Cost optimisation of water treatment works design and operation

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The water industry in England and Wales is one of the most heavily regulated industries and water utilities are faced with increasingly stringent targets for the quality of the water received at customers' taps. Historically, much research and development work has been devoted to process optimisation at laboratory, pilot and full scale.

Numerical modelling of water treatment works (WTW) operation potentially offers a means by which designers or operators can assess the impact of raw water quality variations or process modifications on product quality water, and so provide an indication of risk of compliance failure under different scenarios. However, process modelling of water treatment processes is not particularly well-developed or implemented.

Figure 1 Water treatment works (WTW) in urban environment (Degremont)

The primary aim of the work proposed here is to draw upon previous work to develop a methodology and software tool to minimise operational cost of treatment according to performance characteristics, raw water input and risk acceptance, using a genetic algorithm and Monte Carlo based simulation.

Project aims:

- Build a computational model that can accurately predict the performance of a specific works

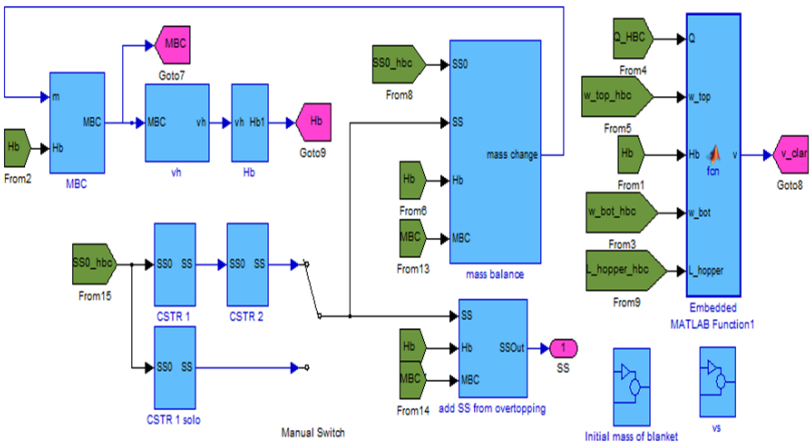

Figure 2 Example of WTW model for sludge blanket clarifier programmed in Matlab/Simulink

- Assess specific works response and reliability based on turbidity; disinfection concentration times contact time (CT) and trihalomethane formation performance criteria, raw water turbidity; temperature and flow rates. Performance will be assessed using Monte-Carlo methods. A population distribution function (PDF) will be assigned to the raw water quality parameters and the performance of the WTW repeatedly assessed. The raw water PDFs will subsequently be altered to provide an indication of system reliability under potential climate change scenarios.

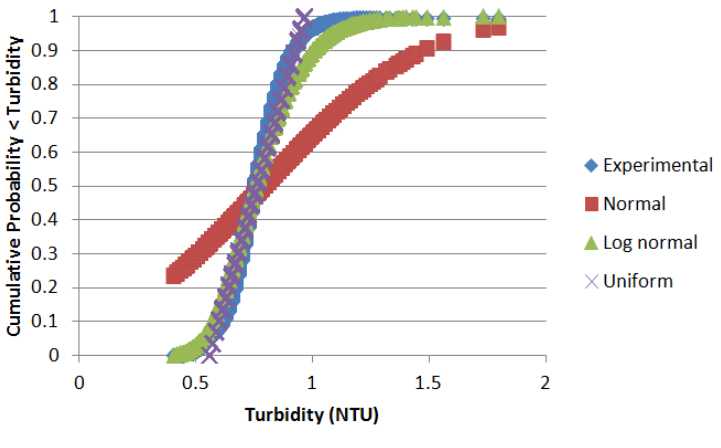

Figure 3 Examples of different probability distribution function (PDF) profiles that could represent turbidity

- Optimise WTW design and operation from an overall cost perspective using a genetic algorithm (GA) technique. After determining the required performance level of a system and providing assets capable of meeting that level, a GA model will minimise an objective function (in this case, total treatment cost) whilst meeting the required performance standard.

Reference: Degremont [online]. www.degremont.co.idprod_drink.htm [Accessed: 17/05/2011].