Classification and quality of groundwater supplies in the Lower Shire Valley, Malawi – Part 2: Classification of borehole water supplies in Chikhwawa, Malawi

AM Grimason*[1,2,4], TK Beattie[3], TD Morse[1,2,3,4], SJ Masangwi[2], GC Jabu[1,2], SC Taulo[1,2] and KK Lungu[1,2]

[1]*Department of Environmental Health, University of Malawi – The Polytechnic, P/B 303 Chichiri, Blantyre, Malawi*

[2]*Centre for Water, Sanitation, Health and Appropriate Technology Development (WASHTED), University of Malawi – The Polytechnic, P/B 303 Chichiri, Blantyre, Malawi*

[3]*Environmental Health, Department of Civil Engineering, University of Strathclyde, Glasgow, UK, G1 0NG*

[4]*Africa Academy for Environmental Health, PO Box 15574, Sinoville 0129, South Africa*

Abstract

This paper compares data gathered from a study of the chemical and bacteriological quality of drinking-water from 28 rural borehole supplies in Chikhwawa, Malawi, with a tiered classification scheme (Class 0 being ideal through to Class III being unsuitable for drinking without prior treatment) developed by investigators from the Institute for Water Quality Studies, Department of Water Affairs and Forestry, South Africa. In general, the majority of borehole water supplies were classified as Class 0 or Class I supplies based upon the chemical analysis and bacteriological examination. However the classification of a borehole water supply was variable and depended upon the parameter, date of sampling and whether or not it was based on the mean or individual concentration. A number of boreholes were classified as II or III as they contained elevated levels of fluoride and nitrate suggesting that consumption over short or prolonged periods of time may lead to adverse or serious health effects, such as skeletal fluorosis in adults and methaemoglobinaemia in infants. Research is required to develop practicable, affordable and sustainable methods to enable villagers to treat Class II/III water supplies and improve the quality of their drinking-water to a class suitable for human consumption.

Keywords: Classification, water, borehole, Malawi, South Africa

INTRODUCTION

Over the last decade an increasing number of studies have been undertaken on the bacteriological and chemical quality of borehole water supplies in Africa. The data accrued by investigators is more often than not compared with the health-based guideline values recommended by the World Health Organization (WHO, 2008). When studies are undertaken in conjunction with European and American investigators, the data presented is often compared with EU and USEPA drinking-water standards. However, it should be noted that these standards are based upon the quality of drinking-water supplied to the consumer's tap after the source water has undergone some degree of conventional treatment. Where national standards exist, investigators have attempted to compare their findings with those standards, but these are invariably those recommended by the WHO. Little attempt has been made to publish drinking-water standards specific to borehole water supplies in Africa.

To address this issue Kempster et al. (1997) undertook a review of South African drinking-water standards and WHO recommendations, and produced a scheme to facilitate the classification of borehole water supplies in rural areas based on single parameters. The rationale behind such a scheme was awareness that 'the boundary between the no-effect level [of constituents] and the threshold for the initial appearance of undesirable effects is not a sharp one' (Kempster et al., 1997 p. 163). In areas of the world under pressure from water resource scarcity, realistically, water quality, both source and treated, can fluctuate on a temporary basis. The scheme was designed with the thought of giving 'a clearer picture of expected effects on the domestic user'. The scheme is based on a select number of aesthetic and health-based parameters that are commonly of concern in drinking-water. On this basis, Kempster et al. produced 4 classes of water quality in terms of suitability for use, ranging from the ideal (Class 0) through to that which is deemed unsuitable for use without further treatment (Class III).

Recently, we undertook a study of the chemical quality of borehole water supplies in Chikhwawa, Malawi (Grimason et al., 2013), and compared our findings with the maximum permissible standards laid down by the Malawi Bureau of Standards for borehole water supplies (MBS, 2005), and the WHO recommended health-based guideline values for drinking-water (WHO, 2008). In this paper we present a summary of the chemical and bacteriological data accrued from that study and compare our findings with the classification scheme proposed by Kempster et al. (1997). We believe that this is the first time that the proposed scheme has been utilised for the classification of borehole supplies outside South Africa.

METHODOLOGY

Eighty-four groundwater samples were collected for chemical analyses from 28 boreholes (n=16 on east bank; n=12 on west

* To whom all correspondence should be addressed.
☎ 00265992303140; e-mail: agrimason@poly.ac.mw or tonygrimason@yahoo.co.uk

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