POOL WATER TREATMENT
ADVISORY GROUP

TECHNICAL NOTE

3 – Sulphate attack

February 2011
An increasing number of reports have been received about problems being experienced in swimming pools due to the use of sulphate-based chemicals. In most cases the initial effects observed are some erosion of the cement grout with a white suspension forming in the pool water when the grout surface is agitated. In one case a hotel pool had a water supply with just over 6mg/l sulphate with balanced pool water but the use of sodium bisulphate (dry acid) and alum (sulphate-based salt) had raised the sulphate level to 1,582mg/l with erosion of the grouted joints quite evident.

The dangers of sulphate levels in pool water were highlighted by PWTAG in December 1987 following the recommendations given in BS 5385: Part 4: 1986.

The current edition of this tiling Code of Practice advises:

Clause 7.3.1 General
Ideally the sulfate concentration (SO3) of water in swimming pools should not exceed 300 mg/l. Where greater concentrations of sulfates cannot be avoided, impermeable adhesives and grouting materials that are not affected by sulfates should be used. High levels of sulfate would otherwise react with and erode materials containing Portland cement (CEM 1).

Clause 7.3.2.9 Pool water conditions
The use of sulfate containing chemicals, e.g. sodium bisulfate (dry acid), should be discouraged due to the need to keep sulfate levels as low as practicable and to prevent sulfate attack on cement grouts, tile beds, screeds, rendering and concrete.

The total dissolved solids (TDS) need not be high for sulphate attack to occur if sodium bisulphate is used in pool water. Sulphate attack occurs under balanced water conditions, even at concentrations below the maximum recommended concentrations, but more slowly since the rate of attack is concentration dependent. Note also that sulphate ions can migrate into the cement mortars, renders, screeds or concrete and begin to react. However the effects will not be immediately evident as they manifest on the surface of mortars in contact with the pool water. Where sulphate attack occurs on Portland cement mortars and concrete, the effects will not be as readily apparent, as in the initial stages the expanded reaction products fill up any pores or fine cracks within the mortar. Once all the voids are filled the further growth of expanded reaction products starts to disrupt the cement mortar or concrete. A classic example of this was where the first sign of a problem was when the tiles in the overflow channel of a freeboard pool tented due to expansion from sulphate attack and the adhesive beneath were found to have disintegrated.

Note that using sodium bisulphate to lower the pH of the pool water effectively adds an equimolar mixture of sodium sulphate and sulphuric acid to the pool water and for the same hydrogen ion concentration you are adding nearly 3.3 times more 'dissolved solids' to the pool water than if you added the equivalent amount of hydrochloric acid. This means that using dilute hydrochloric acid has far less effect on the TDS of the pool water and, since the sodium bisulphate has to be dissolved in water, the amount of 'liquid' added to the pool should be less using dilute hydrochloric acid to control pH.

Note that dilute solutions of either hydrochloric acid or sodium bisulphate with the same hydrogen ion concentration are hazardous; however there is no need to use concentrated hydrochloric acid as hydrochloric acid is available in a range of concentrations for use in swimming pools.

As a result of the long-term experience with the effects of using sulphatebased chemicals in treating swimming pool water, it is strongly recommended that the use of sulphate-based chemicals should be avoided in swimming pools of concrete construction, and where cement based renders, screeds, tile adhesives and grouts are present.

Carbon dioxide *is a better alternative for many pools– but not if the supply water hardness is over 300mg/l, and not in leisure and spa pools where water features expel CO_2. CO_2 does not raise TDS levels and so presents less of a risk of both grout erosion and general corrosion damage.*