Indicators to identify the source of pesticide contamination to groundwater

Thorling, Lærke; Brüsch, Walter; Tuxen, Nina; Roost, Sandra; Aisopou, Angeliki; Binning, Philip John; Bjerg, Poul Løgstrup; Smith, Katrine; Svendsen, Tove; Olesen, Ida H.

Publication date:
2015

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

Indicators to identify the source of pesticide contamination to groundwater

Lærke Thorling[1], Walter Brüsch[1], Nina Tuxen[2], Sandra Roost[2,*], Angelina Aisopou[3], Philip J. Binning[3], Poul L. Bjerg[3], Katrine Smith[4], Tove Svendsen[5], Ida H. Olesen[5]

[1]GEUS, Lyseng Alle 1, 8270 Højbjerg, Denmark [2]Orbicon A/S, Ringstedvej 20, 4000 Roskilde, Denmark, [3]Technical University of Denmark , Dept of Environmental Engineering, Building 113, Miljoevej, 2800 Kgs. Lyngby, Denmark, , [4]Danish Ministry of the Environment, Strandgade 29, 1401 Copenhagen K, Denmark, [5]Region of Southern Denmark, Damhaven 12, 7100 Vejle, Denmark,

In Denmark groundwater is synonym with drinking water. The mainstream Danish political approach favors prevention and action at source over advanced treatments of polluted groundwater. The main pollutants are nitrate and pesticides. Pesticides in groundwater can originate from either diffuse or point sources. Point sources are characterized by high pesticide concentrations leaching from small areas, while diffuse sources are characterized by low concentrations over large areas. Some source types can either be termed diffuse or point sources, e.g. line sources (uses at railways) or more intensive diffuse sources (clean keeping of farm yards). It is important to determine the source type in order to make correct management decisions.

This project aimed to identify and develop a set of indicators that can be used to determine whether pesticides detected in a groundwater sample (e.g. in a monitoring or abstraction well) originate from a diffuse or a point source.

Conclusion

Historical data on pesticide sales in Denmark are a good indicator of the quantity and types pesticides that have been used over time.

A statistical assessment showed that the distribution of sum concentrations and max concentrations clearly show that findings from point sources have higher concentrations than findings from diffuse sources. Here, “high” concentrations are considered to be > 1.0 μg/l, and “low” concentrations < 0.05 μg/l. The number of compounds detected in samples from point sources and diffuse sources also differ. Therefore, a useful indicator for point sources was defined: if a groundwater sample has findings of ≥4 compounds, and/or at ≥ 2 compounds above 0.1μg/l.

Model results show that the breakthrough curves from point and diffuse sources differ, with diffuse sources resulting in flat breakthrough curves, while point sources results in steeper breakthrough curve. Model results also show that the spatial variability of pesticide concentration data is different for diffuse and point sources. Large variations of the same compound can indicate a point source.

The outcome of the project is a set of indicators the origin of pesticides: from a diffuse source or a point source -and these are shown in the figure below. The indicators can only be used one-way; a “YES” implies the given result, but a “NO” answer does not imply any conclusion on the question posed.

The indicators have been used around AArhus to identify whether pesticide findings originate from diffuse sources or point sources. This will have implications for future groundwater protection initiatives.