

The anaerobic baffled reactor (ABR): An appropriate technology for on-site sanitation

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Abstract

This project has studied the appropriateness of the ABR for on-site primary sanitation in low-income communities. The baffled design of the ABR ensures high solids retention resulting in high treatment rates, while the overall sludge production is characteristically low. Effluent COD values measured from a 3 000 ℓ pilot ABR using domestic wastewater at a wastewater treatment works were consistently below 200 mgCOD/ℓ at an HRT of 22 h, and a 1 log reduction of pathogen indicator organisms (*E. coli* and total coliforms) was observed. Analysis of results indicates that the operating flow rate was too high to allow complete fermentation of particulate COD; it is expected that better COD and pathogen removal will be obtained at smaller hydraulic/organic loads. This paper presents results obtained for a 5 month analytical period at a single operating point. Operational and institutional issues relating to the appropriateness of the technology for on-site sanitation are explored, as well as the acceptability of the technology to target communities. Health related aspects associated with reuse of the effluent for agricultural purposes are discussed.

Introduction

Water and sanitation provision in South Africa faces some stiff challenges in the next 20 years: South Africa has been classified as a category I water scarce country; we will experience severe water scarcity by 2025 (Seckler et al., 1999). At the same time, the South African government is in the process of implementing a programme of free basic water for all in which every household has the right to 200 ℓ/d free, safe, potable water (DWAF, 2003). In many rural and informal urban areas, there are insufficient formal sanitation services; in 2001, 18.1 million people out of a total population of 44.8 million (41%) did not have adequate sanitation services (DWAF, 2003). Rapid urbanization has led to the growth of densely populated informal and semi formal settlements, and local municipal structures in many cases do not have the capacity to formalise the housing arrangements, and provide appropriate sanitation services in the near future. On an environmental level, South Africa has many highly sensitive catchment areas including swamps and lagoons that are regarded as national heritage sites, the ecosystems of which are vulnerable to high nutrient loads and variations in salinity. In this background, the South African Water Research Commission is investigating innovative ways of managing potable water demand, appropriate sanitation and food security to provide for the needs of the population, while minimizing environmental impact.

In the current climate of reuse and recycling of resources, traditional concepts of treatment and disposal are constantly being challenged (Verstraete, 2002). Natural waterways must be protected from disposal of nutrient rich effluents and wastewaters since the presence of elevated nutrient concentrations, particularly nitrogen and phosphorus, results in uncontrolled growth of algae

This paper was originally presented at the 2004 Water Institute of South Africa (WISA) Biennial Conference, Cape Town, South Africa, 2-6 May 2004.

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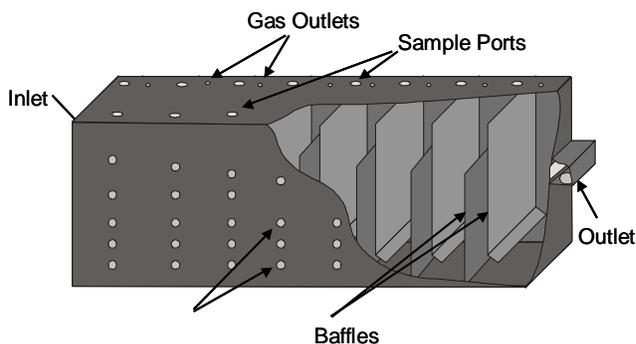


Figure 1

Schematic layout of the pilot ABR, showing hanging and standing baffles

and water plants, causing choking of the water and oxygen depletion in the lower strata of the water way. Great effort and expense are therefore put into nutrient removal processes. However provided nutrients do not eventually contaminate nearby waterways, they may be regarded as a resource, rather than a contaminant in that the irrigation of crops with nutrient rich water will reduce the need for the application of costly fertilisers, thereby reducing wastewater treatment costs, and the cost of crop production (WHO, 1989). However, the financial advantages of irrigation with nutrient rich wastewater can only be achieved if the health of the local community is not jeopardised by the reuse of wastewater.

This project has studied the appropriateness of the anaerobic baffled reactor (ABR) for on-site primary sanitation, particularly in low-income communities. The ABR consists of alternating hanging and standing baffles, which compartmentalise the reactor, and that force the liquid flow up and down from one compartment to the next (Fig. 1). Settling in the upflow region of each compartment results in the retention of high concentrations of biomass and high treatment rates can therefore be obtained, while overall sludge production is characteristically low.