WATEROPOLIS

Evaluation of Granular Ceramics as a Filtration Media for Commercial Swimming Pool Filtration

Project Description

A year long pilot study was performed at an indoor commercial pool in Geauga County Ohio. The testing included an extensive evaluation of common and widely available granular filtration medias and compared the performance results in real time. The intent of the study was firstly to compare the real time turbidity removal capabilities of the various medias and secondly assess the removal ability of cryptosporidium sized particulate (2-5 micron). This assessment also included a polystyrene microsphere challenge on selected well-seasoned medias to compare the ability of the medias to remove crypto sized particles.

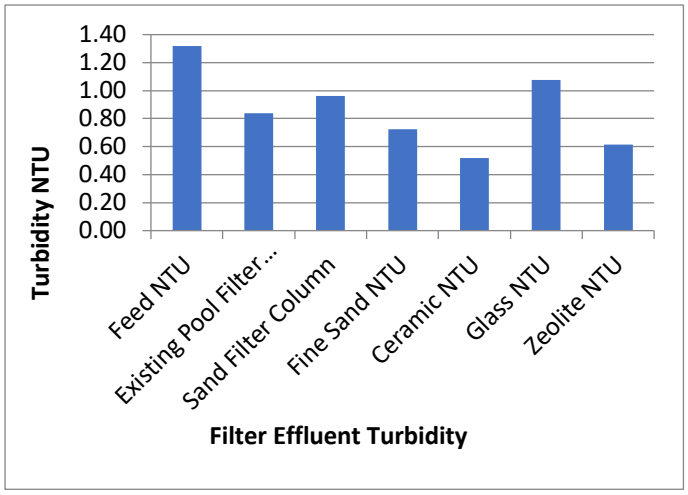
The pilot assembly utilized two, 2" diameter clear acrylic filter columns. One column contained a 0.15 – 0.25 mm spherical ceramic filter media, various other filter medias were installed in the second column and each media was run for extended periods. Column effluent was measured in real time for 2 – 5 micron sized particles (HACH 2200 PCX), and turbidity was also measured and recorded in real time (GLI Accu4).

Pilot Test Results

Turbidity

Typical pool water influent turbidities during the pilot test ranged between 0.14 NTU to 2.5 NTU. (Figure 1) This variation was correlated to bather load. The NSF-50 pool media test protocol requires a 70% reduction in effluent turbidity (the NSF-50 test protocol provides specific test conditions) on average the ceramic media was the only material that achieved ~70% reduction in real time test conditions. In general, turbidity was a poor predictor of particle count removal.

Figure 1. Effluent - Turbidity



Particle Counts

Turbidity removal values do not correlate and are in no way predictive as it relates to a medias ability to remove cryptosporidium ("Crypto") sized particles.

Particle count and head loss data was recorded at 15 second increments and the particle counters were set up to count particles in the 2 - 5 microns (µm) range. These ranges were selected based upon the typical size of Cryptosporidium, which are typically larger than 2 microns.

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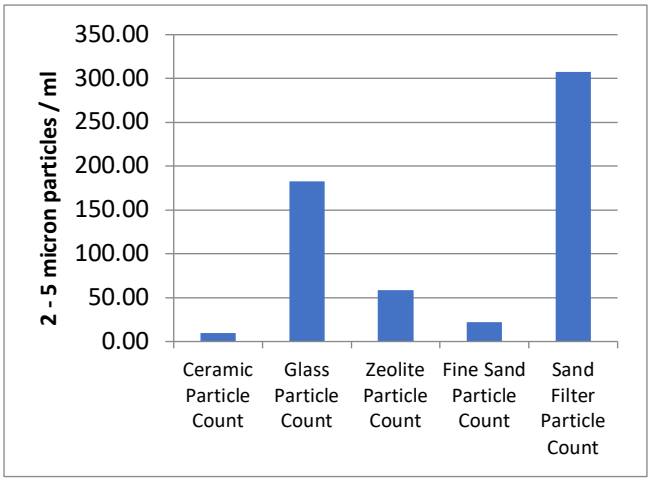
Raw influent particle counts were not measured. The ceramic media effluent particle concentration averaged 9.54 particles per 100/ml, fine grain sand was the next best performing material at 22.1 particles per 100/ml followed by charged zeolite at 58.2 particles per 100/ml.
(Figure 2)

Figure 2. Particle Counts

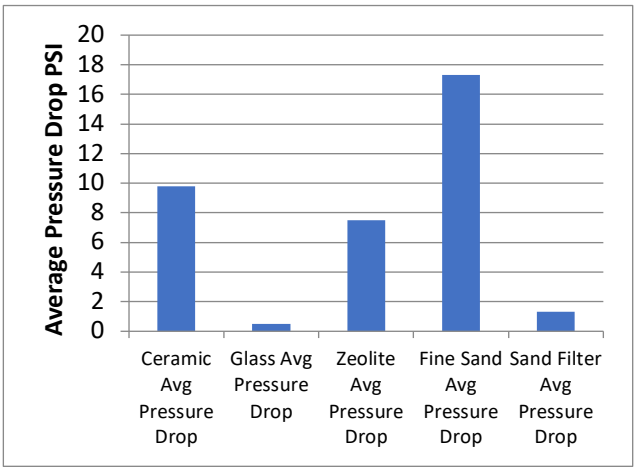


Head Loss

Head loss is the accumulation of pressure across the entire filter bed and is an indicator of filter solids loading. Head-loss can be used to predict the need for filter backwashing. All filter medias tested were installed to identical filter bed depths of 24 inches (610 mm) and all filter columns were run at the same flow rate of 12.0 gpm/ft2 (29.3 m/hr).

Based on the data there is a correlation between average filter head-loss and the filter medias ability to remove crypto sized particles with the exception of the ceramic media. The disproportionately lower head-loss of the ceramic media is a result of its spherical and uniform shape.
(Figure 3)

Figure 3. Head-loss (Avg. Pressure Drop)

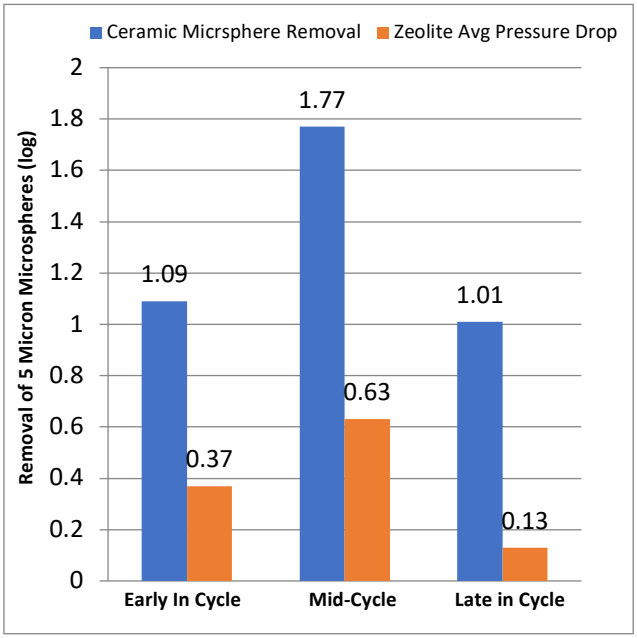


5 Micron Microsphere Removal

An on-site test for crypto removal potential was performed by Dr. James Amburgey. The ceramic media was tested side by side against a “charged” zeolite media that had demonstrated the next best overall filter performance. Fine sand was excluded from the test due to its overly high-pressure loss characteristics which deemed it impractical. For the test, 5-micron, crypto sized luminescent polystyrene microspheres were dosed at the inlet to the filter at a rate to mimic a fecal incursion. The microsphere testing was done at three points during a typical 7-day continuous filter run. (Figure 4)

Microspheres where dosed at 3 different times during the filter run, the initial dose at start up before filter "ripening" had occurred. The middle test was done at 3.5 days into the filter run and the final microsphere dose was prior to backwash at the end of the 7 day filter operation. The zeolite did not perform as well as expected, the ceramic filter media did provide greater than 1.0 log removal (>90%) removal in all three samples.

Figure 4. Microsphere Testing



Conclusions:

Filter Media Performance:

Only the ceramic and fine grain sand was able to achieve > 90% removal of crypto sized particles throughout the test according to on line particle count data. The pressure drop of the fine grain sand makes implementation of this filter media problematic.

Spherical ceramic media did provide >90% removal of crypto sized microspheres. None of other filter medias tested showed any significant capacity for crypto sized particle removal when implemented in a traditional pool filter design.

A reduction in filter flow rate and/or addition of filtration aids would most likely be required to improve the performance of the other filter medias.

It was also noted that backwashing based on filter operational time was an ineffective way to manage the filters. During pool downtime some of the accumulated solids in all pool filter medias hydrolyzed and dissolved back into the filter effluent. It is recommended that filters be monitored for pressure differential and in general be backwashed more often.