MANCHESTER 1824
The University of Manchester

WATER Overview

WATER is a software package for designing water systems in the process industries. It helps designers reduce freshwater consumption, identify water re-use, regeneration and recycling opportunities, and design effluent treatment systems that meet environmental requirements at minimum cost. The software supports mass transfer and washing operations, steam systems, cooling systems and other industrial water uses. By combining targeting with automatic network design, WATER enables designers to improve water efficiency while retaining control over network complexity.

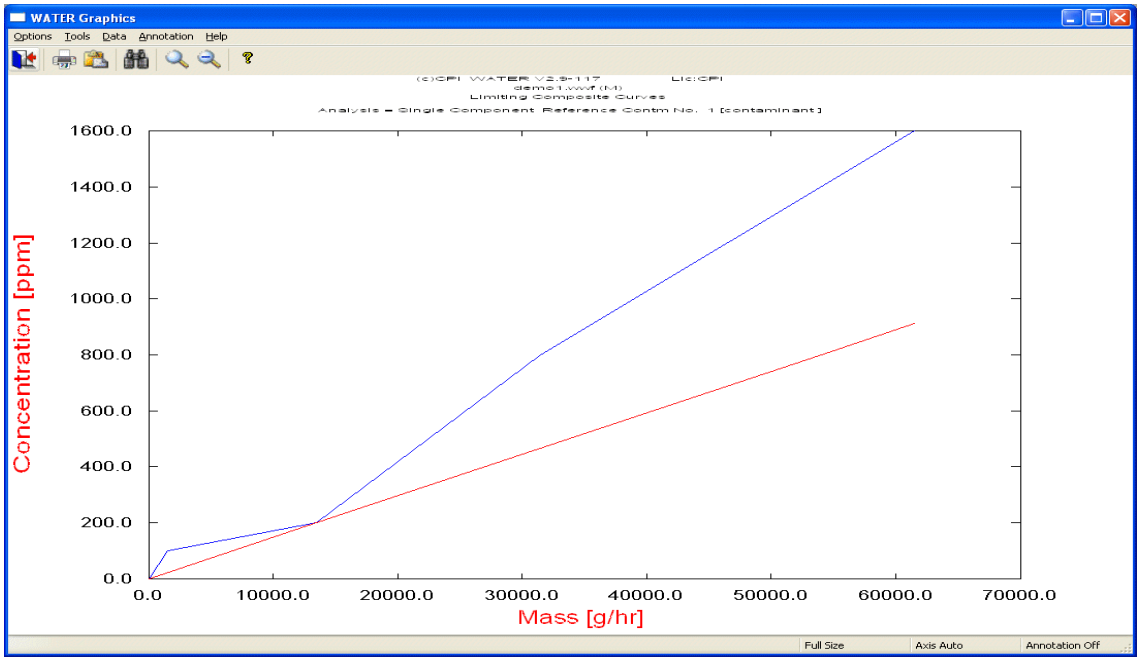
The package supports the main stages of industrial water-system design: minimising freshwater use, selecting and combining available water sources, designing re-use and regeneration networks, and optimising effluent treatment and infrastructure costs.

Issues addressed by **WATER** include:

- Minimisation of freshwater consumption through maximum re-use
- Minimisation of wastewater generation
- Optimisation of freshwater sources when multiple freshwater sources are available
- Automatic design of water re-use networks
- Identification of opportunities for regeneration of water
- Automatic design of effluent treatment networks
- Trade-off between freshwater, effluent treatment and pipe-work or sewer costs

Water Minimisation

WATER minimises freshwater use by identifying where water from one operation can be re-used safely in another. The program uses the water-quality constraints required by each operation and can account for multiple contaminants, maximum and minimum flowrate limits, forbidden matches, and water losses or gains in individual operations. By working from these constraints, **WATER** can target lower freshwater consumption while also reducing the volume of wastewater generated.

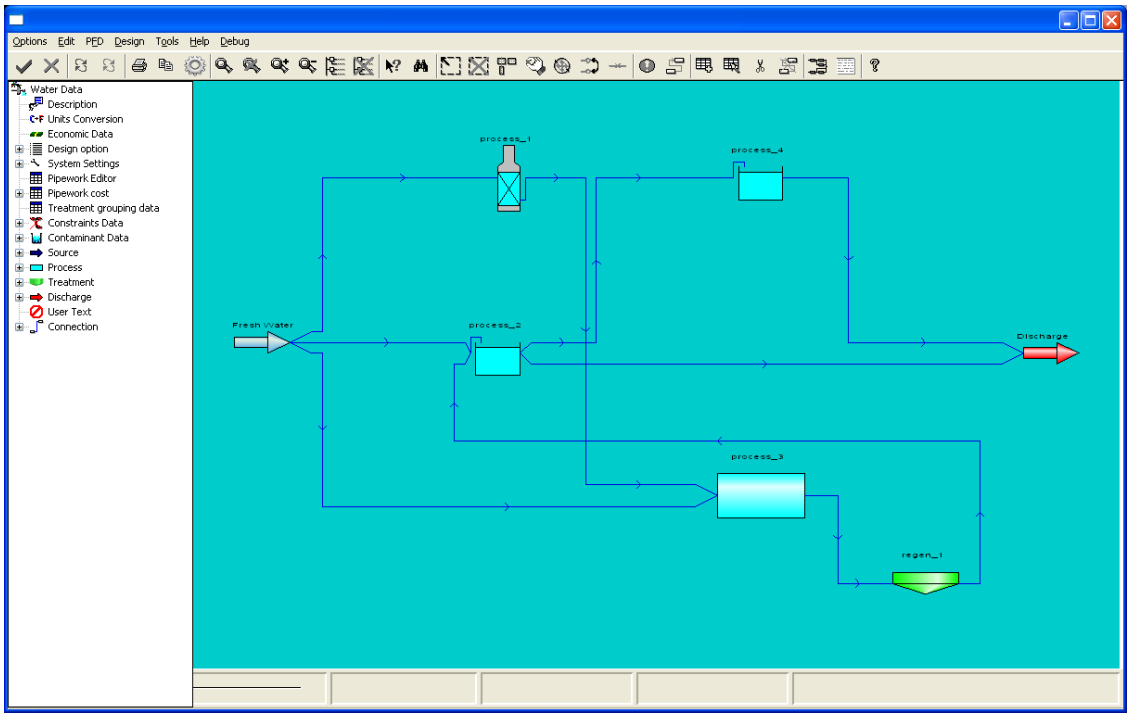


Multiple Sources of Freshwater

When several freshwater sources are available, they may differ in quality, cost and suitability for particular operations. **WATER** optimises how these sources are used so that the overall freshwater supply meets process constraints at minimum cost.

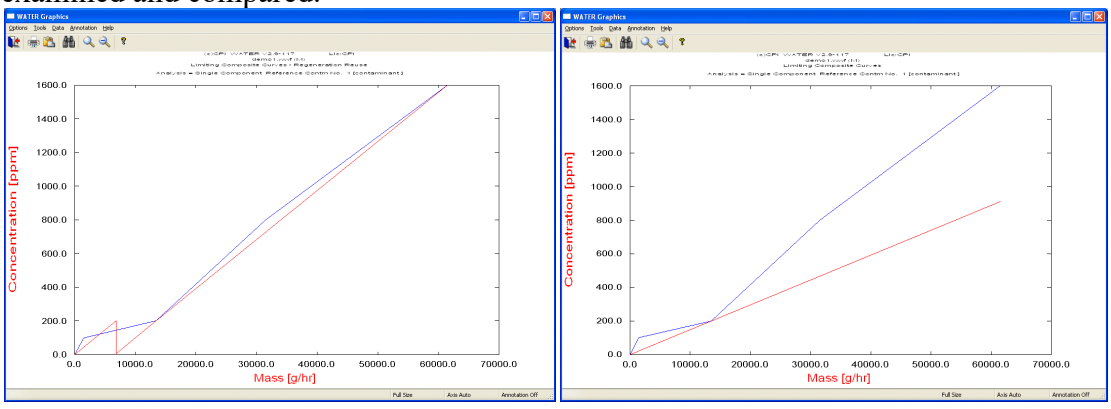
Automatic Design of Water Re-Use Networks

WATER sets targets for water re-use networks and can design those networks automatically. It accommodates maximum and minimum flowrate limits, forbidden matches, and water losses or gains in individual operations, while allowing the designer to control network complexity.



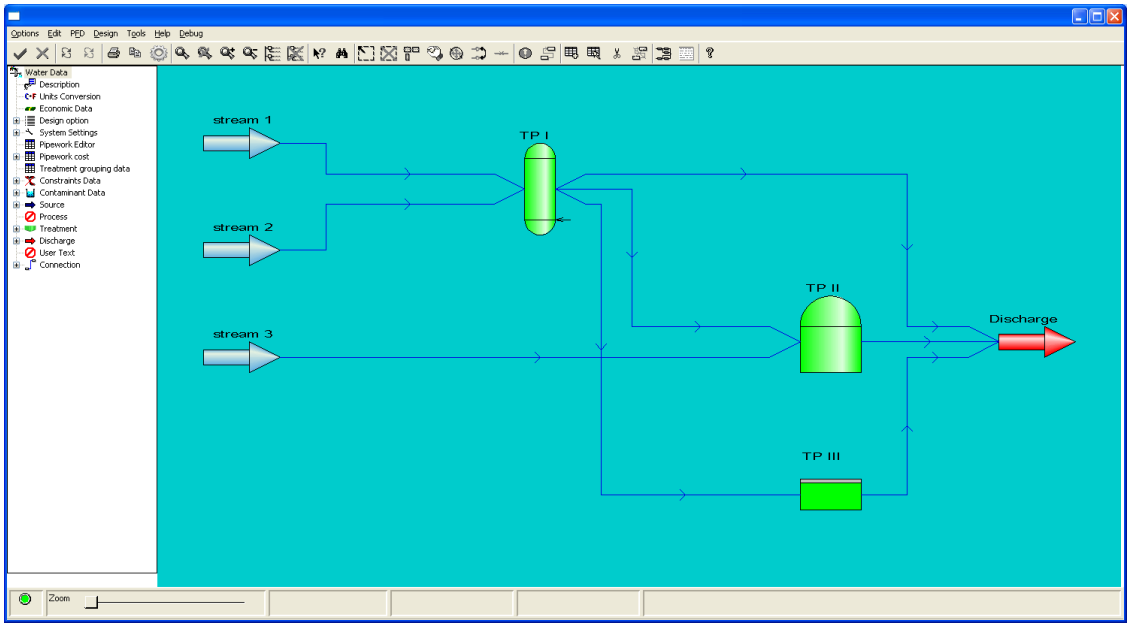
Regeneration of Water

After re-use opportunities have been maximised, further reductions in freshwater demand can be achieved by regenerating wastewater. Regeneration may involve any reaction or separation process that removes contaminants preventing further use. Regenerated water can then be re-used in another operation or recycled back into the same operation. The distinction matters because recycling may be undesirable in some cases. **WATER** allows regeneration re-use and regeneration recycling options to be examined and compared.



Automatic Design of Effluent Treatment Networks

After water use has been minimised, the remaining effluent must be disposed of at minimum cost while meeting environmental discharge regulations. Where appropriate, effluent streams should be segregated for treatment and mixed only when this improves the overall design. This approach leads to distributed rather than centralised treatment. **WATER** can design effluent treatment networks automatically for minimum cost while allowing the designer to control network complexity and apply constraints on flowrates, forbidden matches, and water losses or gains in treatment operations.



Pipe-work and Sewer Costs in Network Design

WATER can include capital costs for regeneration and treatment processes as well as the cost of connecting operations through new pipes and sewers. These costs are considered alongside freshwater costs and other capital costs in the overall trade-off. Including pipework and sewer costs is important because they can strongly influence network structure and complexity.

Together, these capabilities allow **WATER** to support integrated water-system design, from freshwater minimisation through regeneration, effluent treatment and infrastructure-cost trade-offs.