DTU Library

Effect of Pumping Strategies on Pesticide Concentrations in Water Abstraction Wells

Aisopou, Angeliki; Bjerg, Poul Løgstrup; Albrechtsen, Hans-Jørgen; Binning, Philip John

Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):
Aisopou, A., Bjerg, P. L., Albrechtsen, H-J., & Binning, P. J. (2013). *Effect of Pumping Strategies on Pesticide Concentrations in Water Abstraction Wells*. Abstract from European Geosciences Union General Assembly 2013, Vienna, Austria.

EFFECT OF PUMPING STRATEGIES ON PESTICIDE CONCENTRATIONS IN DRINKING WATER WELLS

Angeliki Aisopou[1]*, Poul L. Bjerg*[1]*, Hans-Jørgen Albrechtsen*[1] *and Philip J. Binning*[1]

[1] Department of Environmental Engineering, Technical University of Denmark, Denmark

Pesticide use in agriculture is one of the main sources of groundwater contamination and poses an important threat to groundwater abstraction. Pesticides have been detected in 37% of Danish monitoring wells sampled, with 12 % exceeding drinking water guidelines. Field data captured in monitoring and pumping wells show that pesticide concentrations vary greatly in both time and space. This study aimed to use models to determine how pumping affects pesticide concentrations in drinking water wells placed in two hypothetical aquifer systems; a homogeneous layered aquifer and a layered aquifer with a stream. Two pesticides with different application histories, chemical structure and properties were considered: an old pesticide, MCPP (Mecoprop) which is mobile and relatively persistent; and a new pesticide, bentazone, which is persistent and low-sorbing.

Numerical models of contaminant transport in a pumping well capture zone were constructed using COMSOL Multiphysics. A series of simulations were conducted to examine the effect of pumping strategies (constant versus varying pumping rate), pesticide properties and aquifer hydrogeology on the concentration in drinking water wells.

The results of the simulations show that the pumping rate can significantly affect the pesticide breakthrough time and maximum concentration at a drinking water well. The effect of the pumping rate on the pesticide concentration depends on the hydrogeology of the aquifer. For example, in a layered aquifer a high pumping rate results in a considerably different breakthrough than a low pumping rate, while in an aquifer with a stream the pumping rate has an insignificant effect on the breakthrough at the well. The pesticide properties and application history have a great impact on the observed pesticide concentrations. For example, for a sorbing and non-degradable pesticide (e.g., bentazone), the pumping rate is insignificant, while for a sorbing and degradable pesticide (e.g., MCPP) the pumping rate can affect both the maximum concentration and the breakthrough time at the well. The findings of the study show that variable pumping rates can generate temporal variability in the concentration at the well, similar to that observed in groundwater monitoring programmes. The results are also used to provide guidance on the design of pumping and remediation strategies for the long-term supply of safe potable groundwater. For example, if application of bentazone in a layered aquifer stops today, the concentration at the well will continue to grow for 20 years if a low pumping rate is applied, while the decay will be immediate for a high pumping rate. However, for both pumping rates it will take more than 50 years for the pesticide to be flushed out of the aquifer. This study concludes that well head management of pumping strategies is as important as catchment management for controlling pesticide concentrations in water supply wells and that the approach developed can guide the selection of pesticde monitoring well locations for the protection of drinking water wells.

Contact Information: Angeliki Aisopou, Department of Environmental Engineering, Technical University of Denmark, Miljoevej, Building 113, DK – 2800 Kgs. Lyngby, Denmark. Email: agea@env.dtu.dk.