AQUEOUS COALESCER FOR ELECTROLYTE AND RAFFINATE ENTRAINED ORGANIC REMOVAL

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ABSTRACT

A development and field testing program was undertaken for an improved aqueous coalescer for both electrolyte and raffinate streams. The achievement of such a program would provide low cost and effective coalescence of entrained organic that would improve the performance of subsequent dual-media filters and on raffinate provide for a stand alone solution. The desired goals as a pre-treatment to dual-media filters is to 1) improve final effluent quality, 2) reduce backwash frequency of the filters, and 3) provide a more easily recovered organic then the reprocessing of backwash electrolyte or water.

The system was shown capable of operating at pressures under 140 kPa and obtained entrained organic removal of up to 95%. The low operating pressures allow for lower capital costs and the ability to treat entire raffinate streams previously not feasible due to extremely high capital and operating costs.

This paper will discuss the design and basic operational considerations of this improved coalescer and how it can be applied to new construction as well as operating plants. A unique feature will be discussed as how the coalescer can be incorporated into existing dual-media filters to significantly improve organic removal, extend service runs, and reduce backwashing frequency.

INTRODUCTION

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. The desire is to produce a low operating and capital cost coalescer that can be used to feed these media based systems. It is desirable to remove high levels of entrained organic to provide a more constant aqueous feed stream to this type of equipment.

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 then 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. This consequently causes 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 compensates 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 centre 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.

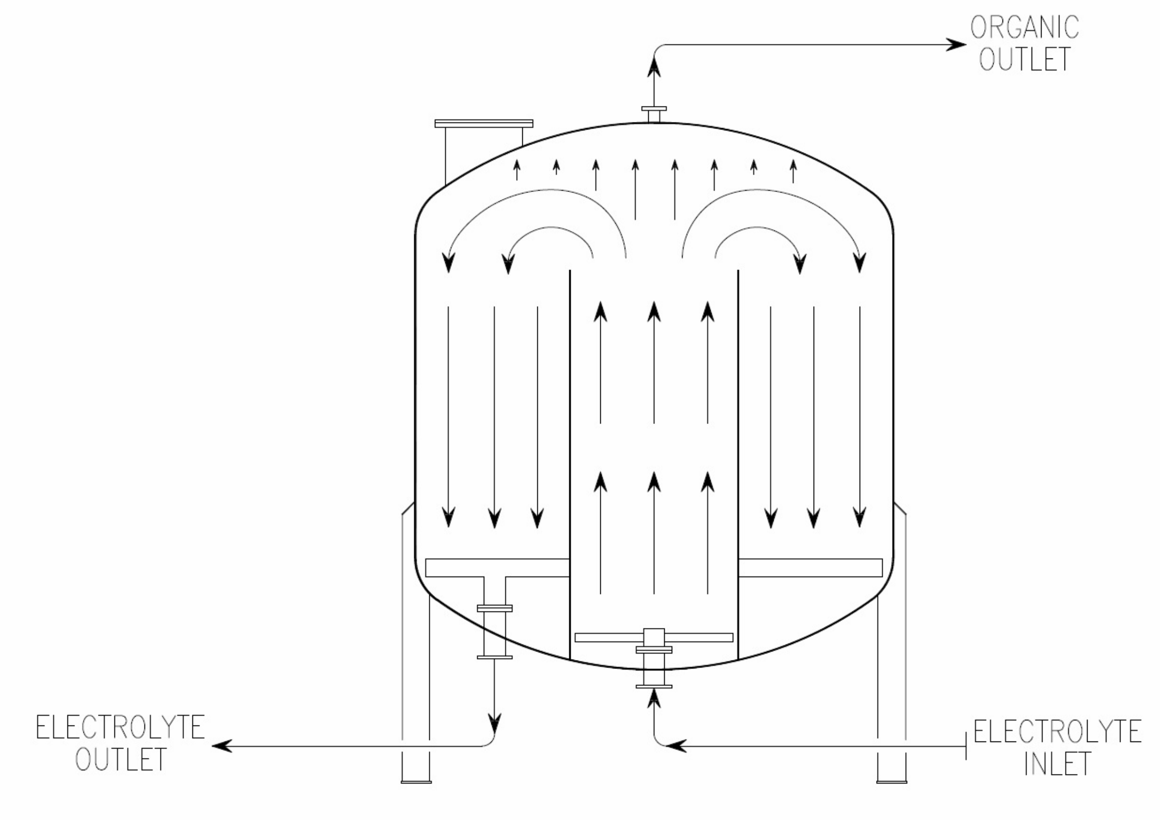

Figure 1 Coalescer Flow Path

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 we install Matrix packing™ that consists of hydrophobic corrugated packing. 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.

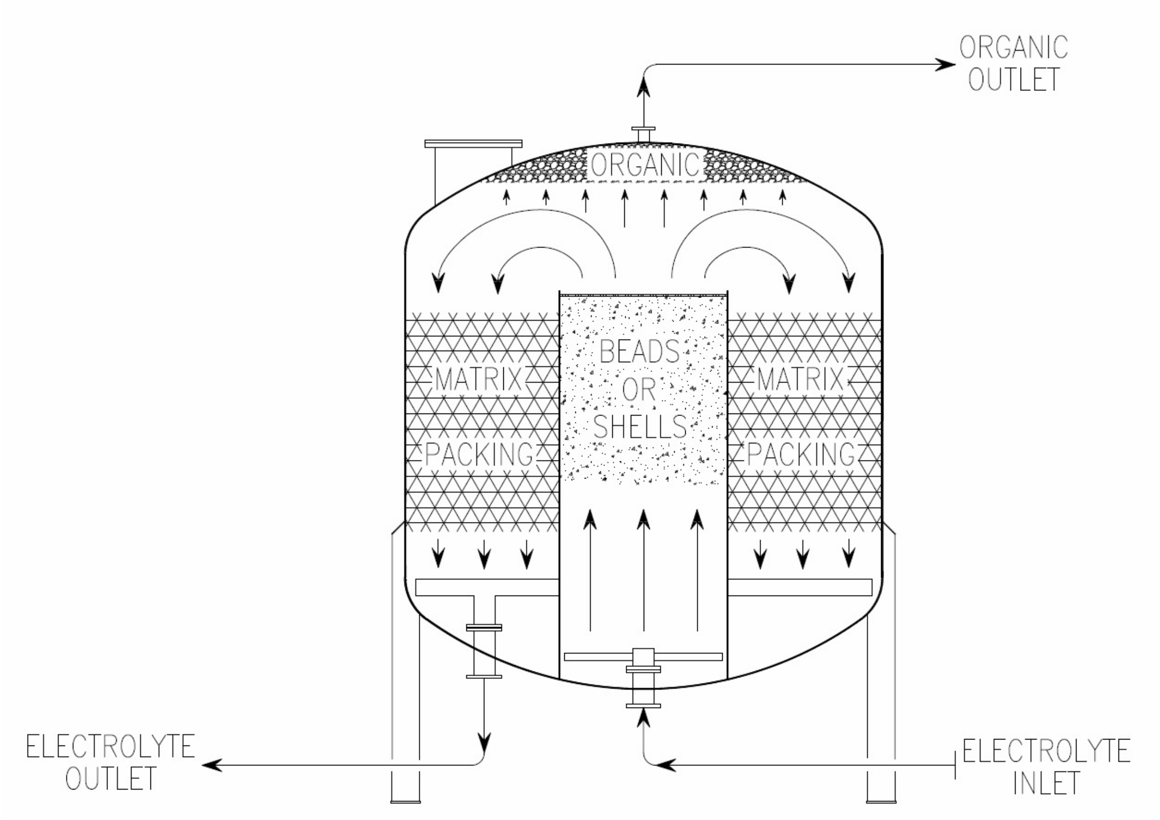

Figure 2 Coalescer with Matrix Packing

A further enhancement is to introduce air into the feed inlet. The air provides lower surface tensions and hence helps coalesce organic. 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.

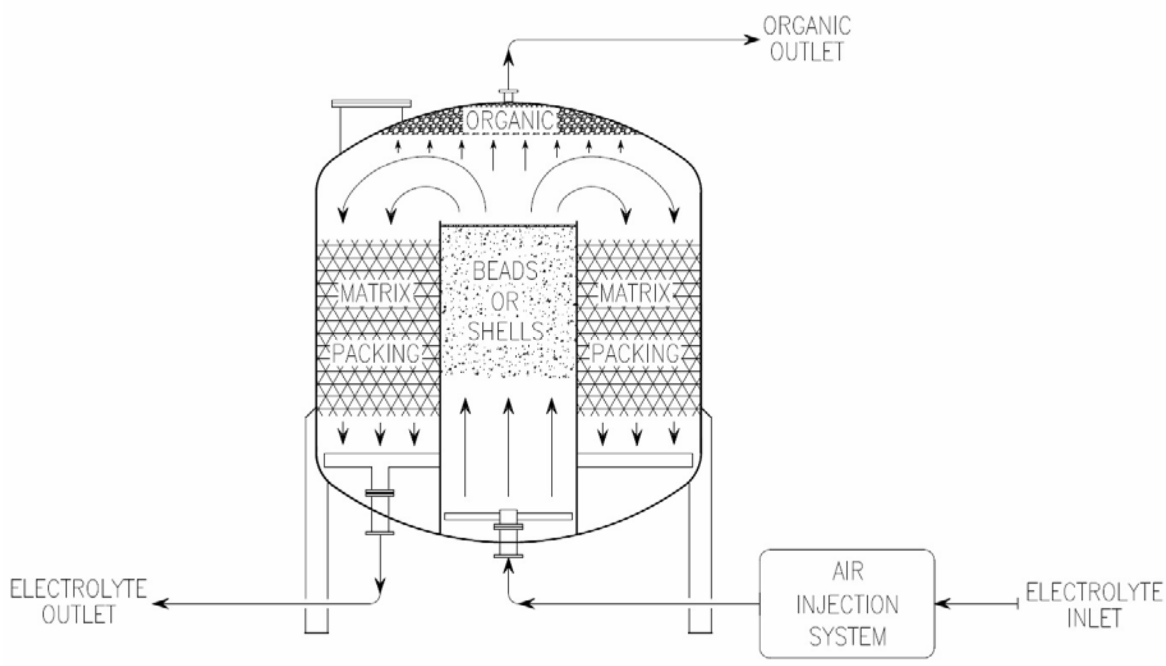

Figure 3 Coalescer with Bubbler

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.

RESULTS AND DISCUSSION

The chart 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.

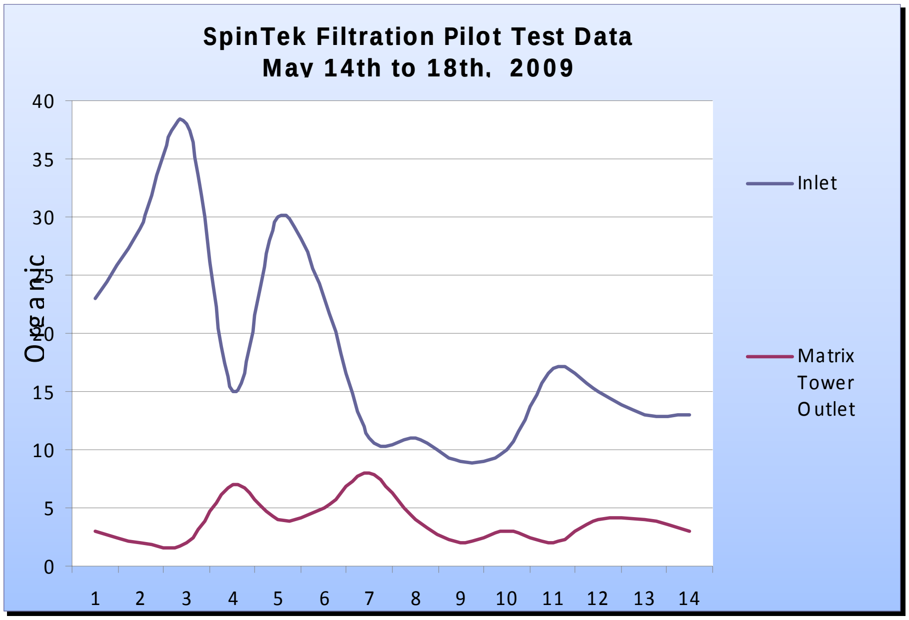

Chart 1 Coalescer Data

The raw data in the table below 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%.

Sample Number	Service Inlet (ppm)	Service Outlet (ppm)	Removal %
1	23	3	87%
2	29	2	93%
3	38	2	95%
4	15	7	53%
5	30	4	87%
6	23	5	78%
7	11	8	27%
8	11	4	64%
9	9	2	78%
10	10	3	70%
11	17	2	88%
12	15	4	73%
13	13	4	69%
14	13	3	77%
		Average	75%

Table 1 Five-Day Run

When the entrained organic level is above 20 ppm, indicating less organic associated with crud, the efficiency rises to 88%.

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

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 Matrix Tower 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.

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.

Large raffinate streams, for example, at 2400 m3/hr could be configured as follows:

Four (4) Coalescers	4872 mm diameter
Three (3) Coalescers	5785 mm diameter
Two (2) Coalescers	7308 mm diameter