Improving the efficiency and sustainability of disinfection at a small rural water treatment plant

MNB Momba[1]*, N Makala[1], Z Tyafa[1], BM Brouckaert[2], CA Buckley[2] and PA Thompson[3]
[1]Biochemistry and Microbiology Programme Unit, University of Fort Hare, P/Bag X1314, Alice 5700, South Africa
[2]Pollution Research Group, School of Chemical Engineering, University of KwaZulu Natal, Durban 404, South Africa
[3]Umgeni Water, PO Box 9, Pietermaritzburg 3200, South Africa

Abstract

The Alice Water Treatment Plant (AWTP) has several operating problems, which often result in poor turbidity removal and inadequate disinfection residual. Some progress has been made in upgrading the skills of plant operators, but the plant performance has failed to improve because of faulty equipment, a shortage of maintenance staff and treatment chemicals that are not delivered in time. The coagulant-dosing pump was found to be malfunctioning for an extended period of time resulting in overdose problems. The self-backwashing filters were no longer backwashing as per design and were producing poor quality filtrate. This in turn increased the chlorine demand and combined with frequent failure of the chlorinators, the plant was producing poor microbiological quality final water. The storage system in the bulk distribution system was investigated and it was found that adequate chlorine residual could be achieved, provided the plant problems were rectified. The difficulties experienced in training and retaining adequately skilled people to run water treatment plants in impoverished rural municipalities have been among the major hurdles to providing acceptable water services in these areas. However a partnership between the Universities and the AWTP came up as a possible solution to these problems. It is therefore recommended that rural municipalities consider this approach and strengthen this relationship, as it played a large role in plant improvement

Introduction

The proper maintenance and operation of water supply, treatment and distribution systems is an essential part of any effort to ensure the on-going production and delivery of the highest quality drinking water possible. If a community fails to recognize the need for training and certification of operators in specific treatment processes, professional guidance and technical assistance in system selection, and adequate funding for operation and maintenance, system operation and water quality will suffer (Swartz, 2000).

Recent studies (MacKintosh and Colvin, 2002; Momba et al., 2003b; Momba et al., 2002) have shown that the majority of small water works in South Africa have difficulty providing adequate treatment and disinfection with the result that consumers are at risk of waterborne diseases even from treated water supplies. Both technical and human factors have been reported to be the major causes of the failure of small rural water treatment plants to provide potable water to their consumers. The Alice Water Treatment Plant (AWTP) is one of such small water treatment plants in the Eastern Cape Province that do not produce safe potable water. Preliminary studies performed by Muyima and Ngcakani in 1998 and by Momba and co-workers in 2002 (Momba et al., 2002) indicated that the Alice drinking water was generally of poor quality.

Since June 2002, researchers from the Universities of Fort Hare and Kwazulu Natal and Umgeni Water have been investigating the causes of inadequate disinfection at the AWTP. The study was designed to look at efforts being made to improve water treatment and disinfection practices for the water supply to the town of Alice through the development of a partnership between researchers at the University of Fort Hare and the Nkonkobe Municipality. In the first phase of the study (September 2002-January 2003), several possible causes of inefficient disinfection of the treated water were identified. These included poor dosing of coagulant and chlorine and excessively long storage times for water in some parts of the distribution system (Momba et al., 2003a). The microbiological quality of the finished water from the AWTP (Momba et al., 2003a) and of samples drawn at various points in the distribution system (Momba et al., 2003b) generally did not meet South African Guidelines for drinking water (DWAF, 1996). Various potential pathogenic microorganisms such as *Escherichia coli, Aeromonas hydrophila, Salmonella arizonae, Vibrio fluvialis, Serratia odirifera, Serratia liquiefaciens, Serratia marsecens, Pseudomonas fluorescens and Pseudomonas aeruginosa* were identified from the water samples collected in the on-site reservoir (Momba and Kaleni, 2002) and various points in the distribution systems (Momba et al., 2003b). There was a possibility of the occurrence of the *Vibrio* at the Victoria East Clinic (one of the sites in the distribution system).

The second phase of the project (April 2003-November 2003) concentrated on two issues/activities, firstly establishing the relationship between the plant dosing system performance and the water quality in the bulk distribution system and secondly transferring knowledge and skills to the operators and the Municipality staff to ensure improved operation of the plant can be sustained in the future. Booster chlorination and lowering the operating levels of the treated water reservoirs were considered to ensure adequate chlorine residual is maintained throughout the distribution systems.

Description of the plant

The Alice plant is a conventional water treatment plant, which includes coagulation, flocculation, sedimentation, rapid sand filtration and chlorination. The design capacity of the plant is

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* To whom all correspondence should be addressed.
☎+2740 602-2365; fax: +2740 602-2429; e-mail: MMomba@ufh.ac.za