Desalination by captive-head washing: results of simple trials

David Young

Proceedings of:

FABRIC

The Threads of Conservation

Best practice conservation philosophy, heritage management and skills training in Australia and beyond

Australia ICOMOS Conference
5-8 November 2015
Adelaide Australia

AUSTRALIA ICOMOS
International Council on Monuments and Sites

DESALINATION BY CAPTIVE-HEAD WASHING: RESULTS OF SIMPLE TRIALS

Introduction

Captive-head washing is a system designed for cleaning dirt and grime from building façades in which the dirty wash water is captured by a wet vacuum cleaner, thus minimising clean-up and waste disposal issues. Figure 1 shows the head in use, cleaning dust and dirt from a brick wall prior to render repairs. The head contains a low pressure spray nozzle which is connected to a water supply. A flexible 'skirt' encloses the head and seals the unit against the wall surface so that the attached wet vacuum-cleaner recovers almost all of the wash water.

The system's potential for reducing salt loads has been recognised for some years (Young, 2008) and anecdotal evidence suggests that it works well enough to justify its on-going use, yet there is little data to supports this. Trials were conducted during the 2014 Longford Academy, a combined training and fieldwork program organised by the Australasian Chapter of the Association for Preservation Technology International (APTI) and located at the Brickendon and Woolmers World Heritage properties at Longford, Tasmania.

Figure 1 Captive-head washing system being used by Walter Heim to remove dust and dirt from brickwork prior to render repairs at Brickendon, Longford.

Woolmers Blacksmith's Shop

The 1820s blacksmith's shop on the Woolmers estate (Figure 2) is a brick building with a roughcast-rendered exterior and limewash finishes on the interior. The 350 mm thick brickwork suffers from rising and penetrating dampness which carry salts through the walls to the interior surfaces. The northwest wall is the worst-effected, the low-fired bricks are severely decayed by salt attack across much of the interior surface (Figure 3).

The powdery surface of the brickwork was hardened by limewater consolidation in May 2013. The 2014 campaign included trials of the captive-head washing system, which was kindly supplied and operated by Walter Heim of Heim Surface Technologies, Sydney.

Figure 2 Woolmers Estate blacksmith’s shop from the north. Failed roughcast rendering on the northwest wall (to the right) is allowing penetrating dampness to carry salts through the 350 mm brickwork to the interior (see Figure 3).

Trials and testing

Trials were conducted on the interior of the northwest wall (Figure 3) and covered an area of 8.8 square metres. The captive-head unit was drawn slowly across the surface to allow time for the wash water to dissolve salt lying on and in the surface of the brickwork. Two separate passes were made across the whole surface of the wall.

The amount of wash water retained by the vacuum system was recorded and samples of each batch were collected and analyses for soluble salts (total dissolved solids) by electrical conductivity. This technique uses a portable conductivity meter and is a quick and simple way of determining the total concentration of salt present, though it cannot distinguish between different types of salt. The salt concentrations are simply multiplied by the volume of wash water to obtain the total amount of salt extracted.

Figure 3 Interior of northwest wall showing extensive decay of low-fired bricks due to salt attack. 8.8 m^2 of the wall was treated with two passes of captive-head washing.

Results and discussion

The first pass extracted 81.6 g, the second 27.8 g making a total of 109.4 g of salt, extracted from a wall area of 8.8 m^2, at an average of 12.4 g/m^2.

Deriving a weight percent salt extraction depends on two assumptions:

- the depth of effective extraction in mm; and
- the density of the brickwork, which is assumed to be 2.0 g/cc (kg/L).

Assuming that the depth of effective extraction is one mm into the brickwork, the average salt extraction is around 0.6% by weight. This is a high figure; it is more than the commonly used

0.5% threshold above which salt extraction is warranted. Alternatively, if the effective depth of extraction is two mm, then the salt extracted is 0.3% by weight, and if the extraction depth is three mm, the figure becomes 0.2% by weight of the brickwork. Any of these results is a good outcome; substantial salt has been removed from the wall.

The amount of salt extracted in the second pass was about one third that of the first pass. However, less water was used in the second pass (15 L instead of 25 L in the first pass), which indicates that the second pass was faster, assuming the water supply rate remains constant. Allowing for the differences in water used, the second pass extracted about 57% of the salt extracted in the first pass for the same rate of passing (i.e. dwell time as measured by water consumption). These results suggest that a third, or even fourth, pass may be effective at salt extraction, and suggest that slower passes extract more salt.

Conclusions

Captive-head washing has proven to be effective at desalinating porous masonry walls with high salt loads. Slower passes across the wall surface will extract more salt. Future trials should test:

- three or four passes across the surface;
- whether time should be allowed for deeper salts to come the surface;
- varying speeds of passing across the surface (i.e. dwell times);
- different substrates and salt loads, and
- different nozzle flow rates, in order to optimise the technique.

Reference

Young, David. 2008. *Salt attack and rising damp: a guide to salt damp in historic and older buildings*. Heritage Council of NSW, South Australian Department for Environment and Heritage, Adelaide City Council, Heritage Victoria, Melbourne.