



## Go with the Flow: Advanced Flow Cell and Scanner Instrumentation

A new two-dimensional flow cell and a dual-energy gamma radiation scanner/detector combination is providing unique subsurface flow and transport experimentation opportunities for users of the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), a DOE Office of Science national user facility. This new instrumentation along with the highly trained staff needed to design, execute, and model experiments using this equipment is available, with approved access, at no cost to researchers around the world who plan to publish their results in the open literature.

Pacific Northwest National Laboratory scientists Mart Oostrom and Tom Wietsma at the Subsurface Flow & Transport Experimental Laboratory within EMSL developed the third-generation flow cell/scanner combination for intermediate-scale experimentation with saturated and unsaturated porous media. The flow cell chamber, resembling a large double-paned window in a metal frame, is packed with layers of soil sediments between the two panes of glass in the exact media, order, and percentages as the sediments determined to exist in the actual study area. The liquid contaminant is injected at the top of the flow cell and saturates the sediments, interacting with the environment on a meter scale as it would in the natural setting. Water tables can also be modeled within the flow cell. The dual-energy gamma radiation system can simultaneously and nondestructively measure the saturation of two immiscible fluids; determine bulk density and water content; and measure water content and salt concentration.

Detailed flow cell experiments such as those to investigate the flow and transport behavior of a complex dense nonaqueous phase liquid containing carbon tetrachloride in heterogeneous Hanford porous materials will aid in the remediation of the Hanford Site. Experiments can incorporate a remediation component, for example, where the soil vapor extraction technique is used to remove carbon tetrachloride from the unsaturated zone.

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