Chlorine risk assessment in emergency situation in water distribution network

Maryam Pakdehi[1], Mojtaba Ardestani[2], Mohammad Hosein Niksokhan[3*]

1. Environmental engineering, faculty of environment, university of Tehran, Iran, Master of Science, 14155-6135. maryam_pakdehi@yahoo.com
2. Environmental engineering, faculty of environment, university of Tehran, Iran, Associate Professor, 14155-6135. ardestan@ut.ac.ir
3. Environmental engineering, faculty of environment, university of Tehran, Iran, Assistant Professor, 14155-6135. niksokhan@ut.ac.ir

Abstract

One major problem with water quality is the disinfection of drinking water and its detail while drinking water systems are vulnerable and surrounded by a wide range of risks. Since we cannot create a system without any risks, we need to manage them effectively to achieve an acceptable level.

In this probe, both hydraulic and free chlorine simulations have been performed in tank 12's water distribution network (which is in Tehran, Iran), and when the chlorine level at the tank was greater than usual, it was specified that which locations at what hours are sensitive. A hazard zonation in terms of maximum chlorine concentration value has been carried out. Finally, with important parameters affecting the sensitivity of the area, priority areas have been defined by Expert Choice software. In the Analytic Hierarchy, 5 criteria that were obtained from Water and Wastewater Company (WWC) technical experts were used. Hence, by elevating chlorine concentration at the tank, the risk assessment for different areas in this network has been carried out. Thereafter, that the nodes watering earlier are more sensitive was objectified, so their water should be cut off first.

Keywords: emergency situation – hydraulic and chlorine analysis – risk assessment – residual chlorine zonation – water distribution network

Introduction

The main risk of public health can happen when water is contaminated by microorganisms. (Gibbs, et al., 2006) Delivering drinking water to consumers without pathogens is the major task of all water organizations. Removing microbial contamination and proliferation in drinking water distribution systems (DWDS) is possible by disinfection to ensure Users' safety (Cristo, et al., 2015). Chlorine is the most commonly, effective, reachable and inexpensive disinfectant. It remains in the network as residual while dosing, measuring and controlling it is very simple. (Freese & Nozaic , 2004) Due to chlorine decay and its reaction with various substances in water and on pipe walls, a much higher concentration at entry is required to achieve a desirable range of chlorine concentration at the DWDS' extremities (Blokkera, et al., 2014; Gibbs, et al., 2006). Therefore, utilities should manage chlorine dosage to have enough residual left at the end of distribution systems and on the other hand refuse customer complaints, corrosion of the pipe or the formation of by-products including trihalomethanes (THMs) suspected carcinogens. Generally, monitoring residual chlorine and coliform levels in the distribution network leads operators to control the chlorine dosing rate at a Water Treatment Plant (WTP) (Gibbs, et al., 2006). The free residual chlorine is by definition the effective chlorine that should be available at