Arsenic retention modelling in subsurface flow constructed wetlands

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INTRODUCTION

The presence of high arsenic concentrations in drinking water has been declared as a major risk to human health in various parts of the world. Recognised health effects include lung, skin and bladder cancer, the blackfoot disease as well as keratosis and skin-pigmentation problems. A suitable treatment of water supplies must face up the arsenic issue.

The best available technologies candidates for drinking water treatment are basically based on physical and chemical processes: filtration, coagulation, ion exchange and inverse osmosis. Their efficiencies in terms of reducing arsenic concentrations from water are very high, but the most important drawback is that their costs are sometimes prohibitive. This fact makes evident the big differences existing between developed and developing countries as well as between urban/periurban and rural areas.

An economically viable and alternative option of treatment is the constructed wetland (CW) technology. CWs have been used for the treatment of a wide set of water. Although their application in arsenic removal from drinking water is relatively new, Rahman (2009) showed that CW systems were highly efficient in removing arsenic. Much has been elucidated in the last few decades about arsenic speciation and the important parameters and processes that affect the speciation and mobility of arsenic under different conditions. However, there still exist some lacks of knowledge about the performance of these systems treating high arsenic waters, basically due to the arsenic retention in these systems involves a large number of physical, chemical and biological processes that take place simultaneously.

Modelling, especially mechanistic mathematical models, has become a powerful tool to better understand the performance of water treatment systems.

The aim of the present contribution is to adapt the finite element code RetrasoCodeBright (RCB) (Saaltink et al., 2004) for the simulation of the most significant arsenic retention processes that take place within horizontal subsurface flow CWs (HSSF CWs).

METHODS

RCB code

RCB is a powerful modelling tool that has been successfully applied in various hydrogeological studies. The code formulates the flow problem in a multiphase approach, which includes porous media composed of solid grains, water and gas. It also enables the simulation of the reactive transport of inorganic dissolved and gaseous species in non-isothermal saturated and unsaturated

problems by finite elements. Llorens et al. (2011a, 2011b) demonstrated that RCB could be used for HSSF CWs simulation satisfactorily.

Model adaptation

RCB is being modified to include the most significant reactions involved in the mobility of arsenic in HSSF CWs. The reactions considered are those exposed by Rahman (2009): adsorption, precipitation, uptake and accumulation by plants and microbial biomass and volatilization as volatile species as a result of microbial and plant actions.

RESULTS AND DISCUSSION

The adaptation of RCB is being done at present. For this reason, we do not still have any results. We are working hard to have them for the Conference.

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