

AN APPRAISAL OF FOUR DIFFERENT SEWAGE TREATMENT WORKS MODELS

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1. Introduction

Entec UK was commissioned by Northumbrian Water Limited to evaluate a number of sewage treatment works process models available on the market and determine which was the most appropriate package to purchase.

2. Model Requirements

Before this survey was undertaken Northumbrian Water Limited did not have the capacity to undertake modelling of sewage treatment works processes. Northumbrian Water Limited decided to investigate which would be the most appropriate model to purchase based on how the models performed with respect to the following criteria.

- the model should be able to assist in improving operational efficiency of existing sewage treatment works
- the model should be able to assist in improving operational performance of existing sewage treatment works
- the model should be able to be used to model the degradation of domestic and industrial effluent
- the model should be able to assist in the design of new works
- the model should be able to be used in determining discharge pollutant loads as part of urban pollution management studies
- the cost of the model should not be excessive.

3. Models Investigated

Entec obtained information on sewage treatment works process models available in the UK and obtained four different commercially available packages for evaluation purposes only. The packages used in the evaluation are listed overleaf.

- *Biowin*, Envirosim Assoc. Ltd. Oakville. Ontario. Canada, UK distributor: Reid Crowther Consulting Ltd, Reading
- *Stoat*, WRc. Swindon

- *GPS_X*, Hydromantis, Hamilton, Ontario, Canada, UK distributor: Cambridge Controls Ltd, Cambridge.
- *ESP*, OLI Systems Inc., Morris Plains, New Jersey, USA, UK distributor: Davy Energy and Environmental, Stockton-on-Tees.

4. Assessment

Each model was assessed in terms of how well it managed to meet the requirements set by Northumbrian Water Limited and also as to how it compared with other models in terms of computing requirements, structure, operation, performance and versatility.

5. Model Testing

As part of the analysis each package was used to model the performance of an existing sewage treatment works. This enabled an assessment of the ease and accuracy with which each model could be calibrated to simulate the measured performance of the works. Newton Aycliffe sewage treatment works was selected to model as it contains a large number of the separate process units commonly found at sewage treatment works and is the most extensively monitored sewage treatment works in the Northumbrian Water region.

The original intention was to analyse the performance of each model against hourly measured effluent quality data. This was not possible as comprehensive hourly records did not exist. Instead the models steady state performance was tested against composite sample data (taken during one day once a week) averaged over a seven month period from June 1994 to January 1995. The model was then used to see how the model performed using time varying hourly influent flow and quality data. Unfortunately there were no measurements with which to check the accuracy of the dynamic simulations through the sewage treatment works. Nonetheless, the exercise allowed a check on how efficiently each model undertakes dynamic simulation.

6. Conclusions

The study has shown that *Biowin* was inadequate for the types of study that Northumbrian Water Limited require primarily due to its lack of a process model to describe trickling filter processes and the fact that it is a COD and not a BOD based model.

Stoat overcomes such limitations in *Biowin* but has drawbacks in that it does not model COD, comparative slowness of operation and its relatively limited use of control loops.

ESP is primarily a chemical modelling package and is complicated to use for biological treatment. It only models suspended growth process and is of no use in trying to improve or analyse the performance of settlement tanks or trickling filters.

Entec concluded that the *GPS-X* model from Hydromantis most closely met the requirements and uses set by Northumbrian Water Limited. It is significantly more powerful than the other models investigated. It models both BOD and COD, simulates processes in all the major units likely to be encountered within a sewage treatment works, allows simulations to be controlled interactively by using a wide range of control variables, and runs comparatively quickly. The main drawback of *GPS-X* is that it runs on a UNIX

platform and not on a PC. This means that the cost of a UNIX platform must be considered as part of the overall price as Northumbrian Water Limited does not presently have such a machine available.

7. General

It is anticipated that if a sewage treatment works model is used by trained process personnel and targeted wisely to tackle appropriate problems, then there may be significant benefits to water companies in terms of improving plant performance and efficiency. Given the cost of purchasing a process model, water companies and consultancies should carefully consider their needs before selection.

The conclusions made by Entec during this survey only apply to the specific needs expressed by Northumbrian Water Limited. These conclusions may well be inappropriate given other selection criteria. Rapid developments are being made in the mathematical description of processes at work within sewage treatment works and in including these models in sewage treatment works software. It is therefore recommended that companies requiring use of a sewage treatment works model should undertake their own investigation before purchasing software.