Crushed Recycled Glass Media in Slow Rate Filtration

Material: Recycled Glass

Issue: *Slow rate filtration systems are an alternative to conventional rapid sand filters in the pre-treatment of community drinking water. These systems are relatively easy to construct and maintain, but require large quantities of filter media. The traditional slow rate filtration medium is sand, but research has suggested that crushed recycled glass can be an effective medium in slow rate filtration systems. Further testing is needed to determine proper maintenance techniques and long-term filter performance. This Best Practice briefly discusses current knowledge of the preparation and placement of crushed recycled glass as a slow rate filter medium. Many of the recommendations presented here are common to other types of filter media.*

Best Practice: Slow rate filtration systems typically consist of a layer of filter medium placed on a layer of support gravel, the thicknesses of which will vary by design. During filtration, water passes through the filter medium and out the support gravel. Typical flow rates for filtration systems of this type vary between 0.04 and 0.10 gallons per minute per square foot of filter cross-section (gpm/ft^2). Research suggests that crushed recycled glass may be used effectively as a filter medium in systems of this type. Tests using pilot column filters indicate that when prepared and placed properly, the filtration abilities of crushed recycled glass are comparable to those of natural sand. These include the reduction of water turbidity and removal of bacteriological contaminants. Generally, water is not treated before introduction to slow rate filtration systems. As such, these systems are usually limited to water with no heavy algal blooms and low turbidity.

Prior to use as a filter medium, recycled glass should be crushed and sieved to the proper size and gradation. The U.S. Environmental Protection Agency recommends that slow rate filtration media have an effective particle diameter (D_{10}) between 0.15mm (100 mesh) and 0.35mm (45 mesh). D_{10} is the particle diameter at which 10% of the media weight is finer. In addition, the uniformity coefficient (U.C.) of the media should be 2.5 or less. The uniformity coefficient is the ratio of D_{60} to D_{10}, where D_{60} is the particle diameter at which 60% of the media weight is finer. Experience also suggests that the crushed glass should contain less than 0.1% by weight smaller than .074mm (#200 sieve). This low level of fines may only be achievable with washing.

Once properly sized, the crushed glass should be washed to reduce contents of organic material or dirt that might leach from the medium or cause excessive turbidity. To prevent contamination during shipment, washing should take place immediately before placement of the glass. For a pilot project, this can be accomplished in a portable electric cement mixer or in a cement truck. For large-scale continuous washing of glass for full-scale project, sand screws are a common piece of equipment that can be adapted to glass. Consult the Thomas Register for manufacturers.

The support medium (gravel) should be lowered first into the filter apparatus in measured lifts and compacted. The crushed glass filter medium can then be placed and compacted in 6-inch thick lifts. The thickness of the support and filter media layers will vary by design. Once the glass is placed, the filter system should be filled with source water. A disinfectant solution should be added to the system and allowed to stand for at least 12 hours before flow begins. A 50 mg/L sodium hypochloride solution can be used for this purpose.

The filter medium in any slow rate filtration system requires periodic cleaning. This can be accomplished by "scraping" or "harrowing". Scraping involves lowering the water level in the filter below the surface of the media and removing any residue that has accumulated on top of the media. The top one inch of media is also scraped off and discarded. "Harrowing" involves turning over the top few inches of media while slowly backwashing the filter. Designers need to account for the fact that glass has a lower density than most other forms of filter media (i.e. sand), and can be fluidized and disrupted at lower backflow rates.

Implementation: Several studies have documented the technical efficacy of recycled glass in water filtration applications. The processing and marketing of adequate volumes, with acceptable quality, at competitive prices, is the next step to market viability. Design engineers should be made aware of the difference in specific gravity between glass and the materials with which they are accustomed to work.

Benefits: Glass can be processed to be a clean, relatively inert, granular material that can be graded in any way required for filtration applications. Slow rate filtration is only one example of a filtration application for which glass appears to be suitable. Investigations into local potential filtration uses could result in new markets for glass processors.

Application Sites: Glass suppliers, design engineers, water treatment facilities.

Contact: For more information about this Best Practice, contact CWC, (206) 443-7746, e-mail info@cwc.org.

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