Desalination and Water Treatment
www.deswater.com
33 (2011) 337–350
September
1944-3994 / 1944-3986 © 2011 Desalination Publications. All rights reserved.
doi: 10.5004/dwt.2011.2662

A case study on the automatic ozone dose control system based on the ozone decay rate in a full-scale advanced water treatment plant

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Received 30 November 2010; Accepted in revised form 27 March 2011

ABSTRACT

Recently, a growing concern about algae-origin taste and odor in drinking water made it possible to introduce ozone and granular activated carbon (GAC) processes to large-capacity (more than 300,000 m^3/d) water treatment plants in the Han River area in South Korea. Especially, concerning the ozone process, the ozone residual of ozone contactor effluent may affect on the biological destabilization, poor physical properties of the following GAC process and operators' health due to high ozone gas concentration in GAC contactor. Therefore, maintaining an optimal ozone dose based on the ozone demand is essential to the operation of the ozone process. The Koyang Advanced Water Treatment Plant (KAWTP) has been utilizing a new type of ozone control method since July 2009, which automatically calculates required ozone dosed based on the instantaneous ozone demand (ID) and the ozone decay rate constant (K_c). The ID and the first-order K_c values are calculated based on the measured dissolved-ozone concentrations from at least three points of ozone contactor. After the calculations of ID and K_c values, the values were applied for the proportional integral derivative (PID) ozone dose control system. PID control is operated through two different methods. The first involves automatic controlling the ozone dose, by which the ozone residual of the effluent from the ozone contactor will be maintained at the desired value set by the operator. The second method was the modified extended CSTR method, which was appropriately modified to fit the KAWTP site specifications, to calculate the *Cryptosporidium*, *Giardia* and virus log inactivation automatically. An automatic ozone dose control system based on the ozone decay rate overcomes the disadvantages of the previous ozone control systems, including late response and variation of effluent ozone residual. In the earlier pilot scale research, an extra device for measuring K_c and ID was used. In this study, the ozone dose was determined by measuring K_c in the full-scale ozone process. It is the first case in Korea that applied ID-K_c-based ozone dose control to a full-scale water treatment plant. According to the operation results of the automatic ozone dose control system based on K_c calculation, adequate-ozone-dose calculation along with the various water quality and inflow rate was performed successfully, and the ozone residual of the effluent was also maintained below the lowest set value during operation. Moreover, the process was adequately run to maintain the target log inactivation the *Cryptosporidium*. Also, calculating the optimal ozone dose that could completely oxidize ozone-consuming matters and leave minimum residual, could be economical due to excessive ozone dose saving, and the biological and physical stability of GAC granule in GAC process.

Keywords: Ozone; Automatic control; ID (instantaneous ozone demand); K_c (ozone decay rate constant); Full-scale

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