Cadmium in the Umtata River and the associated health impact of on rural communities who are primary users of water from the river

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Abstract

Trace levels of Cd were determined in Umtata River which may affect human health. The levels of Zn were also determined since Zn can provide partial protection against the toxic effect of Cd in humans. The levels of Cd varied between trace and 0.007 mg/ℓ while that of Zn ranged from trace to 0.019 mg/ℓ. Generally the levels of Cd and Zn found in the river were below the South African water quality guidelines for Cd and Zn, respectively. The hazard quotients for Cd in the river were calculated in order to show the potential health risks of cadmium to local primary users of water from river and the values were within acceptable limits.

Keywords: cadmium, river water, health risk

Introduction

The Umtata River rises in the plateau region of the Eastern Cape, approximately midway between the Drakensberg escarpment and the sea (Fig. 1). The catchment of the river itself is some 100 km long and up to 50 km in breadth. The geology of the catchment is constituted by mudstones and sandstones of the Beaufort Group from the headwaters to about 30 km from the coast, and thence, by shales, mudstones and sandstones of the Ecca Group, with exposures of dolerite intrusions mostly in the higher lying areas (DWAF, 1998a).

The Umtata River provides water and a conduit for effluent disposal in a densely populated area of the Eastern Cape. Water from the Umtata River is used for various purposes by a large population of the Transkei, most of which is rural - domestic (cooking, drinking and washing), agricultural (that is, livestock watering, irrigation is rarely done in the catchment), and recreational purposes (swimming). Other uses such as aquaculture (fishery) and industrial (cooling of engines in the wood industry) are less significant (Fatoki and Muyima, 2003). One of its major uses is domestic (Fatoki and Muyima, 2003) but is the water fit for its intended uses? The accumulation of metals in an aquatic environment has direct consequences to man and the ecosystem. Cadmium is a common environmental pollutant, which is widely distributed in the aquatic environment. Its sources are mainly from weathering of minerals and soils (Merian 1991); atmospheric deposition from non-ferrous metal mines, smelters and refineries; coal combustion, refuse incineration and iron and steel industries (Merian, 1991); industrial effluents (Prater, 1975); domestic effluents (Preuss and Kollman, 1974); urban storm-water runoff (Field and Lager, 1975) and spoil heaps (Heitfield and Schottler, 1973). The concentration of Cd in unpolluted water is usually less than 0.001 mg/ℓ. The South African guideline for Cd is 0.005 mg/ℓ (DWAF, 1996, 1998b).

The water quality situation in the Umtata River regarding Cd has always been cause for concern. The results of a pollution study on Umtata River done between May 1999 and March 2002 (Fatoki and Muyima, 2003) indicated high levels of Cd in the river ranging from 0.01 mg/ℓ to 0.08 mg/ℓ for representative data (Table 5), which is an order of magnitude higher than the guideline value. Probable sources of Cd in the catchment at the time include:

- Chemical waste discharge from a wood processing factory situated near the source of the river (however the head of factory denied ever discharging waste directly into the river).
- Urban runoff.
- Nickel-cadmium based batteries from the rural communities that had been disposed of in the waste disposal sites.
- Runoff from runoff from agricultural soils in the catchment that used phosphate fertilisers (Cd is a common impurity in phosphate fertilisers).
- Effluent discharge from Umtata Sewage Treatment Plant.
- Natural source due to the geology of the catchment.

The high levels of Cd in the river have given rise to worries that water supplied from the river will be unfit for domestic use and may impact on the "health" of the communities that live on the river banks that depend on it primarily for their domestic water supply.

The following recommendations were then made aimed at preventing or reducing Cd pollution in the Umtata River:

- Monitoring and removal of wastes close to the river banks.
- Management of agricultural practices in such a way as to control the use of pesticides and fertilisers.
- A valid permit to be obtained by the Umtata Sewage Treatment Plant to comply with DWAF effluent regulations according to the National Water Act, 1998.
- Development and implementation of routine education programmes to the rural community on the need to prevent pollution of the river.

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