Executive Summary

Objectives

- Investigate the long term strategic risk from chemical shortages, and options for replacing chemicals identified as having a shortage/escalating cost with alternative chemicals.

- Identify potential new treatment options that have reduced/alternative chemical treatment requirements and lower energy and carbon emissions.

- Identify recycling/recovery processes that will reduce chemical usage and costs.

Conclusions

Many water treatment chemicals are commodity chemicals, with availability and price affected by global conditions. These chemicals would generally be available during short-term shortages but at increased price, e.g. phosphoric acid during 2008. Of greater concern would be commodity chemicals at risk of longer-term shortages, for example where geographically concentrated supplies of raw materials could be interrupted or where the quantities of chemicals used for water treatment are a small percentage of production.

Water treatment chemical usage can be reduced or eliminated as a result of treatment upstream of the treatment works (e.g. reservoir management and riverbank filtration) or changes at the treatment works (including changes that affect chemical species and/or concentrations in distribution).

The water treatment processes with most scope for reduction in chemical use include coagulation/flocculation, GAC adsorption, and disinfection. The water treatment process with the least scope for chemical replacement is plumbosolvency control, as phosphoric acid (or its derivative MSP/SDHO) has no effective chemical alternative.

An assessment of key water treatment chemicals used in the UK identified phosphoric acid as the chemical with the highest risk to supply, followed by polyelectrolytes (used as coagulants/flocculants) and chlorine gas. The risk ranking will vary for individual chemicals based on use at different treatment works and for different treatment processes.

A review of chemical costs for coagulation/flocculation, disinfection and plumbosolvency control showed that switching to a conventional alternative will usually result in moderate changes in cost but this is likely to be secondary to operational issues possibly reducing throughput. The costs of the chemical-free alternatives considered for these processes were significantly or substantially greater than conventional treatment.
Options for further research could include:

- development of effective chemical alternatives to phosphoric acid, e.g. chloropyromorphite, and further development of lead pipe replacement/relining;

- reduction or elimination of usage of conventional coagulants, e.g. through the use of recovered coagulants or through the development of relevant technologies, e.g. non-ageing/non-fouling membranes;

- reduction or elimination of the usage of chlorine through the development of non-chlorine-based chemical disinfectants or non-chemical methods of disinfection, e.g. utilisation of naturally occurring microorganisms in water to kill pathogens, electrolytic disinfection, and LED-UV.

**Recommendations**

1. A watching brief should be kept on current research and technology developments to identify any feasible options to reduce the usage of chemicals in water treatment.

2. Water companies could take a number of actions to reduce the risk of chemical shortages and price volatility, including:

   - contingency planning for short- and long-term chemical shortages;
   - increasing chemical storage capacity and/or sourcing chemicals from more than one manufacturer/supplier;
   - designing new treatment works or upgrades that enable storage and dosing of alternative chemicals, or use processes that reduce the requirement for chemicals;
   - tracking appropriate market indicators and negotiating long-term purchasing contracts with price guarantees.

**Benefits**

A methodology has been developed to identify key water treatment chemicals most at risk from supply shortages. The *Water Treatment Chemical Risk Assessment* spreadsheet accompanying this report can be used to quickly identify chemicals most at risk from supply shortages based on responses to a series of related factors. The spreadsheet can be used to identify the general risk of chemical shortages or the risks for specific water treatment works and treatment processes.

A review of literature, research and technologies has indicated approaches to reduce the usage of ‘at risk’ chemicals as a result of changes to water treatment or the use of alternative chemicals, as well as identifying relevant research and emerging technologies.

Recommendations are made regarding future research and technology developments, and planning for water companies to reduce the risk of chemical shortages and price volatility.

For further information please contact UK Water Industry Research Limited, 8th Floor, 50 Broadway, London, SW1H 0RG quoting the report reference number