is considered one of the solutions that can enable us to enhance conventional wastewater treatment plants; at the same time, the operation and maintenance of IFAS is simple [6]. IFAS combines suspended and attached growth in the same reactor, where attached bacteria are more tolerant to heavy metal shock loads in these areas. In this study, to test the performance of IFAS system under shock loads of heavy metals, a pilot plant of IFAS was subjected to a Cr+6 shock load of 10 mg/l concentration for seven continuous days. The pilot plant was operated under ambient temperatures between 16 and 28 °C. FAB media with a specific surface area of 400 m2/m3 was used with a fill ratio of 50% of the aeration tank volume. The pilot plant volume is 115 liters, the flow rate is (3.61 L/hr), the residence time is around 6 hrs, and the pH is (6.2 - 7.8). The system is operated at a sludge age of 10 days by controlling the excess sludge withdrawal. After applying the Cr+6 shock load, the organic removal decreased to 91% and 85% on the first and second days, respectively. Then, the system was recovered on day 3, and organic removal efficiency was gradually increased until it reached its full treatment capability after 7 days. In conclusion, IFAS showed stability under shock loads of chromium, and the system recovered in a short period. Using IFAS could be a cost-effective option for upgrading existing activated sludge systems and provide operational stability to the inhibitory effect of these pollutants.

References

[1] A. Elawwad, M. Ragab, and H. Abdel-Halim, "An economical, environmental, and social comparison between vacuum and gravity sewers in decentralized sanitation systems, with Egypt as a case study," *Journal of Water Sanitation and Hygiene for Development*, vol. 5, no. 4, 2015, doi: 10.2166/washdev.2015.099.

[2] A. Elawwad, A. Karam, and K. Zaher, "Using an Algal Photo-Bioreactor as a Polishing Step for Secondary Treated Wastewater," *Pol J Environ Stud*, vol. 26, no. 4, pp. 1493–1500, Jul. 2017, doi: 10.15244/PJOES/68426.

[3] A. Elawwad and M. Hazem, "Minimization of sludge production in an integrated UASB–continuous flow sequencing batch reactor system," *Desalination Water Treat*, vol. 91, 2017, doi: 10.5004/dwt.2017.20643.

[4] N. G. Mostafa, A. F. Yunnus, and A. Elawwad, "Adsorption of Pb(II) from Water onto ZnO, TiO2, and Al2O3: Process Study, Adsorption Behaviour, and Thermodynamics," *Adsorption Science and Technology*, vol. 2022, 2022, doi: 10.1155/2022/7582756.

[5] A. Elawwad, A. Naguib, and H. Abdel-Halim, "Modeling of phenol and cyanide removal in a full-scale coke-oven wastewater treatment plant," *Desalination Water Treat*, vol. 57, no. 52, 2016, doi: 10.1080/19443994.2016.1148637.

[6] S. Waqas, M. Bilad, Z. Man, Y. Wibisono, J. Jaafar, T. Mahlia, A. Khan, M. Aslam, "Recent progress in integrated fixed-film activated sludge process for wastewater treatment: A review," *J Environ Manage*, vol. 268, Aug. 2020, doi: 10.1016/J.JENVMAN.2020.110718.