

Customer Acceptability Programme - Phase 1 reduction of manganese & geosmin deposits in supply networks

by
Robert H Prentice MICE, CEng, BSc

South West Water entered into a formal undertaking with the DWI to improve potable water supply service levels through a reduction of Manganese and Geosmin deposits in the supply networks, which previously led to customer complaints of discolouration and taste & odour respectively. A phased approach was agreed allowing South West Water to tackle the issue at the furthest point upstream in the impounding reservoirs, before moving into the treatment processes and supply networks. This phased approach was scheduled to allow monitoring of each phase, post commissioning thereby allowing the effectiveness of each phase to be determined before proceeding with the next.



Stithians Reservoir

photo courtesy South West Water

Customers served

The programme covers 13 supply zones and impacts on:

- * **A population equivalent of 860,268;**
- * **8 impounding reservoirs;**
- * **503 km of supply mains.**

Current situation

The programme started in 2005 and to date four of the reservoir management systems have been successfully delivered at Upper Tamar Lake, Drift, Argal and Venford reservoirs.

A further two are due for completion by the end of March 2008 at Avon and Stithians reservoirs. The remaining two are due for completion by end of March 2009 at College4 and Crowdy reservoirs.

The solution for Stithians proved particularly challenging and is the main focus of this report.

Background

Stithians reservoir is the raw water source that supplies a maximum of 27.7 Ml/day to Stithians WTW which in turn supplies a population equivalent of 276,741 in West and South Cornwall.

The reservoir, formed in 1965 has an area of 1.08 km² and a gross capacity of 5,415 Ml. The mass concrete gravity concrete dam is approximately 241m long and 22m high. The average manganese concentration is 46µg/l with a peak of 175µg/l. The potable PCV for manganese is 50µg/l, determining that manganese reduction was specifically required from the raw water supply.

Technical solution

Due to their extensive experience with water management solutions, APEM Ltd were employed to work in conjunction with a team from South West Water to provide an appropriate solution. An extensive review of available mixing and aeration devices concluded that the Helixor mixer best meets the design criteria for operational efficiency, operational longevity and least impact on recreational use.

The adopted principle for manganese control is to achieve levels of dissolved oxygen (DO) greater than 90% throughout the water column. This is particularly important at the sediment-water interface, where the potential exists for a thin layer of anoxic water to form, which would promote the release of manganese from its insoluble form. These high levels of DO also promote the oxidation of soluble manganese in the water column.

Reservoir surveys

Surveys of the reservoir revealed a total oxygen demand of 7,316 kg O₂ /day measured from the Biological Oxygen Demand (BOD) of the water column and the Sediment Oxygen Demand (SOD) of the reservoir bed. The latter being measured using a purpose developed chamber, providing in situ measurement.

A full bathymetric survey was also carried out to determine the bed topography and the stored water volumes at various levels of draw down. From this information, it was calculated that 50 Helixor units were required to provide complete and controlled mixing and oxygenation of the entire water column. Each unit was located to



Upper Tamar Lake - Air delivery manifold

courtesy Black & Veatch

provide the most effective spread, whilst taking full account of the safety of recreational users.

Air delivery system

Air delivery to the Helixor units is provided by a compressed air delivery system that feeds air individually to each unit at a rate of 10l/s. to allow controlled operational use, the system was designed to allow predefined banks of 10 Helixors to be operated independently or together.

Each Helixor feed pipe also has individual flow control to allow balancing of the system.. The flow to each bank of ten is controlled by an automatic valve arrangement, which is also linked to the compressor arrangement. This ensures that the appropriate air flow is delivered, corresponding to the number of Helixors being used.

The compressors, supplied by Atlas Copco, had to provide a low pressure, high volume air flow. The compressor is a single skid mounted system, with integral cooling, sound attenuation, control system and starters and is common to all installations to allow a reduction in strategic spares and maintenance training.

Recreational use

The reservoir attracts a high number of recreational users and has an angling and watersports centre which encourages sailing, canoeing, rowing, and game fishing. The banks and surrounding land are also used extensively by walkers and bird watchers.

Throughout the project process, the appropriate recreational bodies were consulted, to ensure the installation presented the least possible impact on their activities and the surrounding environment.

To this end, the following organisations were consulted:

- * Regional game fishing representatives;
- * The local yacht community;
- * Cornwall Bird Watching & Preservation Society;
- * Local Planning Authority;
- * Local canoe and rowing societies
- * Royal Yacht Association;
- * Environment Agency.

The system designers Black & Veatch Ltd produced a risk

assessment for the project, which included a section on recreational use. The assessment demonstrated that the risk to recreational users was minimal. Of particular note was the potential risk to yacht users and windsurfers who travel at high speeds across the surface of the water.

These risks were mitigated by positioning the Helixors so that their highest point was 3 metres below the maximum draw down level ever recorded. These levels were then aligned with a recreational management system to ensure recreational use was halted if the reservoir level fell below the lowest recorded level.

The risk of snagging inverted masts and rigging was also assessed and deemed to be minimal. This was further confirmed by an independent assessment by the Royal Yacht Association, who conducted two trials using an inverted yacht and diver to create potential snagging mechanisms. These trials were conducted at Upper Tamar Lake, where the reservoir management system had been installed, and also at a clear water lake using a single installed Helixor. The RYA confirmed the assessment that the installation presented no more risk than those already present in the reservoirs.

Design and construction

As always, when working in areas open to the general public, and especially in areas of environmental and recreational significance, appropriate consultation, suitable design and considerate construction proved key to delivering a series of successful projects.

Key members of the design and construction team were South West Water and APEM Ltd, who produced the process design and system principles. Black & Veatch Ltd produced the system design and assisted South West Water in the consultation process. Black & Veatch also managed the construction of the installations as one of South West Water's principal framework partnering contractors. Principal sub-contractor Falmouth Divers Ltd, undertook all the reservoir based activities.

Work began on the Stithians reservoir scheme in 2006 and is due for completion in April 2008.

Memo: The Editor & Publishers of this publication wish to thank Robert H. Prentice, Programme Manager with South West Water, for producing the above article for publication. ■

OUTSTANDING PEOPLE - EXCEPTIONAL SOLUTIONS

www.hyderconsulting.com

Hyder Consulting is an international advisory and design consultancy which delivers world class excellence locally.

Our aim is to exceed your expectations through tailored solutions for your specific needs and our water and energy team can offer you environmental, engineering and management advisory services.

For further information please contact our water and energy team on uk.water@hyderconsulting.com

