

Optimization of a water treatment process with respect to coagulation and sedimentation process of a conventional water treatment plant.



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Abstract

The coagulation-flocculation mechanism has been increasingly investigated by many researchers in water treatment. A wide variety of chemicals are used for the treatment of raw water with the aim to remove suspended and dissolved particles in raw water. Known conventional water treatment methods that used coagulants such as silica and high lime have been reported to have high operating costs due to the high coagulant consumption and large sludge volume generation. Therefore, there is an urgent need for the investigation of the coagulant and flocculation process with a primary objective of improving removal efficiency, while reducing chemical costs and achieving acceptable final water quality with lower sludge production. Taking this background into account, this study utilized the jar test methodology to establish an alternative treatment regime that can solve the above-mentioned challenges. In this study, two well-defined treatment regimens were investigated. Regime 01 was characterized by the usage of polyelectrolyte known as Zeta-Floc, while regime 02 was characterized by the usage of Zeta-Floc as a primary coagulant and lime as a coagulant aid. The source water for both regimes was abstracted from Vaal Dam with an initial turbidity of 62.4 NTU, the sample was collected in the winter season of the year 2018, and the average turbidity of that season was 63.4 NTU.

The study revealed that Regime 02 can be preferred over Regime 01 as it proved to promote the agglomeration larger-sized particles which settle much faster. At optimal pH of 8.3 and the optimal coagulant dosage of 6 mg/l, it was established that the measured residual turbidity of regime 01 and regime 02 were found to be 4.1 NTU and 2.8 NTU respectively. These were achieved under the rapid mixing of 100 rpm and the flocculation intensity of 30 rpm. Regime 02 proved to yield the lowest residual turbidity and improved physicochemical properties of the treated water as compared to Regime 01, this was due to the addition of low lime as a coagulant aid. Regime 02 archived performed better than the current, which achieved a turbidity of 6.3 NTU. The results obtained from this study highly recommend the usage of regime 02 in the treatment of raw water, it has been proved to reduce chemical cost and does not generate high large volumes when compared to the current high lime regime.

Keywords: Coagulation, colloidal, flocculation, Turbidity, physicochemical, Settling velocity.