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TECHNICAL PUBLICATION

INFORMATION & STRATEGY FOR THE FACILITY MANAGER

Principles of Depth Filtration

A Reprint from Ecodyne

Filtration is the simplest of water treatment processes, but in some ways the most difficult to accomplish. If all suspended particles in water were the same size, they would be easy to filter out. A media with porosity slightly smaller than the particles could be selected, the water run through the media, and particulate matter removal would approach optimum. For large particles, a coarse filtering media would be chosen: for fine particles a fine porosity media would do the job. For higher delivered volumes, and to extend the service cycle of the filter between backwashes, large diameter vessels could be used to delay clogging of the media.

Of course, the size of particles in water varies considerably, especially in surface water where debris as well as fine sand and silt are found. Large pressure vessels are uneconomical, they cost more to build and occupy too much valuable floor space.

Single-Media Filters

Often, single media filters are selected as a compromise. If the media is too coarse, fine turbidity particles pass through and into the filtered water stream. If the media is too fine, large turbidity particles will soon clog it, and the filter must be backwashed more frequently. Frequent backwashing reduces the time the filter is in service and backwashing is costly.

Design engineers usually choose a fine media in a single media filter, since inefficient filtration cannot be tolerated and may do more harm than good. They then place the media in a small diameter vessel, to keep equipment costs down. In operation, the media soon clogs and must be backwashed. More frequent backwashings tolerated as a concession to higher filtering efficiencies. Clogging occurs in the top portion of the bed, rendering the bottom part useless.

In other words, the filter does not function throughout the entire depth of the filter bed, and thus single media filters almost invariably operate inefficiently.

Multi-Media Depth Filters

The multiple media filter, or depth filter, solves all these problems. It combines more than one media in a single vessel, with coarse media on top, intermediate porosity media below it, and fine media below that. As water flows downward through the filter vessel, it encounters media beds of decreasing size, and thus higher filtering efficiency.

The coarse media traps and holds large particles, preventing them from migrating downward through the bed. The intermediate portion traps medium size particles, and the fine media traps the smallest particles. This arrangement of media makes it virtually impossible for large particles to clog the finer media, since they are captured and held in the coarser media above. As a result, each layer of media functions near its optimum efficiency. It odes not matter that the fine particles pass through the top layer; they will be trapped later. The fine media layer can do its job because it is not encumbered with large particles that would clog it.

Because of this arrangement, each media layer filters throughout its bed depth, as does the entire filter, hence the term depth filter. The depth filter also traps and holds more impurities and a single media filter because impurities are trapped throughout the entire bed. As a result of efficient media utilization and less frequent clogging, relatively small diameter vessels that require less floor space can be used.

The multiple media filter is like having several filters in one, without the cost of acquiring and maintaining three separate filters.

Backwashing and Restratification

Even a depth filter will eventually clog and must be backwashed. This presents a special problem — that of automatically restratifying the various media in the same layer configuration in which they were originally bedded. The accomplish this, media are selected not only for size, but for their specific gravity as well. The top media is lighter, and the middle and lower media are heavier. As a result, after thorough backwashing to rid the vessel of particulate matter, the lighter, coarse media remains on the top, the heavy, fine media sinks to the bottom, and the intermediate settles in between. Much research and field testing has gone into depth filter media restratification, and literally hundreds of media have been tested. Today's depth filters reflect the efficiency of restratification that is so necessary for efficient depth filter operation.

As a result of efficient design and restratification, depth filters provide filtration efficiency at a level far beyond that of single media filters, and deliver higher volumes of filtered water from relatively small diameter vessels. They also do it consistently from one service cycle to another, indicating the efficiency of media restratification.

Depth filters routinely remove particles as small as ten microns. With the use of filtering aids such as flocculants to clump particles together; they remove particles as small as one micron. For comparison, the human eye cannot see particles smaller than 75 microns.

Today's depth filter is the answer to the need for high volumes of clean, filtered, high clarity water at a reasonable cost.