GreenWater Technology

High Efficiency Filtration

Case Study: Pharmaceutical Lab Cooling Tower

The San Francisco Bay Area is home to many biopharmaceutical laboratories, where quality assurance and control is at a premium. One such company incorporated a GreenWater Technology Revolution High Efficiency Filtration System, to test its performance next to the conventional sand filters that they had been using to keep their process water clean. The results spoke for themselves.

The laboratory was located along the San Francisco Bay and utilized two identical cooling towers, located at ground level, with regular exposure to heavy winds. Prior to the installation of the Revolution filter, both cooling towers ran identical, traditional sand filters for system treatment, providing the best possible assurance for similar water composition and component condition. The chief facility engineer chose, at random, which cooling tower the Revolution HEF System would be installed on, and the sand filter for that cooling tower was bypassed.

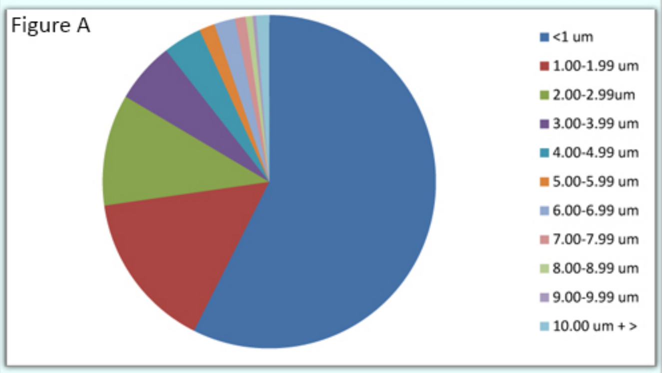
Just ten days post Revolution HEF System installation, approximately 100 system turn-overs had been completed, and water samples were taken from each tower and sent to an air and water quality testing lab for composition analysis. Laser particle analysis was then performed on each water sample, and the findings are detailed below. Composition counts of each sample were organized by particle sizes. Figures A and B provide the information gathered from testing, including the surface area and volume percentages for each size group, as well as mass recorded in parts-per-million.

HEF vs. Conventional Sand Filter: Side-by-Side Composition Testing Results

Figure A shows the laser particle test results for the conventional sand filter. The tested water sample had a total particle count of over 800 thousand and a mass rating of approximately 64 PPM. More than 99% of the total mass was from particles larger than one micron.

Conventional Sand Filter Particle Distribution

Figure A

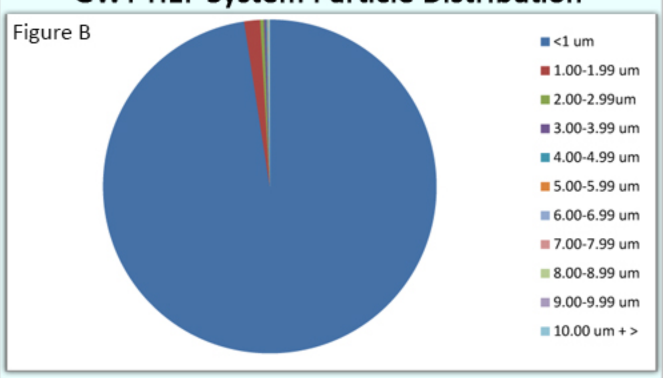


Grouped	Total Counts	Counts %	Surface Area %	Volume %	Mass (PPM)
<1 um	460055.74	57.45%	0.00%	0.00%	-
1.00-1.99 um	122211.13	15.26%	1.44%	0.10%	0.0640
2.00-2.99um	86648.54	10.82%	4.08%	0.48%	0.3052
3.00-3.99 um	47134.55	5.89%	4.99%	0.79%	0.5063
4.00-4.99 um	29917.74	3.74%	5.63%	1.11%	0.7089
5.00-5.99 um	12136.44	1.52%	3.57%	0.83%	0.5312
6.00-6.99 um	16087.84	2.01%	6.81%	1.82%	1.1626
7.00-7.99 um	8467.28	1.06%	4.88%	1.46%	0.9349
8.00-8.99 um	5362.61	0.67%	4.04%	1.34%	0.8548
9.00-9.99 um	2822.43	0.35%	2.69%	0.97%	0.6220
10.00 um + >	9972.57	1.25%	61.87%	91.10%	58.2791
Total	800816.87	100.00%	100.00%	100.00%	63.9690

Figure B shows the process water treated by the GWT Revolution HEF System, which had a total particle count of less than 180 thousand, and 97% of that was sub-micron. GWT's HEF System also filtered the water down to a mass rating of less than 0.1 PPM.

GWT HEF System Particle Distribution

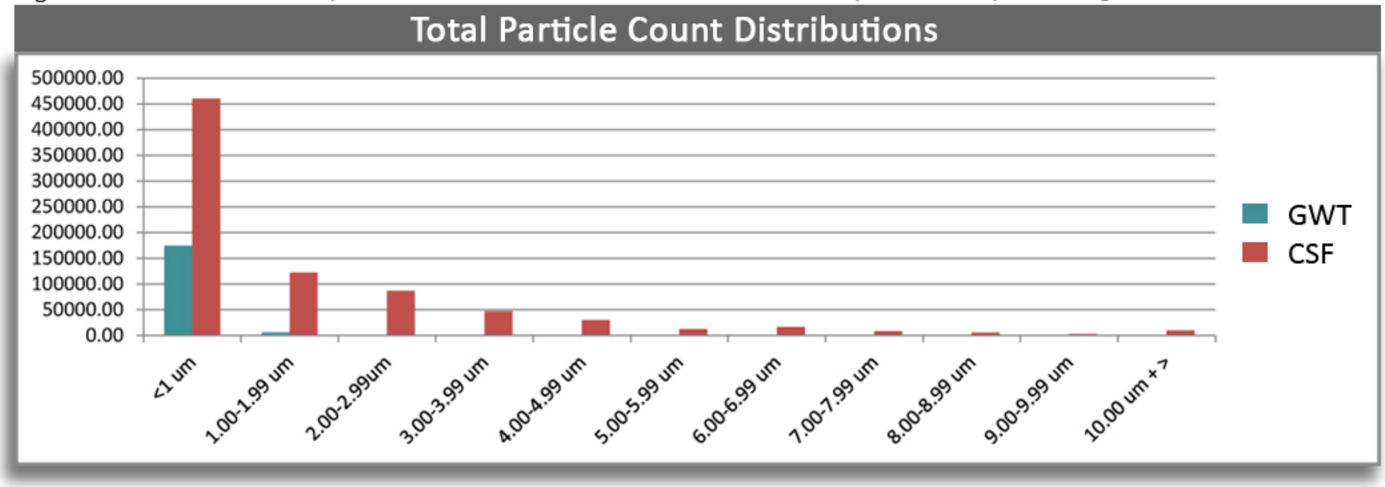
Figure B



Grouped	Total Counts	Counts %	Surface Area %	Volume %	Mass (PPM)
<1 um	174111.91	97.53%	0.00%	0.00%	-
1.00-1.99 um	2772.68	1.55%	8.04%	2.16%	0.0015
2.00-2.99um	630.16	0.35%	7.31%	3.30%	0.0022
3.00-3.99 um	378.09	0.21%	9.87%	6.04%	0.0041
4.00-4.99 um	189.05	0.11%	8.78%	6.66%	0.0045
5.00-5.99 um	63.02	0.04%	4.57%	4.10%	0.0028
6.00-6.99 um	189.05	0.11%	19.74%	20.31%	0.0137
7.00-7.99 um	0.00	0.00%	0.00%	0.00%	-
8.00-8.99 um	126.03	0.07%	23.40%	29.86%	0.0201
9.00-9.99 um	0.00	0.00%	0.00%	0.00%	-
10.00 um + >	63.02	0.04%	18.28%	27.58%	0.0186
Total	178523.00	100.00%	100.00%	100.00%	0.0673

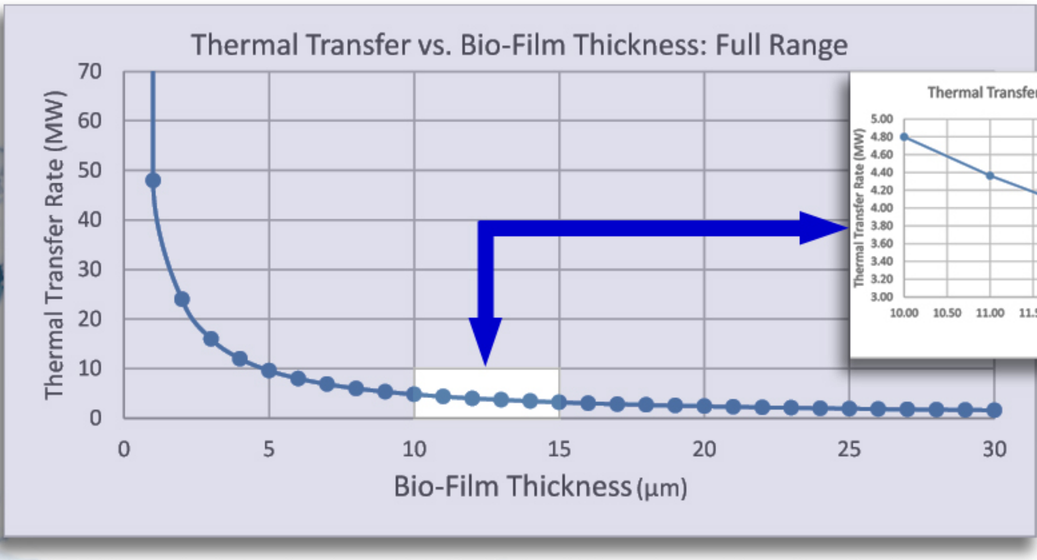
Total particle count distributions by size for the sand filter and Revolution HEF System are compared in Figure C. The sand filter still has visible ratings for particles all the way up to greater than 10 µm, while the only significant count for the Revolution System is less than one micron. GWT's System decreased total particle count by 80 % and the count of particles larger than one micron by 98 %. The parts-per-million mass rating in the water treated by the GWT Revolution HEF System was one-thousand times less than the rating of the water from the traditional sand filter. The severe drop in suspended material resulted in a dramatic increase in thermal energy capacity of the water, increasing the cooling tower's performance while reducing energy costs to the facility.

Figure C: Particle distribution comparison of conventional sand filter vs. GWT Revolution HEF System on side-by-side cooling towers.



Inorganic materials such as sand and mineral scale are roughly 10 times less thermally conductive than water, and bio-film is nearly 100 times less conductive. Figure D shows how the thickness of a layer of bio-film on the inside of a cooling tower can affect the thermal transfer rates of the system. As the thickness of bio-fouling decreases, the rate of energy transferred through that layer increases exponentially. For the 30 µm (0.001 in) increase in bio-film thickness shown, the thermal transfer rate decreases by 97 %. This huge jump in the capability of the system to expel heat is reflected by a decrease in the energy costs of the facilities.

Figure E is an expanded view of the chart in Figure D, showing the transfer rate trend between 10 and 15 µm (0.0004 and 0.0006 in). By cutting the film thickness by just five microns, the thermal transfer rate increases by 50 %, a huge payback for such a small depth change. This efficiency to thickness change ratio increases as the system gets cleaner. GreenWater Technology's HEF Systems filter down to a level that eliminates the nutrient source for the bio-films, effectively starving them, causing them to flake and fall off of the surface. GWT's Revolution System thereby cleans the inside of the loop, significantly increasing thermal transfer rates of the system.



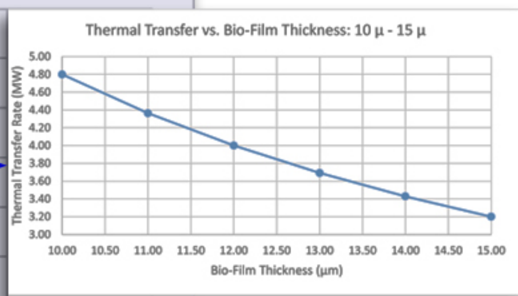


Figure E: Close-up view of Figure D.

Numbers given are for a 2 m x 2 m section of wall, with a temperature differential of 20 °C.

Figure D: Line graph showing the adverse effects bio-film layer thickness have on thermal transfer rates.