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Tracer tests with artificial tritium to derive hydraulic properties of constructed wetlands.

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Constructed wetlands technology (Kadlec and Knight, 1996) is a cost-effective and environmentally friendly method used world-wide to treat wastewaters of different origins. Efficiency of soluble pollutants removal is thus primarily related to the extent of contact between wastewaters and the reactive surfaces. Knowledge of hydraulic properties is therefore a prerequisite for studies of constructed wetlands functioning (Wachniew & Rozanski, 2002). Tracer technique is a valuable tool used to gain insight into wastewater flow phenomena in constructed wetlands. Residence time distribution (RTD) obtained as a breakthrough curve of a non-reactive tracer carries synthetic information on wetland hydraulic properties. Quantitative wetland characteristics are derived with help of an assumed mathematical model of wastewater flow.

This work summarizes tracer test performed with tritium and bromide (KBr) in a constructed wetland in Poland: horizontal subsurface-flow system with *Phragmites australis* in Nowa Slupia. Fig. 1 presents results of the test obtained for one of three parallel cells of the Nowa Slupia wetland. Solid line represents RTD fitted to experimental results on the basis of the Multi Flow Dispersion Model (Maloszewski et al., manuscript in preparation). Four peaks of the RTD presented on Fig. 1 reflect contribution of four components to the total flow through wetland cell. Three components are related to subsurface flow, the fourth component was identified as corresponding to surface flow. Hydraulic parameters (mean water travel times, water volumes, dispersion numbers) were derived for all flow components through each of wetland cells (see Table 1).

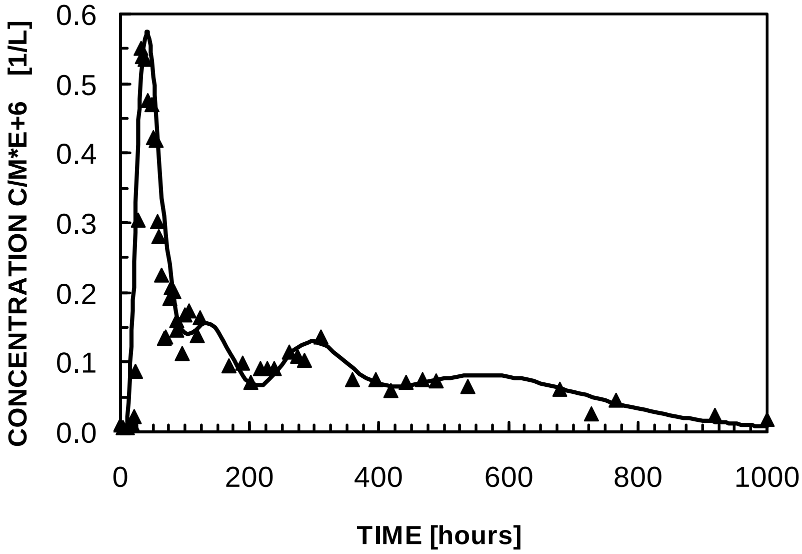

Fig. 1. Normalized output concentrations of tritium for one of cells of the Nowa Slupia wetland (triangles) and the fitted RTD (line).

Table 1. Model parameters fitted to the experimental RTDs for all flow components: mean water travel time - τ[h], dispersion parameter – P_D, relative contribution of the cell to the total flow – p.

		bromide			**tritium**		
		τ	**P_D**	**p**	**τ**	**P_D**	**p**
	Flowpath 1	66	0.05	0.59	69	0.05	0.67
Cell 1	Flowpath 2	130	0.03	0.21	132	0.03	0.19
	Flowpath 3	258	0.04	0.12	252	0.03	0.08
	Surface flow	650	0.04	0.08	560	0.04	0.06
	Flowpath 1	95	0.16	0.35	93	0.13	0.42
Cell 2	Flowpath 2	236	0.03	0.25	229	0.03	0.29
	Flowpath 3	488	0.02	0.17	433	0.01	0.10
	Surface flow	780	0.03	0.23	710	0.01	0.19
	Flowpath 1	60	0.13	0.25	56	0.11	0.32
Cell 3	Flowpath 2	156	0.03	0.15	156	0.03	0.15
	Flowpath 3	312	0.02	0.22	312	0.02	0.19
	Surface flow	650	0.03	0.38	650	0.04	0.33

Simultaneous use of two tracers allowed for comparison of their suitability for tracer tests in constructed wetlands. Differences in recoveries of tritium and bromide are related to evapotranspirative loss of tritium from the wetland.

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