Elemental Iron ($\text{Fe}^0$) for Better Drinking Water in Rural Areas of Developing Countries

Chicgoua Noubactep$^{1,2}$ and P. Woaf$^3$

$^1$ Angewandte Geologie, Universität Göttingen, Goldschmidtstraße 3, D - 37077 Göttingen, Germany
$^2$ Kultur und Nachhaltige Entwicklung CDD e.V., s/c S.M. Youmbi Peka, Bonhoefferweg 2, D - 37075 Göttingen
$^3$ Laboratory of Modelling and Simulation in Engineering and Biological Physics, Faculty of Science, University of Yaounde I, Box 812 Yaounde, Cameroon

Abstract. Many of the reasons behind the anthropogenic contamination problems in rural environments of developing countries lie in changes in the traditional way of life and the ignorance on the toxic potential of introduced manufactured products. A generalization trend exists within the international community suggesting that water in developing countries is of poor quality. However, the water quality is rarely analytically determined. Existing potabilization solutions may be prohibitively expensive for the rural populations. Therefore, efficient and affordable technologies are still needed to ameliorate the water quality. In the recent two decades, elemental iron has shown the capacity to remove all possible contaminants (including viruses) from the groundwater. This paper presents a concept to scale down the conventional iron barrier technology to meet the requirements of small communities and households in rural environments worldwide.

Introduction

Water is essential to life and its quality is a major issue in sustainable development (Gadgil 1998). In humid areas of developing countries water problems are currently reported to be related more to quality preservation than to shortages (e.g., Brown 2007, Garcia 2007). Guidelines have been developed for maximum acceptable values for a number of contaminants in drinking water (WHO 2004). Specific guidelines are presented for acceptable concentrations of (i) bacteria, viruses, and parasites; (ii) chemicals of health significance including specific inorganic and
organic constituents, pesticides, disinfectants, and disinfection by-products; (iii) radioactive constituents; and (iv) substances and parameters in drinking water that may give rise to complaints from consumers. Availability of plentiful and safe water for domestic use has long been known to be fundamental to the development process, with benefits spreading across all sectors, such as labour productivity and obviously health sector. It has been shown that the most common and deadly pollutants in the drinking water in developing countries are of biological origin.

The population in the developing world suffers from six main diseases associated with water supply and sanitation (i) Diarrhea, (ii) *Ascaris*, (iii) *Dracunculiasis*, (iv) *Hookworm*, (v) *Schistosomiasis*, and (vi) Trachoma (Gadgil 1998, Sobsey et al. 2008). Many of the poorest people in developing countries must collect water outside the home and are responsible for treating and storing it themselves at the household level. This practice is a serious public health issue and has been addressed in the Millennium Development Goals, which aim to halve, by 2015, the proportion of people without access to safe water in 2000 (UN 2000). Looking toward the future, the water management must involve promoting improved international cooperation (Brown 2007, Micklin 1996).

One of the internationally recommended action to improve water management is water pricing. Water pricing is considered as a key tool: (i) to promote water use efficiency, (ii) to prevent water pollution, and (iii) to make for a more rational allocation of water (Micklin 1996, Sobsey et al. 2008). The idea behind water pricing is that the more one pays for water, the more careful he will use it. The more one must pay to pollute water, the less he will pollute. Economists have long advocated water pricing as helpful key to solve water resource use problems. For water pricing to be effective, water laws and institutions that inhibit formation of open water markets, have been reformed. Comprehensive and accurate water measuring system are currently established where it does not exist. At the end of the chain produced water should be affordable also for poor people, unless the goal of making potable water available could not be achieved. Thus, the question arises how sustainable is water pricing for developing countries?

Rural environments in developing countries have been reported to suffer from aching chemical pollution problems mostly from anthropogenic nature. Many of the reasons behind the chemical anthropogenic problems lie in changes in the traditional way of life and the ignorance on the toxic potential of recently introduced industrially manufactured products (Noubactep 2008a). Frequently, the sole available income generation activities (mining activities, intensive agriculture) are the source of water chemical pollution. Traditionally, there are three main sources of drinking water in rural areas: (i) rain water, (ii) surface water (spring, stream, river), and (iii) shallow groundwater (well). A recent development throughout the world is the installation of drilled wells with mechanic pumps. Drilled wells is considered as the best solution for bringing clean and quality water to surface. But the actual cost (about € 6000 or US$ 9500 each drilled well in Cameroon for example) is prohibitively expensive for many small communities. Therefore, the drinking water problem for developing countries is far from been solved. Ideally, all available water sources (rain water, surface water and shallow groundwater)