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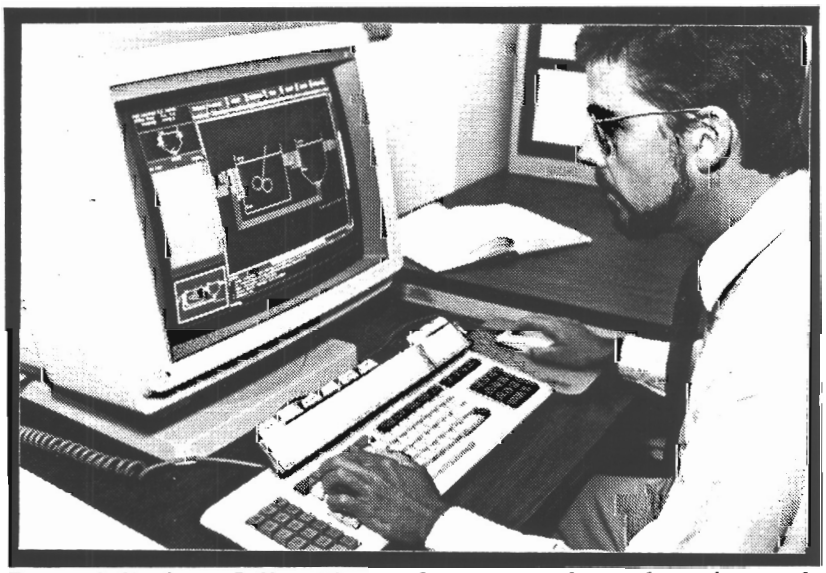
NEW SIMULATION SYSTEM HELPS ENVIRONMENTAL ENGINEERS CONSIDER OPTIONS; CUT COSTS FOR WASTEWATER TREATMENT PLANTS

A powerful computer simulator originally developed for troubleshooting complex military electronic systems may find a new use helping environmental engineers improve the performance and lower both the capital and operating costs of wastewater treatment facilities.

The result could be cleaner waterways, more efficient treatment systems -- and better use of scarce municipal construction funds, say researchers developing the simulator system at the Georgia Institute of Technology.



Research Engineer Jeffrey Murray demonstrates how schematics can be produced on the wastewater simulator. A reactor and clarifier are shown with connecting piping. (Color/B&W Available)

"This simulation capability will allow us to do a much more effective job of evaluating wastewater treatment systems for removal of organic matter and biological nutrients," said Dr. F. Michael Saunders, professor of Civil Engineering and coordinator of Georgia Tech's Environmental Engineering Program. "It will allow the design engineer to do a better job of considering all design options, and it will allow a facility operator to look at how an existing system would behave under numerous conditions."

As water quality standards have become more stringent, systems to treat municipal and industrial wastewater have grown increasingly complex. As a result, computer models of their operation must consider more than 13 variables, each

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represented by a differential equation -- and each affecting the other.

In addition, noted Saunders, wastewater treatment systems operate under constantly changing conditions -- meaning engineers must consider the dynamic nature of many variables, including unusual events such as sudden surges of water from thunderstorms.

"It's a straightforward process-engineering problem, but it takes more variables and more complexity than we could ever handle working out equations on a calculator," he added. "We know these plants work, but we don't have the computer modeling tools necessary to make their design a routine process."

The new simulator system would allow engineers and plant operators to study how proposed changes would affect the treatment system without physically altering the real plant. The simulator incorporates a model developed by the International Association on Water Pollution Research & Control to describe the behavior of the systems.

"Our objective is to take that model and put it into an arena where it can be much more flexible, more dynamic and much more user friendly," Saunders added. "We are taking a modeling technique that is well developed from fundamental equations and transporting it into a simulation system that came out of the electronics industry."

The Tech researchers believe the increasing availability of high-performance computers and the growing need to maximize the efficiency of wastewater treatment systems will make simulators a more routine part of an environmental engineer's job.

"We are trying to handle electronically some of the problems environmental engineers are facing on a day-to-day basis," said Jeffrey P. Murray, a research engineer with the Georgia Tech Research Institute. "The simulator will reduce the drudgery and rote work, allowing the engineers to be more creative in coming up with a solution. It could bring the kind of optimization and prefabrication verification that exists in electronics into civil and environmental engineering."

The simulator could be used by design engineers, operators of wastewater plants and even college engineering students learning about design issues. And because it can simulate the complete operation of a proposed new facility, he suggested the simulator could be used by regulatory agencies to ensure the validity of a new design.

"You can save tremendous amounts of money in physical prototyping by trying out multiple scenarios on the computer and then seeing which one holds the most promise," Murray explained. "We have been doing this for a long time in electrical engineering, but not in environmental and civil engineering."

The wastewater simulation system is derived from a software support environment developed by Georgia Tech to help the U.S. Air Force troubleshoot its complex military electronics equipment. A key component of this system is a powerful electronic circuit simulator which is also capable of more generalized problem solving. This capability is exploited in the environmental engineering arena to determine the growth activity of microbes, the effect of adding a more concentrated food stream to a wastewater reactor -- or what may happen if toxic chemicals get into the reactor.

Though the software running it is complex, the system can be used by engineers with little computer experience, Murray said. Environmental engineers use a graphical interface (currently developed on top of Mentor Graphics Corporation computer-aided engineering software) to schematically describe the configuration of tanks, pipes, valves and other components that are part of a proposed system. By answering questions about flow rates, nutrient concentrations, oxygen levels and similar variables, the engineers provide information the computer needs to simulate the treatment system.

"The system will take the schematic information and generate all of the software for the simulator, which in turn will generate the results interactively," he explained. "The users can concentrate on designing the wastewater treatment system rather than dealing with the software. The user is never going to have to see the software code."

Though it now operates on an Apollo workstation, the simulation system could be transferred to other UNIX-based workstations -- or even to the new generation of UNIX-based personal computers.

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