VORTISAND®

Technical Review Addendum

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Sonitec INC.

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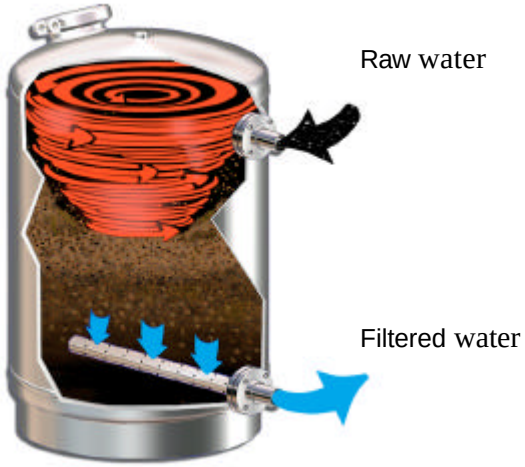
VORTISAND

Technical Review



Proven to filter down to 0.45 MICRON

VORTISAND uses centrifugal force (vortex effect) to whirl the untreated water above the media (multi layers) helps to collect the large suspended solids on the side wall of the tank, collect the majority of particles above the filter bed and develop a filter cake of the smallest particles. This significantly increases the effective filter surface within the tank.

This turbulence produces a sustained cleaning action, cross flow filtration, that forces the suspended solids to accumulate on the inside walls of the tank. As a result, much finer sand can be used without any clogging problems. The water, now largely free of impurities, is then filtered through the media and subsequently collected. Contaminants trapped above the sand are removed using an automatic backwash cycle which requires less water and a shorter operating time than traditional sand filters. This process contributes to longer cycles and much finer filtration levels.

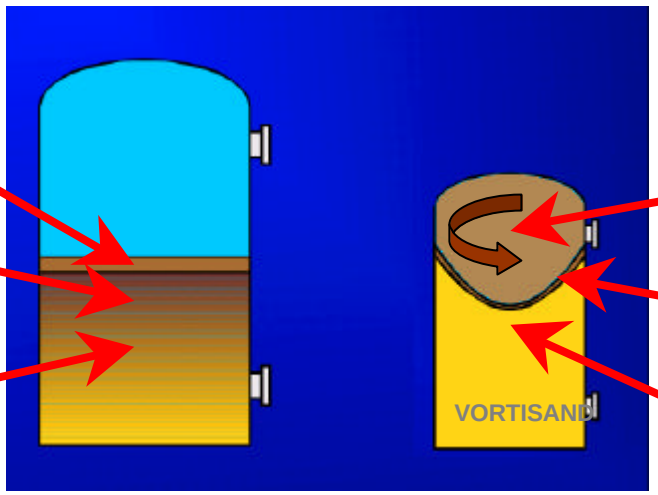
The Vortisand is the only company that provides a, patent pending, chemical cleaning cycle during backwash to maintain the high efficiency filtration by keeping the media clean over a period of time.

Conventional Depth Filtration Down Flow

Filter Cake
(dependant)

Contaminant Accumulation
2 – 5 lbs / CuFt

Working Media



Cross Flow Filtration Vortex Effect

Contaminant Accumulation

Filter Cake
(limited)

Working Media
(ultra fine level)

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The typical Depth Filter Down Flow approach uses the media bed hold solids at a rate of 2 to 5 pounds of solids per Cu Ft. The Vortisand works on Cross Flow Filtration, like a membrane system, which allows the water to maintain a cleaning action at the top of the ultra fine media working layer. If this same media was used in a conventional down flow design, the filter would blind over and channeling would quickly develop thoughout the bed. This technology allows Vortisand to filter down to 0.45 micron, easily carry away solids during backwash and maintain a higher filter efficiency.

The conventional down flow depth filter technology can only filter 10 to 15 micron in particle size. Typically after backwash the filter can reduce solids down to 15 micron until a filter cake is developed and then filtration may decrease to 10 micron. Once the filter cake creates a higher then design pressure differential, the solid captured in the top lay of the conventional filter bed can channel down through the bed and out the bottom distribution piping, resulting a surge of TSS back into the cooling tower filter.

Another significant difference in the two technologies is that the depth filter will require higher water flow during back wash, requiring a larger pipe to be installed on both the backwash water and the backwash waste water line, to carry away waste water. Typically, a down flow filter will use 25% to 50% more backwash water over the same period of time, resulting in higher utility and higher waste water cost.

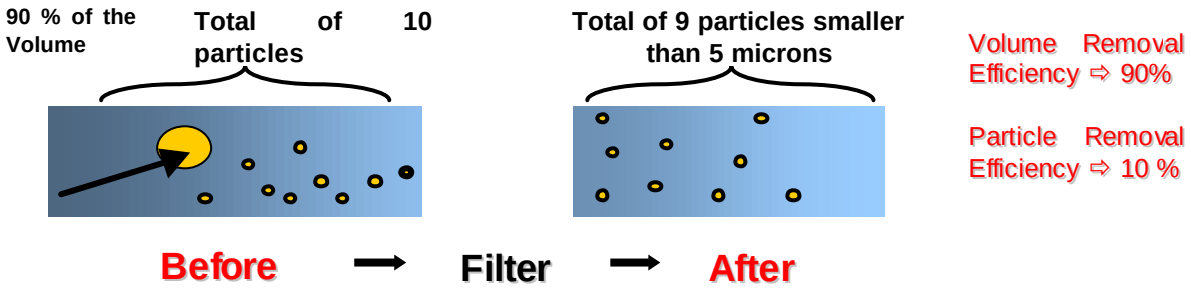
The limitation of a conventional depth filter is 10 -15 micron filtration efficiency. The filter requires a filter cake to form before filtration down to 10 micron can be realized. The filter quality changes during filtration the filtration cycle, the backwash rate is the same as process flow or higher, use of chemical dispersants limit filters effectiveness and energy requirements require higher filtration efficiency due to high turn over rate requirement to filter down to 10 micron. Overall, the utility cost is higher, the cost for waste water treatment is higher and typical energy cost will be higher if properly sized.

Key Benefits of the Vortisand

- Proven technology for over 25 years in both small and large flow systems
- Nominal 0.45 sub-micron and proven to remove TSS down to 0.25 micron
- Reduces all (TSS) total suspended solids in circulating water loops by more than 90%
- Filtration up to 20 gpm / sq.ft. (2-4 times greater than conventional filters)
- Improve chemical effectiveness by significantly reducing suspended solids
- Reduces nutrient food source for biological formation, typically related to those particles less the ten micron
- Reduces energy consumption
- Low backwash flow rate and volume of water
- High efficient filtration means smaller foot print installations and easy to install
- Durability & Maintenance free operation
- Low horsepower requirement
- Variable and full flow systems
- Fully automatic systems with adjustable OIU settings
- Filtration efficiency unmatched

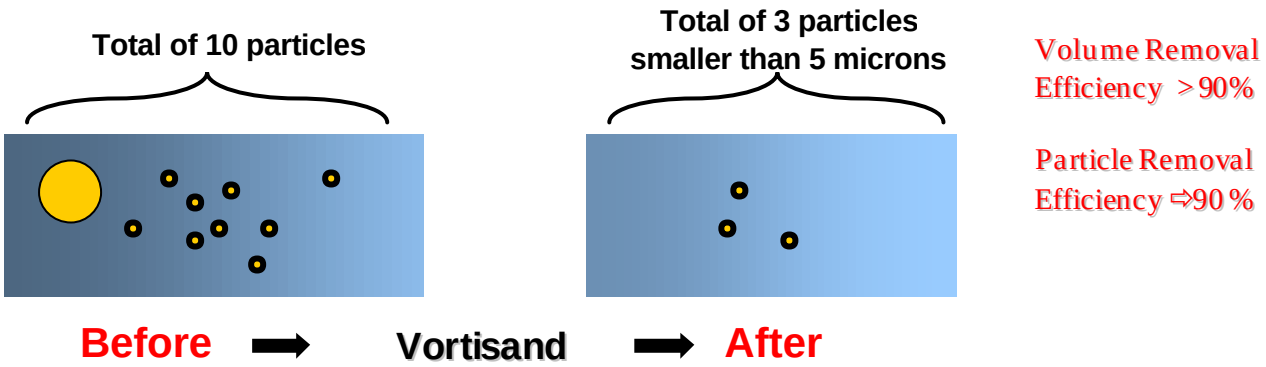
Importance of Filtration to Less Then 1 Micron

Conventional Filtration - Filtration by % Volume / Weight Removed



Conventional filtration performance is based on the ability to remove a % of volume of total particle by weight, even though the total number of particles removed may be only be 10 to 15%.

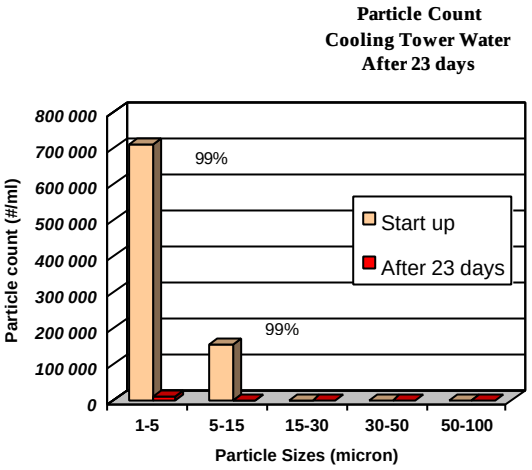
Vortisand High Efficiency Sand Filtration - Filtration by Particle Total T.S.S. Removal



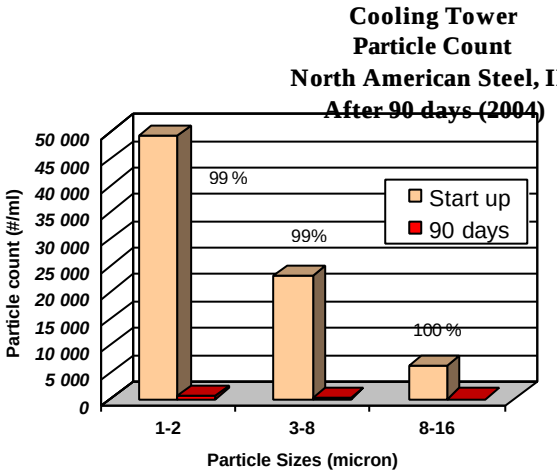
The Vortisand high efficiency sand filtration will not only remove the particles filtered by the conventional approach, but will remove all TSS,even down to less the 1 micron. Typically, 85-90% of the particles found in the recirculation cooling tower water are smaller than 5 micron in size. Despite their larger number, these very fine particles usually make only 5-10% of the total volume in the water. Typically 90% of the volume of the particles is represented by particles 5-7 micron and larger.

It has been proven that fouling is due to the very fine particles that can plate on the surface due to the low laminar flow and velocity. Small bacteria, which reject a polysacharide product (binding agent) start building up, creating slimy condition that attracts and retains other particles.

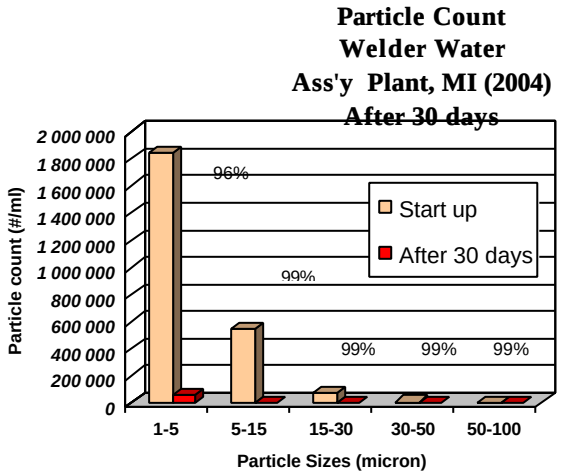
Typical Vortisand Performance in other Industrial Applications:



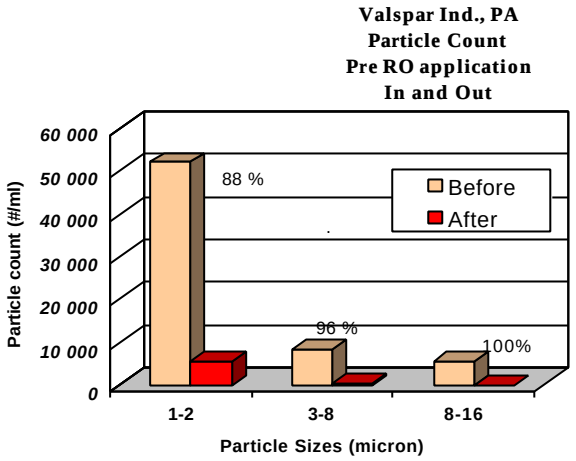
Automotive Assembly Plant Cooling Tower Application. **After 23 days** of operations, note the **reduction of TSS – 99%.** 1 to 5 micron particles were reduced from 700,000 count to less then 7,000.



North American Steel reduced TSS by 99% in less then 90 days. Note all particles above 8 micron removed.



American Automotive Assembly Plant closed loop-cooling water. The majority of particles found in the closed loop water was suspended iron**. After 30 days 99% of all particles were removed**. Note the total number of particles less then 5 micron was 1,800,000 in count. This system has a, patent pending, chemical feed system to prevent the iron from fouling the filter. Welding tip replacement was reduced by more then 60%, because of less fouling, resulted in less labor cost and less downtime.



This is a pretreatment to a RO, which has run 90% recovery and the first cleaning was not required for over two years. This performance is important because this application is a once through system. Based on the Vortisand filtering the water just once, we were able to remove 88% of all particles 1 to 2 micron, 99% of all particles 3 to 8 micron and all particles above 8 micron. The filter was sized for more contact time, but the technology demonstrated just how well it works.

Why would any company concerned about reducing TSS use a conventional down flow depth filter. The normal approach to filter below 10 micron is to use a MF or UF membrane, which is cannot be justified based on the total capital cost requirements of these technologies. In cooling water application we have 1,000's of applications that have proven the technology and the effectiveness of this cross flow filtration technology.

Filtration Technology Comparison

FILTRATION TECHNOLOGIES	VORTISAND	SINGLE-MEDIA	STRAINER	SEPARATOR
COMPARISON		SAND FILTER		
				
Filtration Efficiency	0.45 - 2 micron	10 - 30 microns	25 - 50 microns	40 microns
# turnovers/day	10/day	24/day	24/day	57/day
% of circulation flow	5%	10%	10%	25%
Filter Flow Rate (gpm)	120 gpm	240 gpm	240 gpm	600 gpm
Volume of Water (backwash)	400 gal	1,250 gal	N/A	N/A
# vessels	2 X 20"	1 x 48"	N/A	N/A
Filter pump (HP)	3 HP	7.5 HP	10 HP	15 HP
Pipe Size (Inlet/Outlet)	2"	4"	4"	6"
Agitation recommended	No	Yes	-	Yes

Chart Bases: Circulation pump: 2,400 gpm, Volume of water: 15,000 gal.

Vortisand key advantages compared to technologies listed above: Filtration to 0.45 Micron, less circulation required, less energy to operate, less backwash per cycle, installation cost less.

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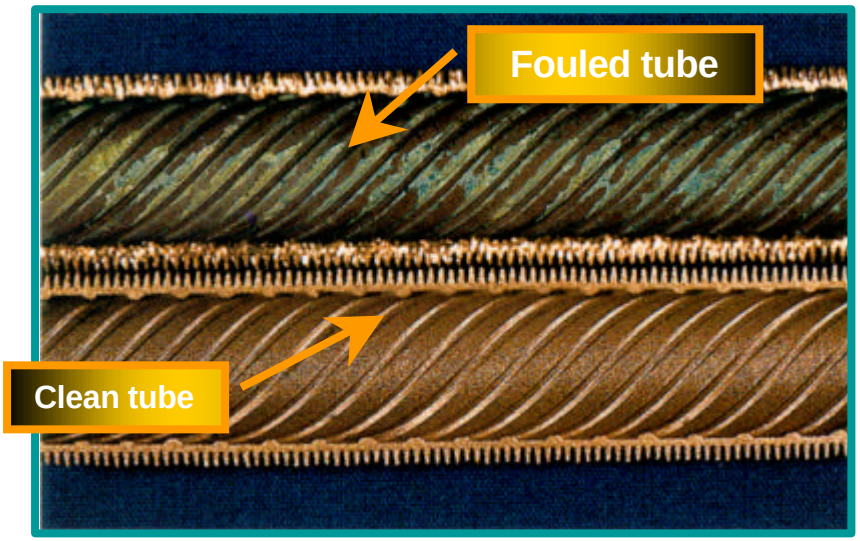
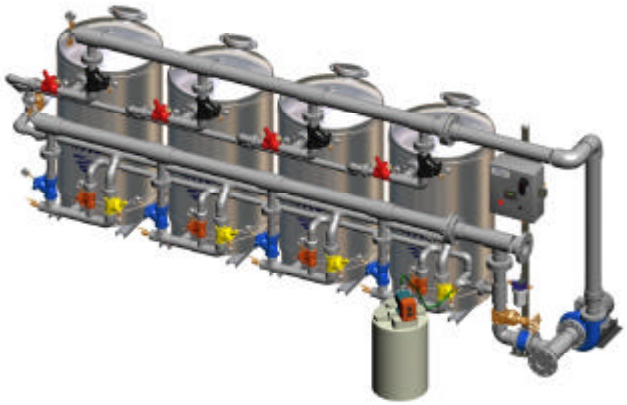
OPTIMIZING PERFORMANCE WITH ENHANCED TUBES



Use filtration to minimize suspended solids in the system. This will reduce the potential for fouling of water side surfaces, which results in under-deposit corrosion and loss of efficiency. Selection of bed size and appropriate filter media should be based on specific operating conditions and an analysis of particle size distribution in the recirculating water.

Chemical Cleaning Automated CIP System



Sonitec is the only company to offer a chemical cleaning process designed specifically to maintain media filtration effectiveness. This patented pending process allows our customers to maintain a clean media over the normal life of the media. It will ensure that the filter will not degrade quality over time, develop channeling, loss the ultra fine media due to biological growth in the filter bed, increase biological load to the cooling tower and reduce filtration performance.

The filter will provide chemical feed after a set number of backwashes. In the spring high run off may require the addition of a dispersant to reduce silt fouling and during the summer and fall the addition of chlorine will help to reduce bio growth.

The amount of chemical, type of chemical and frequency will be based on site specific need. Chemical feed will be added during the backwash cycle by the PLC and the HMI will allow the customer to set the frequency of chemical cleaning cycles, which could be every 3 to 8 backwash cycles.

Project Review - SHELL CANADA
MAKEUP AND COOLING TOWER WATER FILTRATION

1. Cooling tower system is open type, 25,000 gpm circulation rate
2. Make-up is St-Lawrence river water, average hardness between 80 to 110 ppm
3. Tower is counterflow, 4 cells, 42 X 120ft
4. 4 circulating pumps @ 12,500 gpm each
5. 46 exchangers connected to system
6. Cooling tower water parameters are:
   - pH: 7.0 to 7.4
   - Filtered phosphate: 13 -17 ppm
   - Free chlorine: 0.5 - 1.0 ppm
   - Cycles of Concentration: 3 – 6

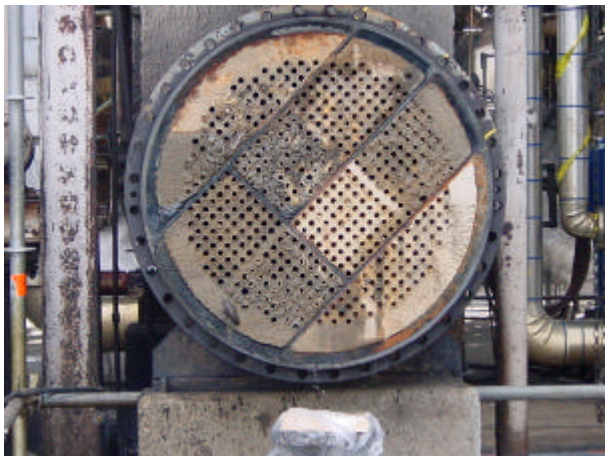
History of problems include: (1) at exchanger internal tubes fouling, (2) fouling was mostly carbonate precipitation mixed with bio residue and iron, (3) deposits & debris was found on the tube sheet surface of first pass and (4) time between cleaning depends on process temperature, bulk water temperature and tubeside velocity, range between 1 and 3 years.

The solution was to install a Vortisand, Model-AWT26-30-SP at a flow rate of 2,400 gpm. Special gradation of sand media allows capture of finer particles below 1 microns. The system was designed to a high filtration rate filter of 20 gpm / sq..ft, allowing for a compact system. The centrifugal separation (vortex) over filtration bed allowed the finer cake formation and finer particle removal as opposed to deep bed conventional filters. Low backwash water requirement, 5 to 8 times less than conventional filters reduced operation and waste water cost.

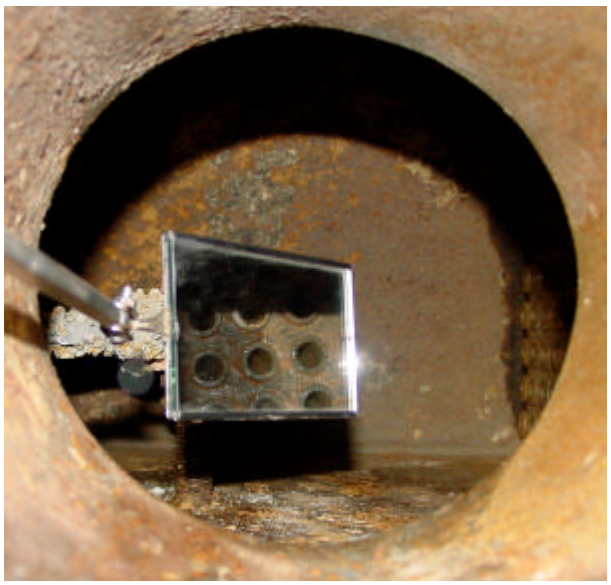
The Benefits

The benefit to Shell Oil included: (1) **Turbidity Reduction - 3 times lower after 30 days of operation**, (2) **Iron Reduction - 5 times lower after 30 days of filtration,** (3) **Cleaner Shell & Tube Exchangers - no periodic tube cleaning maintenance** and (4) **greater heat exchange efficiency** (reduced fouling), (5) **No premature shutdown** and (6) most important, **improved plant operations.**

Decreased blowdown and higher cycle of concentration improved system reliability reduced waterside fouling and maintained peak efficiency throughout the production cycle. Reduced maintenance reduced operational cost based on less frequent mechanical cleaning and reduced corrosion. Reduced water chemical usage reduced operational cost and chemicals used were more effective because of reduced particle load. Unit energy savings was based on efficient condensation produces less gas to be compressed and reduced distillation tower operating pressure requires less heat.



Dirty shell & tube heat exchanger without Vortisand® water filtration. Source: Shell (2004) This condenser presently is not filtered by a Vortisand, budgeted for 2006 installation. The same source water and operational conditions are found on the clean condenser below but is filtered with a Vortisand, installed in 2002.



Clean shell & tube heat exchanger with Vortisand® water filtration (7 turnovers of total volume) . Note: cooling water on tube side of heat exchanger. *Source: Shell Canada 2004*