Tower-Flo vs. "Hybrid" Filters
A Position Paper

The purpose of this discussion is to examine the technology and claims of certain "hybrid" filters. These filters claim extraordinary particle retention sizes – as small as .45 micron – by combining two particle removal methods: centrifugal separation and sand filtration. Because of the absence of any industry standards or any independent testing and certification organizations examining solids removal technologies, there is a frustrating absence of data and documentation with which to objectively evaluate claims. We are left with entirely subjective discussions of concepts and principles, understandings of certain mechanical operations, and the apparent logic – or lack thereof – from which to derive conclusions. And while the sales literature distributed by "hybrid" filter manufacturers contains a wide variety of disputable claims, this paper will focus on the most egregious.

In a nutshell, manufacturers of these "hybrid filters" claim that their filters:

- will trap the preponderance of the very finest of the fine particles (.5 micron) in cooling water;
- can accomplish this with a much smaller filter (smaller diameter, lower flow rate, smaller "sampling" of the total volume of water in the system);
- can accomplish this with a filter installed in a pipe-to-pipe, or slipstream, style (an installation style known to minimize the amount of filterable material a filter can possibly see).
- will backwash less frequently than traditional sand filters;
- will use less water to backwash than traditional sand filters.

Manufacturers of "hybrid" filters will support these claims with attractive graphs and charts that cite *no* sources. Attractive, but nowhere near as scientific as they might appear at first glance.

PARTICLE RETENTION:

The sales literature distributed by manufacturers of "hybrid" filters invariably trumpets "down to 0.45 micron", "...0.5 Micron Sand Filters". Only a more careful reading of the literature and the specifications documents reveals other references which serve to place *qualifications* on the trumpeted claims, such as:

- "nominal 0.45 micron" (American Heritage Dictionary: nominal: 2. Existing in name only and not in actuality. In dimensional lumber, how long has it been since a nominal "2-by-4" was really 2" x 4"?).
- "...sized to remove 90% or more of the 0.5 to 10 micron particles..."
- "The filters ability to remove the extremely fine 1/2 - 10 micron particles..."
- "...remove 80% or more of typical tower water particles (0.5 to 15 microns)..."

Sales literature distributed by Diamond Filters makes comparison to Multimedia Filters (in which they misrepresent, graphically, the order of media loading) and says about sand filters:

> "Claims of 90% removal of 5 micron ***and larger particles*** are very misleading, as only 5% of 5 micron particles will be removed. Grouping 5 micron particles with much larger particles allows the claim to be met by removing a few large volume particles from the tower sump, even though the vast majority of fine particles remain...".

First, Tower-Flo's Filter Media and Particle Retention statement (see *www.towerflo.com/media.pdf*) does not state performance based on particle size ranges; Tower-Flo states "...100% of 20 micron particles....99% of 10 micron particles...90% of 5 micron particles..."

Second, ***if*** the logic of Diamond's argument against sand filter's particle retention were to hold true (which it doesn't when applied to Tower-Flo's particle retention), then it must also hold true when evaluating Diamond's own published retention claims. Isn't their claim of of "90% removal of .5 to 10 micron" every bit as misleading as what they claim we say, and much more misleading than what we actually say?

Third, Tower-Flo provides filter media that is consistent with the American Waterworks Association standard for fine filter sand for potable water; the same material that drinking water in the US is filtered through. Diamond trumpets "NSF Certified" media. NSF (National Sanitation Foundation) certifies various media for its effective particle size claims (under NSF Standard 50 - Pool and Spa Equipment) and /or its health effects (under NSF Standard 61 -Drinking Water Additives - Health Effects). There is only one **sand media** producer in the US whose effective size claims have been confirmed, therefore certified, by NSF under Standard 50. Tower-Flo's primary media vendor is that one, certified producer; Northern Gravel Company, Muscatine, IA. (Other producers occasionally used by Tower-Flo, produce filter sands to the identical specification of size and uniformity co-efficient, but not tested and certified by NSF).

This all begs the question, so what? How clean is clean and how clean does cooling tower water need to be? Is "drinking water clean" clean enough? Is it really necessary to try to make cooling tower water that much cleaner than drinking water?

SIZING

Cooling tower water constantly gains dirt. Cooling tower water must be filtered fast enough to keep up with that constant dirt gain. So, sizing a filter is simply about two things: a) determining the total volume of water to be filtered; and b) determining how frequently that total volume needs to "turn-over" through the filter (*see www.towerflo.com/filsiz.pdf*).

Nearly 30 years of experience has taught Tower-Flo that a one hour turn-over of total volume adequately keeps up with the dirt gain of the majority of cooling towers. Evaluation of operating and environmental conditions effecting the dirt gain of every tower, but especially important when system volumes exceed 10,000 gallons, may dictate modification of the turn-over rate to keep pace with dirt gain.

Some other sand filter manufacturers size their filters based on a percentage of the condenser water recirculation rate. While the recirculation rate is an arguably easier number to find, it is merely suggestive, not definitive, of the volume of water to be managed by filtration. In many cases, percentage of flow rate sizing can result in an appropriately sized filter system. However, when it misses it often misses by a wide margin resulting in filters which are significantly oversized or undersized for the job. It is the volume of water, not the flow, that needs to be filtered.

"Hybrid" filter manufacturers try to make filter sizing look like a science by relying on pseudo-scientific data and measurements which have dubious – if any – relevance to the removal of suspended solids from water! To determine filter sizing, Diamond wants design recirculation rate, design ΔT, average summer heat load, something they call evaporative heat loss, evaporation gpm, cycles of concentration (principally, a measurement of unfilterable *dissolved* solids in water, as opposed to the filterable *suspended* solids), and blowdown (the method for managing dissolved solids as measured by cycles of concentration). From all of that data, irrelevant though it may be, Diamond somehow magically makes a quantum leap to a recommended filter size with no explanation of how you got from point A (pseudo-scientific data) to point B (filter size). Pseudo-science looks good but completely defies explanation!

It has been Tower-Flo's experience that "hybrid" filter manufacturers almost always propose radically smaller filter systems than Tower-Flo would propose for the same application; filters that simply cannot filter fast enough to keep up with the dirt gain! This may be explained by three points: 1) the absence of a logical progression from point A (pseudo-scientific data) to point B (filter size) makes any sizing recommendation *look* scientific; 2) "hybrid" filter manufacturers don't build a filter vessel bigger than 30" diameter in anything other than stainless steel (flow rates over 100 gpm require multiple vessels); and 3) while "hybrid" filter manufacturers are driven to be the lowest first cost option, they are limited to expensive stainless steel vessels.

Filtration is about managing the dirt gain in a body of water so keep your eye on the ball; volume and turn-over rate!

INSTALLATION STYLE:

Manufacturers of "hybrid" filters advocate installation of their equipment in a pipe-to-pipe connection style which they refer to as "sidestream" installation (Tower-Flo calls this a "slipstream" installation). Tower-Flo advocates installation of its equipment on the basin of a cooling tower or on a cooled water storage reservoir, *completely independent* of the water recirculation system and refers to it as "sidestream" installation (*see www.towerflo.com/iss.pdf* for a review of all installation styles).

Besides the difference in terminology, the difference in the ***effectiveness*** of sidestream versus slipstream is significant (*see www.towerflo.com/ssvsssbull.pdf*). A slipstream installation cannot influence the movement of solids to the filter for removal as effectively as a sidestream. A slipstream installation must address system pressure at the point of installation, plus the boost of the filter's pump, in rating the operating pressure of the filter system resulting in a more expensive filter vessel (hence, the hybrid filters' 125 psi vessel).
Slipstream installation does absolutely nothing to address the accumulation of debris in the basin of the cooling tower, the "dirtiest" part of a cooling water system. ASHRAE Guideline 12-2000 - Minimizing the Risk of Legionellosis - rec-

ommends steps, including equipment for the removal of solids, to maintain a clean cooling water system. Those recommendations are not addressed by a slipstream installation which ignores the dirt settled in basin of the cooling tower.

If your objective is to trap a higher volume...of the highest concentration of solids...with a smaller, lower flow rate filter system and somehow, miraculously, do all of that *and* backwash less frequently, then you must limit the solids your filter sees by selecting the least effective installation style, namely slipstream.

BACKWASH

Again, "hybrid" filter manufacturers claim their equipment backwashes less frequently than sand filters. There are only two ways that a filter that traps .5 micron material can backwash less frequently than a traditional sand filter. One way is to install the filter in the least effective style so as to minimize the solids that get to the filter in the first place; less solids getting to the filter results in less frequent backwash. The other way is based on the setting of the differential pressure switch that initiates automatic backwash; the higher the ΔP switch setting, the progressively finer material that will be trapped by the filter. With more trapped material and less frequent backwash, the more the filter's flow rate will decline from its design flow.

The "hybrid" filters' companion claim that their equipment uses less water to backwash doesn't hold water (pardon the pun). It is true that they backwash at a lower flow rate, 45 gpm for their 30" filter system versus 100 gpm for a 30" Tower-Flo filter system. However, the "hybrid" filters backwash for 8 minutes; 45 gpm x 8 min = 360 gallons. Tower-Flo backwashes for 3 minutes; 100 gpm x 3 min = 300 gallons. Correspondingly, a "hybrid" filter for 800 gpm uses eight 30" diameter tanks which backwash sequentially resulting in 45 gpm x 8 min x 8 tanks = 2,880 gal of backwash water. The similar Tower-Flo filter system would be a TFB-84 using a single 84" diameter tank rated for 770 gpm; its backwash would be 770 gpm x 3 min = 2,310 gallon or 570 gallons less than the similar "hybrid" filter. Which type of filter uses less water to backwash? The devil's in the details!

INSTALLATION REQUIREMENTS:

Another significant issue between "hybrid" filters and traditional sand filter systems about which the "hybrid" devices-make no comment. All standard Tower-Flo filters are complete, skid-mounted filter assemblies. Installation involves three plumbing connections, a single point electrical connection, installation of filter media, and – in the large Series TFB filter systems – field installation of the collection laterals into the collection header inside the filter vessel prior to loading of the filter media.

On the other hand, "hybrid" filters larger than a single 30" tank (more than 100 gpm) are not, generally, skid mounted and fully assembled. They require significantly more field assembly by the contractor; i.e., setting tanks; connecting inlet, outlet, and backwash headers, floor mounting of control panel, electrical and pressure tubing connections to each tank, etc. In our experience, the less the contractor is forced to be responsible for in field assembly, the less time consuming and costly the installation and the less finger pointing if something should go awry.

CONCLUSION:

Any filtration device added to a cooling water loop will improve, to some degree, the quality of water in that loop. In terms of the claims of particle retention, we are literally splitting hairs. A human hair is generally considered to be around 100 microns in diameter, minus for fine hair and plus for coarse hair. The naked eye is capable of discerning down to about 40 micron. Traditional sand filters equipped with AWWA grade sand for drinking water – capturing 20, 10 and 5 micron particles – are removing particles much smaller than the eye can see. How clean is adequately clean for cooling water?

The particle size removal contest is really designed to dazzle and distract; to take your eye off the ball. The real issues are these: is the filter adequately and appropriately sized to meet the filtration challenge; and, is the filter to be installed in such a way as to maximize its effectiveness. The reputation and integrity of sand filter manufacturers, as well as those who recommend, specify, purchase and install filtration devices, is at stake.