WEARS
AUSTRALIA

Reprint from April 2009
Water & Wastewater Treatment
Magazine

Case Study - Burncrooks
Reservoir, Scotland

www.wears.com.au

GURNEY ENVIRONMENTAL LTD
FROM WATER SUPPLY TO WATER RE-USE

King's Lynn Norfolk PE30 4JJ UK
T: +44-(0)1553-776202 • F: +44-(0)1553-776335
E: info@GurneyEnvironmental.com • W: www.GurneyEnvironmental.com

Wizards of Oz control manganese in Scotland

An Australian technology for reservoir treatment has been installed in Europe for the first time. **David Orme** of Gurney Environmental explains how

A large axial flow pump has been installed at Burncrooks Reservoir in Scotland to reduce the levels of manganese and other metals arriving at the water treatment works. The installation, to the north of Glasgow, is the first installation of its kind in the Northern Hemisphere. The innovative ResMix system, designed and manufactured by Australian company Wears, has been used extensively down under, but has only recently arrived here.

Manganese (Mn) is a trace element that occurs naturally in soil, water, and plants. The presence of manganese in drinking water supplies may be objectionable for a number of reasons.

At concentrations above 0.15mg/l, manganese stains plumbing fixtures and laundry and produces undesirable tastes in beverages. As with iron, the presence of manganese in water may lead to the accumulation of microbial growths in the distribution system. Even at concentrations below 0.05mg/l, manganese may form coatings on water distribution pipes that may slough off as black precipitates.

Traditionally, manganese levels in the water supply are controlled within strict limits by a process of chemical removal and filtration at the water treatments works. As the manganese level in raw water is often seasonally variable, the filter capacity needs to be sufficient to meet peak loading and this can result in a larger capital investment than might otherwise be necessary.

If raw water manganese levels could be reduced to a minimum throughout the year, significant savings in both capital and operational expenditure could be achieved. This is the rationale behind the ResMix system.

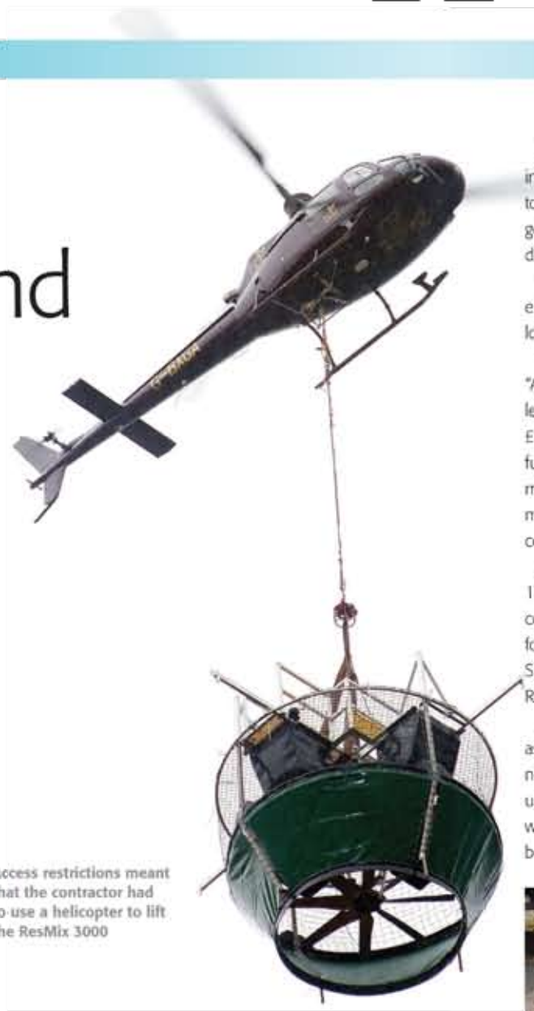
Manganese most commonly enters the water supply through run off from water catchments and through the release of manganese ions from bottom sediments in raw water reservoirs. Typically, during the summer, the surface water (epilimnion) of a reservoir heats and therefore becomes less dense.

Barrier to convection

Below this surface layer, which is nominally 3-4m deep, the water remains cold and more dense (hypolimnion). These layers are separated by a thermocline, which acts somewhat as a barrier to normal convection circulation and prevents the hypolimnetic water from being circulated or mixed.

In the absence of mixing the hypolimnetic water becomes anoxic and this depletion of dissolved oxygen (DO) leads to the leaching of metal ions, including manganese, from bottom sediments. Reservoir operators have long accepted that breaking this strata or destratification is the best method of initial treatment of storage water.

Conventional methods of mixing reservoirs have usually relied on compressed air systems that attempt to raise anoxic bottom water from the hypolimnion. As well as being energy hungry, these bottom-up mixing methods tend to disperse precipitated metals throughout the water column rather than allowing them to settle to the bottom. Nutrients are also raised to the surface encouraging the growth of blue-green algae.



Access restrictions meant that the contractor had to use a helicopter to lift the ResMix 3000

By contrast, the ResMix system uses a top-down mix that moves oxygen rich water from the surface/epilimnion down through the thermocline into the hypolimnion to maintain a uniform temperature and DO gradient throughout the water column. The DO/Mn correlation is well known and well documented. Whenever DO is maintained at about 2mg/l or more, Mn & Fe are effectively oxidised.

Using the ResMix system, the Mn is reduced by imparting DO from the surface layer where oxygen is absorbed through the air surface interface and then distributed throughout the water column. By repeatedly replacing the water at the air/surface interface the surface does not reach saturation and as a result increased amounts of DO can be absorbed.

A DO molecule will attach readily to soluble Mn, which will then drop out of solution. With the ResMix system the reaction is at depth and the solid precipitates more rapidly to the bottom.

Steve Elliott, managing director of Wears sums it up: "Put simply, if DO is increased, the soluble Mn will drop out as a precipitate. The advantage of top to bottom exchange is that the DO is made available where the Mn is generally in higher concentrations (at the bottom), and as a result the oxide does not have to settle through the full water column.

"Along with this, ResMix ensures that thermal inversion is completely eliminated preventing reservoir turnover. The result is low total Mn and very low soluble Mn."

Toni Ferretti, project manager at Scottish Water Solutions explains further: "At this particular water treatment works there was a history of manganese levels peaking in the summer months. A major capital investment of up to £8M in new filters was under consideration to ensure compliance with future statutory requirements, although the existing works was capable of meeting standards throughout most of the year. ResMix offered us a method of controlling these summer peaks at a relatively modest capital cost."

Operating costs were another consideration; typically running at less than 1kW the ResMix system uses about 10% of the energy of traditional compressed air systems, needs less maintenance and can be 'set and forget' or connected to existing SCADA systems for complete control. Supplied through Scottish Water Solutions' construction partner GMJV, the ResMix system was installed and operating in less than four days.

Allan King, GMJV's site agent comments: "Despite less than ideal weather, assembly of the ResMix system was completed in three days. Although normally craned into the water, access restrictions resulted in us opting to use a helicopter for the lift, the moorings having been laid in advance. The whole procedure took less than half an hour and was judged by all to have been a great success."

Above: Setting the pitch of the impeller to suit the reservoir depth. Right: Assembling the ResMix 3000 prior to installation

WEARS Awards

Performance has been recognised when the company received the:

- Institution of Engineers Australia Engineering, Excellence Award, for outstanding achievement in engineering, usefulness, concerns for human and natural environment and benefit to the community.
- The National Engineering Award for engineering excellence for the control of metallic ions in potable water supply;
- Inducted into the exclusive Australian Engineering Achievers Group;
- The Queensland Heritage Award;
- ISO Award for import technology replacement.
- Clunies Ross National Science and Technology Award

IAN CLUNIES ROSS
MEMORIAL FOUNDATION

THE INSTITUTION OF ENGINEERS, AUSTRALIA