

POLLUTE

Version 8

Example 13: Comparison with Analytical Method



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Version 8

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Description

In this example the results of POLLUTE are compared to those obtained by the analytical solution given by TDAST. TDAST is a computer program for 2-D plane dispersion in an infinitely deep porous media, developed by Javandel et al. (1984). An infinitely thick layer is considered, however for comparison purposes the calculations will be restricted to the first 10 m. Below the layer the bottom boundary is assumed to extend to infinity and have the same properties as the layer above.

The following parameters are assumed for the example:

Property	Symbol	Value	Units
Darcy Velocity	v_a	1.0	m/a
Diffusion Coefficient	D	0.01	m ² /a
Distribution Coefficient	K_d	0	cm ³ /g
Soil Porosity	n	1	-
Dry Density		0	g/cm ³
Soil Layer Thickness	<u>H</u>	10	m
Number of Sub-layers		20	-
Source Concentration	c_0	1	g/L
Times of Interest		4	a

Data Entry

Open the Examples project and open Case 13.

General Tab

Run Auto On Off Save Save As

General Layers Boundaries Special Features Subsurface Model

General Information

Model Title: Case 13: Comparison with analytical method

Maximum Depth: 10 m

Darcy Velocity: 1 m/year

Laplace Transform Parameters

TAU: 7 N: 100 SIG: 0 RNU: 10

Run Parameters

Output Units

Time Units: year Depth Units: m Concentration Units: mg/L

☐ All Depths ☒ Specified Depths

☒ Concentrations at Specified Times ☐ Maximum Concentrations

+ Add X Delete

Depth	Units
0.5	m
1	m
1.5	m
2	m
2.5	m
3	m
3.5	m
4	m
4.5	m
5	m
6	m
7	m
8	m
9	m
10	m

+ Add X Delete

Time	Units
4	year


The general data for this example can be specified on the General tab. In this example there is one layer and the Darcy velocity is 1 m/a. The times and depths to calculate the concentrations can be specified at the bottom of this tab. menu. In this example the concentrations will be calculated at 4 years and at 14 depths from 0.5 to 10 m.

Layers Tab

Run Auto On Off Save Save As

General Layers Boundaries Special Features Subsurface Model

+ Add X Delete Copy Paste Move Down Move Up

Name	Sublayers	Thickness	Thickness Units	Dry Density	Density Units	Porosity	Hydrodynamic Dispersion Coefficient	Dispersion Units	Distribution Coefficient	Distribution Units	Fractures	Symbol
Soil	20	10	m	0	g/cm ³	1	0.01	m ² /a	0	m ³ /kg	None	

The layer data for the layer can be specified on the Layers tab. When there is no sorption (i.e., the distribution coefficient is zero) the dry density is not used and can be specified as zero.

Boundaries Tab

Run Auto On Off Save Save As

General Layers Boundaries Special Features Subsurface Model


Top Boundary

☐ Zero Flux
☒ Constant Concentration
☐ Finite Mass

Concentration

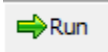
Bottom Boundary

☐ Zero Flux
☐ Constant Concentration
☐ Fixed Outflow Velocity
☒ Infinite Thickness

Base Symbol 

The boundary conditions for the model can be specified on the Boundaries tab. In this example, the top boundary has a constant concentration and the bottom boundary is represented by a layer of infinite thickness.

Model Execution



To run the model and calculate the concentrations press the Run button on the toolbar.

Model Output

After the model has been executed, the output for the model will be displayed.

Output Comparison

The results given by TDAST can be compared to the output by creating a new imported dataset using [File > New > Imported Dataset](#).

Create New Dataset

Name:

Time Units: Concentration Units:

Depth Units:

+ Add - Delete

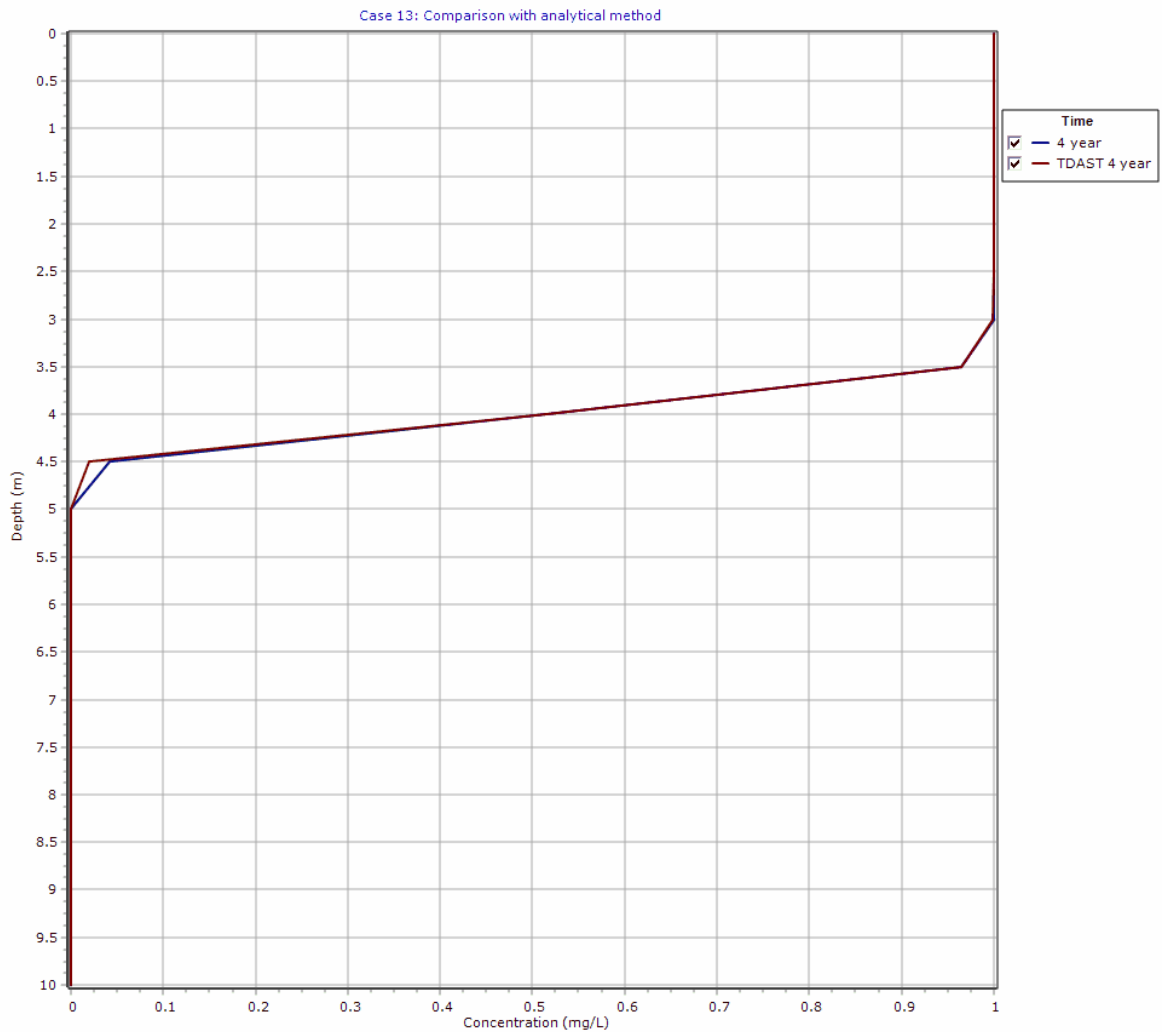
Time	Depth	Concentration
4	0	1
4	0.5	1
4	1	1
4	1.5	1
4	2	1
4	2.5	1
4	3	0.999
4	3.5	0.965
4	4	0.514
4	4.5	.02
4	5	0.0003
4	6	0
4	7	0
4	8	0
4	9	0
4	10	0

OK Cancel Help

Concentrations obtained by both methods are in close agreement for a dispersion coefficient of $0.01 \text{ m}^2/\text{a}$. However, it should be noted that at higher values of dispersion coefficient, for example 5 or $10 \text{ m}^2/\text{a}$, the POLLUTE program will not give the same result as TDAST. This is because POLLUTE considers only 1-dimensional migration in the layer below the source, whereas TDAST considers 2-dimensional migration.

Depth vs Concentration

The Depth vs Concentration chart can be displayed by selecting the Depth vs Concentration item for the Chart Type.



Output Listing

To display the output as a text listing that will show the calculated concentrations as numbers, click on the List tab.

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Case 13: Comparison with analytical method

THE DARCY VELOCITY (Flux) THROUGH THE LAYERS $V_a = 1$ m/year

Layer Properties

Layer	Thickness	Number of Sublayers	Coefficient of Hydrodynamic Dispersion	Matrix Porosity	Distribution Coefficient	Dry Density
Soil	10 m	20	0.01 m ² /a	1	0 m ³ /kg	0 g/cm ³

Boundary Conditions

Constant Concentration

Source Concentration = 1 mg/L

Infinite Thickness Bottom Boundary

Laplace Transform Parameters

TAU = 7 N = 100 SIG = 0 RNU = 10

Calculated Concentrations at Selected Times and Depths

Time year	Depth m	Concentration mg/L
4	0.000E+00	1.000E+00
	5.000E-01	1.000E+00
	1.000E+00	1.000E+00
	1.500E+00	1.000E+00
	2.000E+00	1.000E+00
	2.500E+00	1.000E+00
	3.000E+00	9.998E-01
	3.500E+00	9.646E-01
	4.000E+00	5.141E-01
	4.500E+00	4.133E-02
	5.000E+00	2.277E-04
	6.000E+00	1.928E-09
	7.000E+00	1.927E-09
	8.000E+00	1.927E-09
	9.000E+00	1.927E-09
	1.000E+01	1.927E-09

NOTICE

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