

Modelling of the Transport of Substances through Reactive Porous Materials

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Wastewater treatment is the process of removing contaminants from wastewater. About 1 million houses in Sweden were estimated to have local wastewater treatment systems, with 55% being used full time¹. Recent research has shown that using reactive filter materials, i.e. Polonite and Filtra p is a promising technique for the removal of Phosphorous (P) from domestic wastewater². The purpose of the present study is to develop a model to assess the efficiency and longevity of reactive filter materials for full scale wastewater treatment applications. In this project the flow through such a porous materials and the sorption of substances on to its surfaces will therefore be modelled. Parallel to this project, different experiments with the waste water and phosphate solutions will be carried out. The results from modelling and experiments will be compared leading to refined models and new experimental setups.

The filtration process is considered to involve at least two separate and distinct steps: First, the transport of P compounds (dissolved or solid) or wastewater particles to the solid-liquid interface, and second, the sorption of substances, i.e. dissolved phosphorus compounds or particles to this surface. In water filtration, transport models are being derived which are based on models developed by investigators in air filtration³. Figure 1 shows such a basic transport model in waste water filtration. A suspended particle following a streamline of the flow may come in to contact with the collector by virtue of its own size (case A in Fig 1), which is called interception. The path of the particle is influenced by the combined effect of the buoyant weight of the particle and the fluid drag on particle (case B in Fig 1). Finally for particles smaller than 1μ transportation is accomplished by the random bombardment by molecules of the medium. This transportation is called Brownian diffusion (case C in Fig 1).

In order to model such a filtration process, a transport equation for concentration of P/wastewater particles in combination with their reaction rate equation with filter materials will be solved numerically using Ansys CFX 11 and Matlab.

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¹Palm et al., *JTI Uppdragsrapport, Uppsala*, (2005).

²Gustafsson et al., *J. Water research* **42**, 189 (2008).

³Mu Yao et al., *J. Environ. Sci. Technol.* **5**, 1105 (1971).

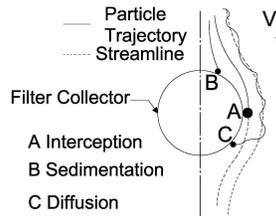


Figure 1: Basic transport mechanism in waste water filtration