

# Analytical solutions of the convection–dispersion equation applied to transport of pesticides in soil columns

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## Abstract

Mathematical solutions are presented to describe leaching and degradation of pesticides in a specific type of column experiment, which is frequently required for the official registration of pesticides. In the column experiment in question a 2 cm layer of soil containing a known amount of the pesticide is placed on top of a soil column with a length of 28 cm. Water is added to the layer on top of the column for a certain period at a constant rate, while allowing free drainage at the bottom of the column. This induces leaching of the compound from the top layer. The mathematical solutions presented allow interpretation of the experiment in terms of the half-life and the sorption coefficient of the compound from the measured amount in the leachate and the amount remaining in the column after leaching. Example calculations are carried out for the German and US leaching scenarios, which are currently used in admission procedures for new and existing pesticides. It is concluded that, for a standard soil with an organic carbon content of 0.01 kg kg<sup>-1</sup>, the German BBA guidelines are suitable to estimate half-lives ( $T_{50}$ ) and sorption coefficients ( $K_{oc}$ ), for compounds with  $T_{50} < 20$  days and  $K_{oc} < 0.06$  m<sup>3</sup> kg<sup>-1</sup>. An alternative leaching scenario, as described in the US–EPA guidelines seems to be useful to estimate  $T_{50}$  in the range 10–250 days and  $K_{oc}$  in the range 0.05–0.20 m<sup>3</sup> kg<sup>-1</sup>. © 1998 Elsevier Science Ltd. All rights reserved.

**Keywords:** Environmental fate; Leaching experiments; Mathematical modelling; Organic contaminants

## Software availability

Name of software:	TRASUM	Year first available:	1998
Developer and contact address:		Hardware required:	IBM PC Intel 386 or better with at least 640 KB RAM and 10 MB free harddisk space
Fortran version:	E.J.M. Veling, Delft University of Technology, Faculty of Civil Engineering and Geosciences, Section for Hydrology and Ecology, P.O. Box 5048, 2600 GA Delft, The Netherlands E-mail: ed.veling@ct.tudelft.nl	Software required:	MS–DOS 3.3 or later; for displaying diagrams included in this paper: XY for DOS (Van Heerden and Tiktak, 1994).
Pascal version:	J.I. Freijer, National Institute of Public Health and the Environment, P.O. Box 1, 3720 BA, Bilthoven, The Netherlands	Program language:	Borland Turbo Pascal v5.0 or later (2192 lines); Fortran 77 (2178 lines).
		Program size:	51 KB (Pascal version).
		Availability and cost:	Code and executable available on request, free of charge.

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