DESIGN OF PERMEABLE ADSORBING BARRIER TO MITIGATE HYDRAULIC RISK BY CHROMIUM CONTAMINATED GROUNDWATER

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The use of permeable reactive barriers (PRB) as contaminated groundwater remediation technique is so far becoming a valid alternative to pump and treat systems (Blowes et al., 2000). PRB are specifically adopted for removing highly toxic substances, such as heavy metals (chrome, cadmium, lead, etc...) and chlorinated solvents, widely used in a number of industrial processes.

PRB applications consist in placing within the aquifer reactive porous media, which, by means of physical chemical or biological processes, either retain pollutants or transform them into non toxic substances (Morrison and Spangler, 1993; Gillham and Burris, 1997; Benner, 2000). Various processes may take place inside a PRB: adsorption; ions exchange; precipitation; oxidation-reduction; biodegradation.

Depending on geometry, PRB are called: a) funnel and gate type; b) continuous barrier type (Day et al., 1999). Funnel and gate barriers (Fig. 1a) make use of an impervious funnel shaped barrier, collecting contaminated water flow towards permeable reacting gate. Funnel is usually made of plastic diaphragms, while gate is excavated with buckets and then filled up with reacting medium. Continuous barriers (Fig. 1b), although more expensive, allow interception of entire plume, thus ensuring better efficiency.

Before designing a PRB the study of motion field within contaminated aquifer is mandatory, in order to know pollutant plume spatial and temporal evolution. Once the pollutant to be removed from the aquifer is selected, it is possible to choose the most appropriate reacting/adsorbing medium. Barrier geometrical design is a complex issue, because it depends on chemical processes rate within the barrier, chemical and hydraulic characteristics, site related factors, such as pollution source extension and pollutant amount and concentration. Other PRB features are durability and building technology, in order to optimize its costs.

The design of an adsorbing barrier is shown to depend on hydraulic soil parameters and on physical chemical adsorbing medium parameters. Design criteria are applied to the case of a barrier protecting a shallow aquifer from a point source chromium pollution. Numerical model results show how the introduction of the barrier effectively protects groundwater by significantly reducing chromium concentration peaks.

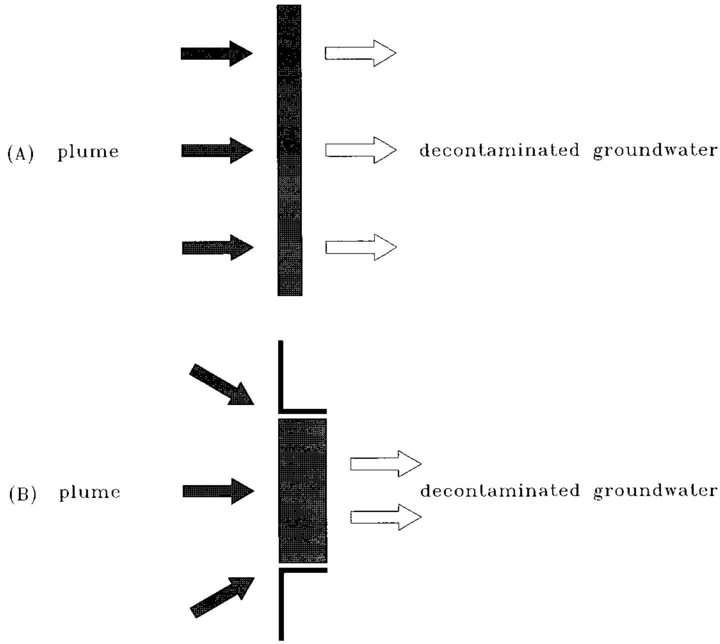

Fig. 1 Sketch of continuous type barrier (A) and funnel and gate barrier (B).

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