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Cover Story
SpinTek: Improving the Aqueous Coalescer

SpinTek's Aqualescer – an Improved Aqueous Coalescer

By William A. Greene, SpinTek Filtration, Inc.

The removal of entrained organic from aqueous streams is an essential process to minimize plant operating costs and maximize the quality of the electrolyte. Current technology is the CoMatrix™ filter and conventional Dual-Media filters.

For each Solvent Extraction Plant it is necessary to consider electrolyte filters to remove the entrained organic from the principal stream. For 10 years now, the improvements in solvent extraction processes have led to a reduction in the levels of entrained organic. In the last decade, for example, the amounts of entrained organic in the rich electrolyte could reach more than 100 ppm, but now those values reach 20 or 10 ppm. Because of this, the efficiency of the filtration equipment is decreasing exponentially due to the lower amount of organic and therefore less coalescence.

Because of this it is necessary to design a new equipment or device capable of reducing and also coalesce the organic to increase the efficiency in the filters and get outlets lower than 2 ppm in the electro-winning feed lines, instead of 5 ppm or more. SpinTek Filtration has been working to offer a product that allows a pre-coalescence at low cost. This equipment can control the flow problem due to operational conditions, delivering a homogeneous flow.

In addition, entrained organic recovery equipment has found very limited commercial implementation due to the very high flow rates compared to electrolyte and subsequent higher than acceptable capital costs. Another goal is to produce a low cost but very high flow rate system that can consistently remove 75% or greater organic removal.

The following reports on the recent study of an improved Matrix Tower™ and the initial application is for the removal of organic (liquid ion exchange + diluent) from a strong copper electrolyte solution.

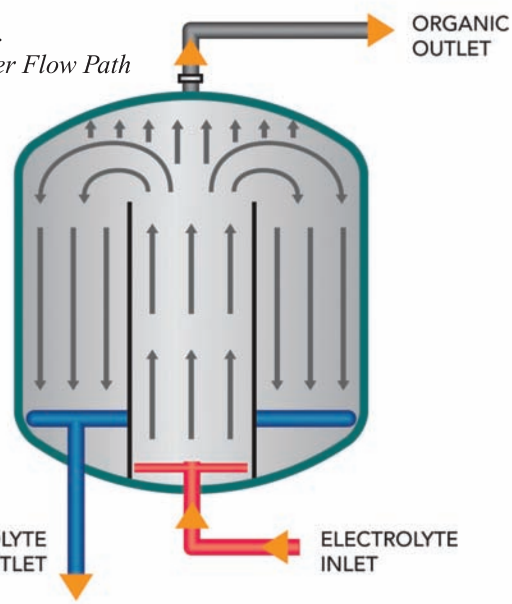
A Matrix Tower coalescer design produces an enlarged droplet size of the organic for more efficient removal by the subsequent filter. It is commonly known that as modern SX-EW plants become increasingly more advanced in design, the organic droplet sizes decrease accordingly as a result of this enhanced mixer/settler operation, causing lower efficiency in the filters. Crud and organic loads associated with crud can also be reduced from the electrolyte by placing less of a load on the filters.

An added benefit is that a reliable coalescer can smooth out levels of entrained organic to a media filter and thus compensate for normal plant upsets that can cause excessive organic levels from entering a filter. By stabilizing the organic level to electrolyte filters reduces the chance of overrunning these filters, which send organic to the tank house. The service cycle of the filters prior to backwash can be more accurately predicted. The added benefit of fewer backwashes is that filters are on line for longer periods of time and the amount of water or lean electrolyte used for backwashing is minimized.

METHODOLOGY

The coalescer can be viewed as a "tank within a tank" where the outer tank can be pressurized up to 100 kPa and has an access manway and nozzles for service inlet, service outlet and organic recovery. The inner tank is a cylinder that is connected at the bottom but open at the top. The flow path is up through the center of this cylinder and then the electrolyte changes direction and flows down through the annulus formed by the inner cylinder and the inner walls of the outer tank. The organic floats to the top of the tank and exits the system.

Figure 1. Coalescer Flow Path



The operation of the system is enhanced by placing anthracite or polyethylene beads in the cylinder and putting a grid on the top of the cylinder to prevent the escape of the coalescing media. In the annulus area, Matrix packing™ that consists of hydrophobic corrugated packing is installed. The distance between the corrugations are typically 12 mm up to 17 mm. The flow rate through the cylinder is in the 60 m3/hr-m2 range. Hence if anthracite is used the flow velocity forces it to the top of the cylinder and the containment plate.

Free organic can be formed and flow to the top of the cylinder. To further improve organic removal efficiencies if the organic touches the Matrix packing, the hydrophobic nature of the packing will cause the organic to stick to its surface. This organic on the plates eventually form larger droplets that break free from the Matrix packing and are buoyant enough to flow upwards (counter flow to the electrolyte) and migrate to the dome of the tank and exit the coalescer.

The general concept of this new technology is pre-treatment organic equipment, which decreases the levels of entrained organic and also coalesce the residual organic for recovery improvements in the electrolyte filters. There is no similar equipment in the marketplace.

Also to improve the coalescence, SpinTek studied the way to add pressurized air in the inlet feed line to increase the efficiency of the unit.

A further enhancement is to introduce air into the feed inlet. The air provides lower surface tensions and hence helps coalesce organics. The air/organic then reaches the media layer where larger organic droplets are formed that will float up to the top of the domed top.

The test system was set up and operated at 38 (l/m) and used the feed pressure from the electrolyte filter feed pumps, and after usage, the electrolyte was returned to the same feed tank. There was no loss of electrolyte from the plant during operation of the pilot.

The coalescer was operated for 48 hours without sampling to stabilize operation and to coat the system with organic from the feed electrolyte. It is necessary to coat the coalescer with organic as this will be its normal operating condition.

The parameters that influence the efficiency of recovery in filtration equipments are:

Concentration of entrained organic, organic droplets size, homogeneous in the entrained organic feed flow, extractant type, homogeneous electrolyte inlet flow, pressure in the inlet line, pressure in the outlet line, copper concentration in the solution, electrolyte temperature, electrolyte viscosity and an adequate residence time on feed tank.

These parameters are not dependent on the filter itself, they depend on the design and operation of the plant. Of course, the filters also have parameters to consider, referring to media bed granulometric, backwashes steps and times, coalescing design, operational considerations, etc.

During May 2009, SpinTek ran a pilot system considering the new coalescer concept followed by a CoMatrixTM filter in Minera Gaby S.A. The following report is a study designed to compare the combination of the Coalescer and CoMatrix Filter versus the CoMatrix Filter removal process.

The testing of the coalescer is to determine if the system can smooth out the organic entrainment levels entering the electrolyte filters. The system would allow for a more consistent flow to the filter and remove the impacts of organic surges from the electrolyte feed tanks.

The Coalescer and CoMatrix will be operated in series with the rich electrolyte first entering the Coalescer and the effluent of the Coalescer being the feed to the CoMatrix.

It is often desirable to provide larger organic droplets for the CoMatrix filter removal process. As the organic droplets pass through the Matrix Plates, the droplets will adhere to the surface and coalesce with other droplets causing the organic to rise due to buoyancy of their size. If the droplets are smaller than 10 micron in size, the droplet will pass through the Matrix Plate without coalescing.

As for the Anthracite Media, it should capture these smaller size organic droplets through coalescing. Several problems can occur in the Anthracite Media when exposed to crude during the service opera-

Figure 2. Coalescer with Matrix Packing

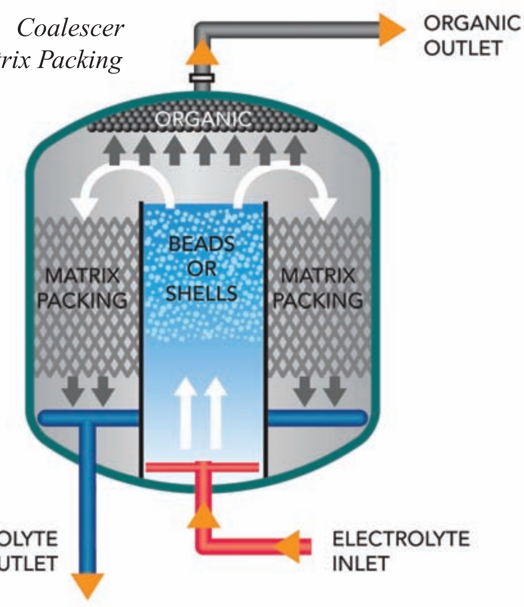
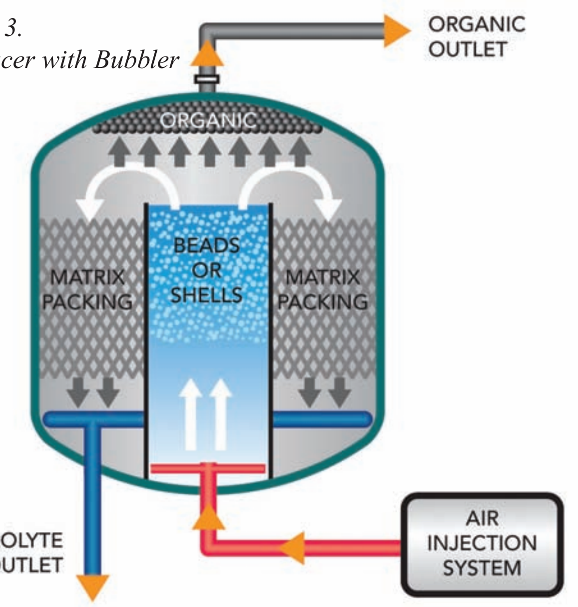


Figure 3. Coalescer with Bubbler



tion. Crude is a combination of organic droplets, water, particulate and air. This could have two major consequences in the Anthracite Media Layer.

First, the Anthracite Media Layer could cake-up and crack during backwash. This will allow the organic droplets to pass through these cracks to prevent any efficient removal. Second, the crude could adhere to the anthracite and this could cause the anthracite to float. The anthracite will be removed during backwash and depleting the Anthracite Media Layer. This will decrease the efficiency of this layer in removing organic droplets.

The facility at the Gaby´s Solvent Extraction Plant offered the opportunity to use the new Coalescer and CoMatrix Pilot to evaluate the removal of small organic droplets and crude during service operations.

The flow sheet of the test program is as follows. The direct feed from the coalescer to the CoMatrix was done to minimize pumping issues and other operational conditions for the test units.

In actual implementation, the configuration would be the electrolyte feeding the Matrix Tower coalescer and then be gravity fed to the electrolyte feed tank. The existing pumps would then feed the electrolyte from the feed tank to the CoMatrix filters.

RESULTS

The chart to the right shows the result of the Matrix Tower coalescer over a continuous five (5) day service run. As can be seen, the results show low levels of organic in the total effluent with the vast majority of organic removed by the coalescer.

Efficiency removals approached 95% during parts of the service run.

The removal efficiency of the filter is low because of the lower amounts of organic due to less coalescence. The principal objective for this removal in series is to assure a minimum amount

Sample Number	Service Inlet (ppm)	Service Outlet (ppm)	Removal %
1	23	3	87%
2	29	2	93%
3	38	2	95%
5	30	4	87%
6	23	5	78%
		Average	88%

Table 2. Over 20 ppm

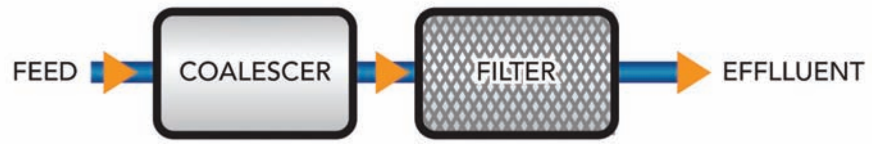


Figure 4. Flowsheet - Coalescer with CoMatrix

of organic in the outlet. The raw data in Table 1 gives an indication of system performance. As can be seen with organic inlet concentrations as low as 9 ppm, the average entrained organic removal was 75%. Considering the CoMatrix Filter, the average entrained organic removal reached 90% total.

CONCLUSIONS

The coalescer performed well even with the presence of significant amounts of crud (organic + suspended solids) and the system was never out of service during the five (5) day test run.

The system consistently averaged 75% organic removal from the feed electrolyte. When the organic present in the feed was greater then 20 ppm the efficiency rose to 88%. As the level of organic is even higher in the 30 ppm range removal efficiency rises to the 95% range.

The coalescer has the ability to significantly reduce the amount of organic in the electrolyte, which will extend the service run of CoMatrix™ or Dual-Media filters used to polish and filter the electrolyte. In this pilot, the overall efficiency rose 90% considering Coalescer and CoMatrix Filter.

The system is a low cost method of entrained organic removal either as a stand-alone system on raffinate or a pre-treatment to polishing filters on electrolyte. As an example, a 4872 mm diameter Matrix Tower coalescer operates at 600 m3/hr and can be constructed of FRP or thin wall stainless steel, which is enough for many electrolyte or strip applications.

The reason why the removal efficiency decreases at lower entrained organic (below 20 ppm) is because of the lower amount of organic in a turbulent feed (pressurized line) that allows less probability for natural coalescence due to smaller size organic droplets, normally less than 10 microns. The only way to increase the efficiency under this condition is to allow a natural coalescence giving more residence time, and also maybe considering progressive cavity feed pumps instead of centrifugal to avoid high turbulence and mix agitation on discharges.

Several problems can occur in the Anthracite Media when exposed to crude during the service operation. Crud is a combination of organic droplets, water, particulate and air. Crud must be taken out from the system, and the previous coalescer is an excellent way to avoid amounts of crud to come inside the filters, increasing the media removal efficiency.

Large raffinate streams, for example, at 2400 m3/hr could be configured as follows, considering a design rate of 30 (m3/hm2):

Four (4) Coalescers - 4872 mm diam.
Three (3) Coalescers - 5785 mm diam.
Two (2) Coalescers - 7308 mm diam.

For more information contact:

SpinTek Filtration, Inc.

10863 Portal Drive

Los Alamitos, CA 90720 USA

Tel: (714) 236-9190

Website: www.spintek.com