

## MICRO-COMPUTER APPLICATIONS IN ENVIRONMENTAL ENGINEERING

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**Abstract**—Micro-computers can have wide applications for simulating many processes in environmental engineering. Micro-computers can have potential applications in environmental engineering for (i) selection of the best optimized water distribution network models, (ii) selection of the best optimized sewerage network models, (iii) forecasting of chemical water quality variables in surface water and (iv) modeling of contaminant transport into groundwater.

### INTRODUCTION

Micro-computers are finding an increasing application in solving many environmental problems. The following are the areas where micro-computers can be best utilized for simulating and forecasting processes in environmental engineering:

1. Forecasting of water quality in rivers and streams.
2. Forecasting of wastewater treatment plant performance.
3. Modeling and simulation of air quality.
4. Simulation and modeling of groundwater contaminant transport.

#### *(A) Forecasting of surface water quality utilizing micro-computers*

Micro-computers can have a potential application in monitoring surface water quality. Surface water quality variables vary spatially and temporally. Many of the models utilized for monitoring surface water quality utilize ordinary and partial differential equations. Models employing differential equations can be run on micro-computers with ease. Uncertainty in surface water quality variables can be forecasted utilizing the random generators on micro-computers [1].

#### *(B) Modeling and forecasting of wastewater treatment plant performance utilizing micro-computers*

Wastewater treatment plant performance can be simulated and modeled utilizing micro-computers. Forecasting of wastewater treatment plant performance is highly essential for assessing the impact of nitrogen and phosphorus present in wastewater on the aquatic growths in rivers and streams. A feasible strategy for the application of micro-computers in forecasting wastewater treatment plant performance is presented in Fig. 1.

#### *(C) Utilization of micro-computers in forecasting dissolved oxygen water quality violations in rivers and streams*

Forecasting of water quality variables in rivers and streams is essential for preventing dissolved oxygen water quality violations in streams and rivers. Probability of violation of the dissolved oxygen water quality standards can be simulated by the utilization of micro-computers. For this purpose, the driving variables of dissolved oxygen in streams and rivers are input to a stochastic dissolved oxygen water quality model and the probable violations of the dissolved oxygen in streams and rivers can be forecasted. A flow sheet for simulating the dissolved oxygen water quality violations in streams and rivers is presented in Fig. 2.

#### *(D) Simulation of probable occurrence of hazardous gaseous spills utilizing micro-computers*

The probable occurrence of hazardous gaseous spills into air can be simulated utilizing micro-computers. For this purpose, gas concentrations are continuously monitored in air utilizing the automated measuring equipment and the information can be continuously fed to a micro-

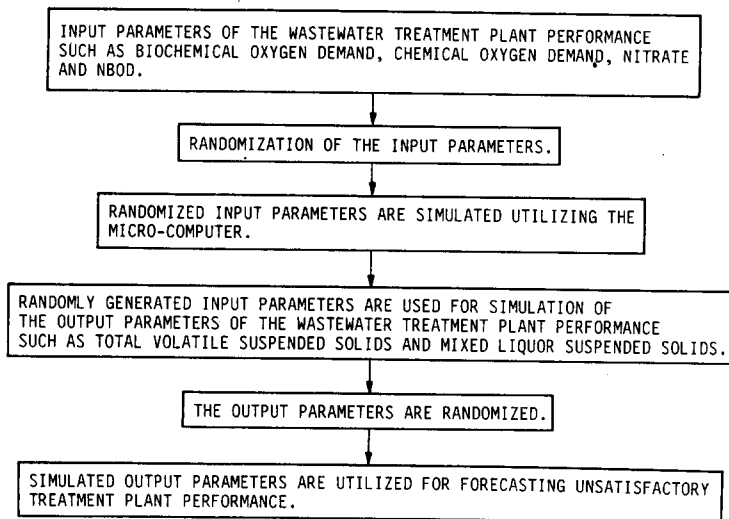


Fig. 1

computer for simulation and modeling of hazardous gaseous spills into air. A feasible strategy for simulation and modeling of hazardous gaseous concentrations in air is shown in Fig. 3.

*(E) Utilization of micro-computers for modeling contaminant transport into groundwater*

Contaminant transport into groundwater can be effectively simulated and modeled utilizing micro-computers. Thus, the possible contamination of groundwater from the leaching of the sanitary landfills and waste dumps can be forecasted utilizing micro-computers. For this purpose, input parameters at the contamination site like the soil characteristics are input to a groundwater contaminant transport model and simulations are then performed utilizing micro-computers for forecasting the transport of contaminants into groundwater. A feasible strategy for utilization of microcomputers for this purpose is shown in Fig. 4.

*(F) Utilization of the micro-computers for forecasting storm water drainage patterns*

Storm water drainage patterns can be effectively forecasted utilizing micro-computers. Forecasting of storm water draining patterns is needed to design sewerage systems for coping with increased volumetric loadings during peak periods of rainfall. For this purpose, available data on storm water drainage patterns during previous years is input to a stochastic model for the simulation of possible storm water drainage patterns during subsequent years. A feasible strategy for forecasting storm water drainage patterns utilizing micro-computers is shown in Fig. 5.

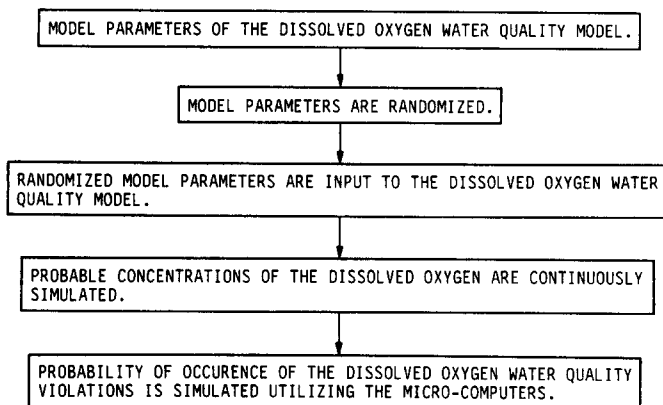


Fig. 2

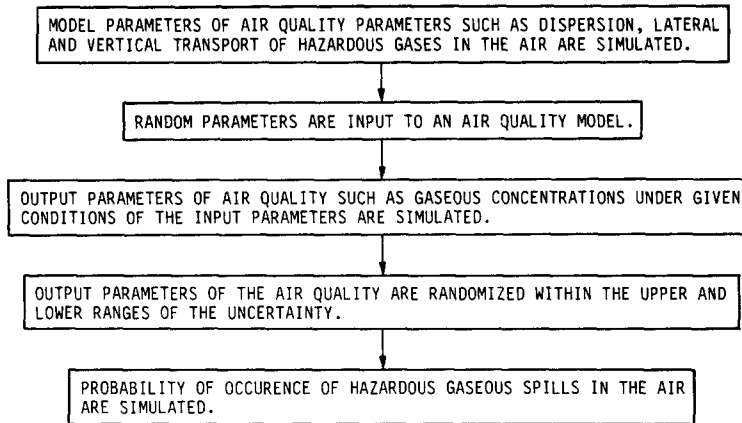


Fig. 3

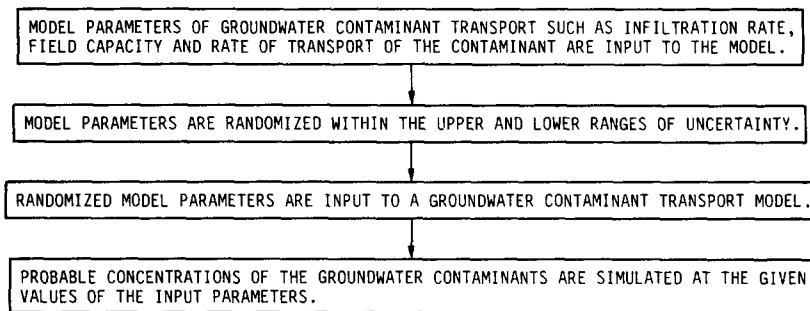


Fig. 4

### (G) Utilization of the micro-computers for the optimization of sewerage systems

Micro-computers can gainfully be employed for optimization of sewerage systems. Optimized sewerage networks need to be simulated for increasing the cost effectiveness of a sewerage network layout. For this purpose, system configurations of several sewerage networks can be simulated on micro-computers and in this way the best optimized sewerage network can be modeled. The best optimized model is then selected on the basis of cost effectiveness and ease of network layout.

### (H) Utilization of micro-computers for optimization of water distribution networks

In a similar way, water distribution networks can be simulated utilizing micro-computers. For this purpose, system configurations of several water distribution network models are simulated. In this way, the best optimized water distribution network model can be simulated which would be the best optimized model in terms of cost effectiveness and piping layout. A flow sheet for the selection of the best optimized model with regard to the cost effectiveness and piping layout is shown in Fig. 6.

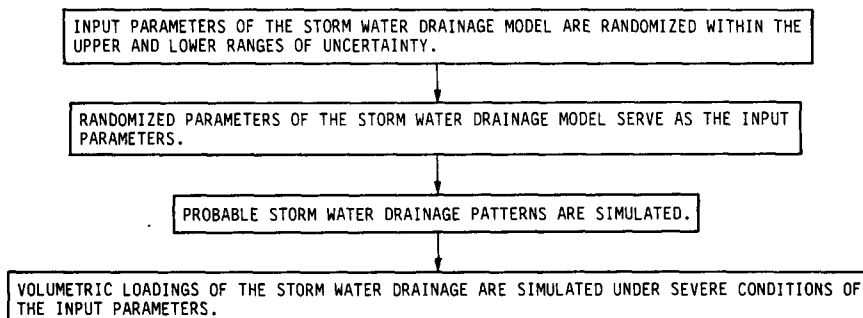


Fig. 5

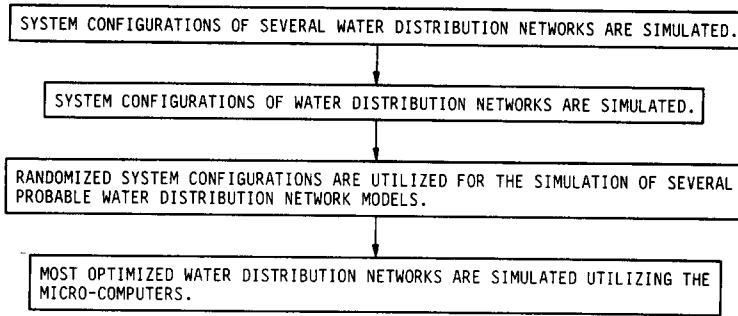


Fig. 6

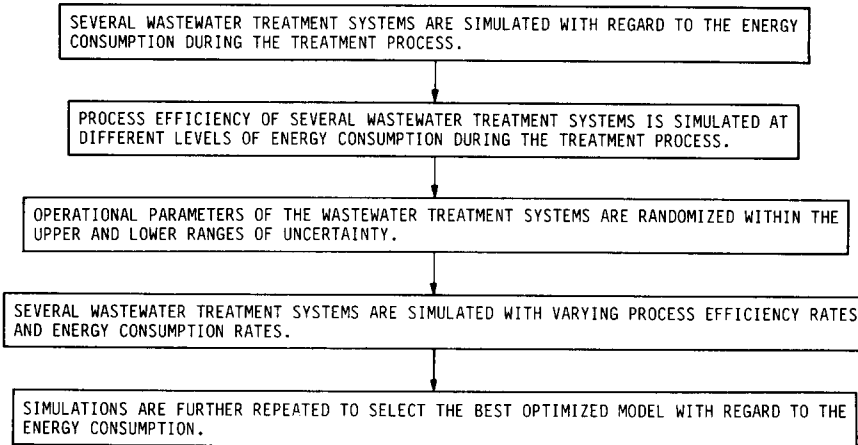


Fig. 7

### (I) Utilization of micro-computers for the energy optimization in wastewater treatment systems

Energy optimization in wastewater treatment systems is essential for reducing the operational costs associated with wastewater treatment systems. Energy consumption in wastewater treatment systems under a variety of operational conditions can be simulated on micro-computers to select the best optimized wastewater treatment system model with regard to the energy consumption and ease of operational maintenance. A strategy for simulation of the best optimized wastewater treatment system model with regard to energy consumption presented in Fig. 7.

## SUMMARY AND CONCLUSIONS

Micro-computers can be gainfully employed for simulation of several processes in Environmental Engineering. The most useful and striking applications of micro-computers in Environmental Engineering are their utilization in forecasting of wastewater treatment plant performance, forecasting of water quality in streams and rivers and energy optimization in wastewater treatment systems. Micro-computers in a similar way can be utilized for optimization of sewerage network systems as well as optimization of water distribution network systems. Hazardous gaseous spills into air and air quality variables can be modeled and simulated utilizing micro-computers.

## REFERENCE

1. S. V. R. Rao and K. F. Willis, Computer aided optimal water sampling strategies for the protection of the aquatic environment from hazardous spills, *Comput. Math. Applic.* (in review).