SIMULATION OF GROUND WATER SYSTEMS WITH ANALOG MODELS[1/]

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ABSTRACT

Prior to the middle 1950's, analog modeling of ground-water systems was limited to the consideration of the steady-state response of aquifers whose permeability distribution was necessarily considered to be homogeneous and isotropic. Since that time, analog modeling capabilities have rapidly expanded to include the consideration of time dependent, non-homogeneous, non-isotropic systems with non-linear boundary conditions.

Today, a really extensive ground-water systems can be simulated with networks consisting of several tens of thousands of resistors and capacitors that approximate the layering of many aquifers and confining zones. Equipment used to impose pumping and recharge stresses to the modeled system has developed to the point where as many as 6,000 to 10,000 independent input functions can be economically imposed on the models. Non-linear boundary conditions can be simulated by using passive electronic devices whose electrical characteristics realistically simulate such hydrologic functions as recoverable evapotranspiration losses, the transition from confined to unconfined storage coefficient, and flow through the unsaturated zone.

A hybrid computing system using a relatively small digital computer in conjunction with the large multi-layer analog model is now being developed by the U.S. Geological Survey. That system is designed to select, measure, plot, and contour water-level data from the models, and to impose on the models pumping, recharge, and other stress functions. The hybrid system is designed to be interactive, with the hydrologist controlling the programming of the analog model with the digital computer, and appraising the output of the model through displays made available from the digital computer.

In the future, analog modeling undoubtedly will be of great value to the hydrologist in evaluating complex, multi-layered ground-water systems with non-linear boundaries: and with the development of hybrid capabilities, problems involving dispersion of mass transport can also be studied.

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