Abstract

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Mathematical Modeling of Aeration Efficiency and Dissolved Oxygen Provided by Stepped Cascade Aeration

Abstract Mathematical modeling has been a vital tool in the field of environmental engineering. Various models have been developed to simulate the level of aeration efficiency (AE) provided by different aerating structures to raise levels of dissolved oxygen (DO) in streams one of which is the stepped cascade structure. Three models developed by Gameson et al., WRL, and Nakasone, in addition to Qual2k, a computer program for stream modeling, have been used in this research values of AEs obtained have been compared to those computed using DO measured from a built model at a WWTP. A stepped cascade structure was installed with different heights to aerate five flowrates with different levels of COD. An adjustment has been made to the Nakasone model to test the effect of pollutant load on the amount of aeration that could be reached. Values of AEs computed using the Gameson model were 30%, 39.5%, and 40 % for cascade heights (Hd) 45, 60, and 75cm respectively for the five flowrates (q) that ranged from 21-66m3/hr. Values of AEs from WRL model were 32.8%, 42%, and 43 % consequently. Values of AEs from Nakasone model ranged from 4.6-7.5%, 6-10%, and 7.6-12% respectively. For the adjusted Nakasone model, values of AEs ranged from 3.2-4.9%, 3.3-5.3%, and 4.1-6.7% respectively. Finally, the AEs computed using the values of downstream DO generated by Qual2k ranged from 4-18%, 2-15%, and 2.5-5.1% correspondingly. Around 80% of the downstream DO values computed using the Nakasone and adjusted Nakasone model were closer to those measured in the field, thus more reliable in cascade design. Keywords Aeration efficiency cascade aeration cascade height COD flowrate mathematical modeling