A standard test for filter media cleanliness

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Abstract

Rapid sand filters are expected to produce clean, safe water, without interruption, for many years. Unfortunately, filters very often develop some problems during this time, most of which only become apparent when the damage is already done. Routine measurement of filter media cleanliness could provide the necessary early warning, which is the reason why the American Water Works Association (AWWA) suggested a media cleanliness test for inclusion in a structured filter assessment programme at drinking water treatment plants. After performing such assessments at 3 South African water treatment plants, the authors found that the results were not consistent, the turbidity could not be measured easily and the guideline values seemed to be excessively conservative. This led to an investigation to find a method for *stripping* the filter deposits from the media grains with an easy, reproducible method, and for *characterising* the stripped deposits.

After a series of tests on various filter media, using 6 stripping methods, 2 methods were identified that met the criteria in the first objective. The first, a magnetic stirrer method is a mechanical agitation method and the second, referred to as the cylinder inversion method, is a manual agitation method. Each of these methods was chosen on the basis of their operator and speed-of-agitation independence.

The criteria in the second objective were met by an in-depth suspended solids (SS) analysis performed on the filter media residue, with the total mass of solids removed from the media quantitatively separated on the grounds of acid solubility and volatility at 550°C. *Standard Methods* (1985) 209C and 209D were applied to the sample, with and without acid addition, in order to characterise the total filter media residue using 4 groupings: Soluble, non-volatile; soluble, volatile; non-soluble, non-volatile; and non-soluble, volatile.

By meeting the criteria of these 2 objectives, the previous non-specific suggestions in the literature have been improved to suggest the performing of tests in a well-specified, uniform way, the results of which can be internally compared.

Keywords: filter deposits, filter residue, filter media, cleanliness, floc retention

Introduction

In almost all South African water treatment plants, rapid sand filtration is the backbone of the process, providing the primary barrier against turbidity and protozoan cysts and oocysts in the final water.

Rapid sand filters almost inevitably develop some technical problems during the many years they are expected to continuously produce clean, safe water. With time, it is observed that media is lost, mudballs are formed, cracks appear, media grains grow by chemical deposition and backwash rates gradually decline due to, e.g. worn pump impellers and leaking valves. Unfortunately, most of these problems become apparent when the damage is already done. However, in all these cases an early warning is given by filter media that are not properly cleaned after every backwash cycle. If the cleanliness of the media grains is routinely measured, the potential for some of the more serious problems could be detected at an early stage and the problem possibly arrested before serious damage is done.

It is such thinking that led the American Water Works Association (AWWA) to include a media cleanliness test (called a floc retention test in their publications) in a battery of tests suggested for a structured filter assessment programme at drinking water treatment plants (AWWA, 2000). The test is simply described as taking approximately 50 g of filter sand, adding 100 mℓ of water, shaking it vigorously and decanting the resultant suspension into a beaker. After 5 repetitions, the turbidity of the suspension is measured and reported as NTU (nephelometric turbidity units) / 100 g of sand. A value of 30 to 60 NTU indicates a clean bed, 60 to 120 NTU indicates a slightly clogged bed, 120 to 300 NTU indicates a clogged filter with mudball formation potential, and values above 300 NTU indicate a serious problem with highly probable mudball formation.

The Water Research Group at the Rand Afrikaans University was involved in such filter assessment programmes at 3 South African water treatment plants during 2000 and 2001 and performed this media cleanliness test with all the other prescribed tests (Ceronio et al., 2002a;b). Some difficulties quickly became apparent. Results were not consistent, the turbidity could not be measured easily and the guideline values seemed to be excessively conservative. The media cleanliness test thus had to be improved and standardised before it could be widely adopted as a comparison standard. The project comprised 2 different parts, which will be reported on in this paper:

- To find a method for *stripping* the filter deposits from the media grains with an easy, reproducible method, and
- To find a method for *characterising* the stripped deposits in a meaningful way to provide some clues for corrective action should the media be clogged.

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Received 30 August 2003; accepted in revised form 10 November 2003.