Success – Changing a Process to Reduce Filter Usage and Lower Operating Costs

CRITICAL PROCESS FILTRATION, INC.

Description of the Filtration Challenge

A customer was designing a process to create a high-value liquid product. One of the process steps resulted in a mixture of the liquid with a high level of solids. After that step, the suspended solids were to be removed and the liquid product pumped downstream for further filtration and other processing.

At bench scale, the customer's process development team was using a traditional dead-end, microfiltration media. The filter system:

- was fouling within a very short period of time.
- required a large number of filters to process a batch, because of the high particle load.

The customer's team concluded that the number of traditional filters required would make the filtration costs prohibitive.

The customer's process engineers called on our Technical Service Team to research alternative filtration technologies that might last longer and remove solids more economically.

The Team received a sample of the liquid/solid mixture for testing. The sample was agitated to assure that the solids were evenly distributed in the mixture. The testing performed was a standard "filterability" test using several possible particle removal filters. The test determines the amount of fluid that can pass through the media before fouling. Single filters as well as multiple filtration media in a series were tested.

The Team found:

- Initial testing of the fluid found that the solids content was approximately 50%
- All filter media tested performed according to specifications, but fouled within a very short time.
- The throughput volume for all media tested was too small to allow the economical use of standard, dead-end cartridge filters

The conclusion of the Technical Services Team was that the level of particles in the fluid needed to be lower in order for normal cartridge filtration technologies to succeed. However, as testing was being conducted, the Team noticed that the fluid needed to be agitated periodically to avoid the solids settling to the bottom of test feed containers. This indicated that an alternative technology, such as centrifugal filtration, might reduce the amount of solids in the solution enough to allow the use of more efficient dead-end filtration media.

Success Story

Process Review

The Technical Services Team met with customer's process development and quality personnel to do a step-by-step review of the process developed and tested in the customer's lab. As with all process reviews conducted by the team, a series of questions was asked to determine what factors will most affect the process, the characteristics of the fluid and filter performance. During the meeting, the Team found the following.

1. What are the processing steps from initial mixing of the ingredients to the proposed location of the filters?

   ➤ Ingredients are added to a mix tank (including some ingredients from upstream mix tanks) and pumped directly to the filtration step. (Figure 1 shows a simplified schematic of the process).

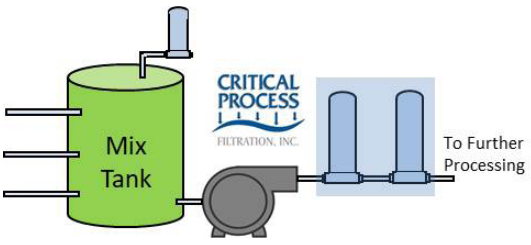
2. What are the process filtration goals?

   ➤ Remove solids from the fluid to allow further downstream filtration and purification.

3. Does the chemical composition of the fluid change?

   ➤ It is the same in all batches - including the level and type of solids in the fluid.

Figure 1 - Initial Filter Process Design



4. What are the known or suspected contaminants to be removed
   - The customer provided analyses showing that the solids had a consistent distribution of sizes and all batches had approximately 50% solids.

5. Do the process conditions change?
   - The flow rate, pressure and temperature are consistent and well within filter operating limits.

6. Are there cleaning and sanitization requirements?
   - No filter cleaning was required. Filters will be changed after each batch.

7. What are the target batch size and expected processing time?
   - The target batch size at full production is several thousand liters, though a solution to the solids removal issue is required to allow the process to move forward.

At the conclusion of the meeting, the Team asked if any testing had been done to determine how long it took for the solids to settle out of solution if there was no agitation. The customer had not considered a settling step, preferring to have the fluid continuously moving through all process steps.

After further discussion, the Team and customer engineers chose to do further testing that included testing the effects of a settling step on the characteristics of the liquid. If there were no ill effects, then it would be determined if the solids would separate from the fluid in a reasonable time - allowing economical filtration with traditional cartridge filters.

Solids Separation Testing

The customer submitted an additional sample for further testing. The Team agitated the sample to assure consistent solids distribution and divided the sample into multiple batches. Each batch was agitated for a period of time and then allowed to settle for a different amount of time. As observed during the previous testing, the solids separated and the high-value liquid remained at the top of the container. Analyses of the liquid, including filterability analyses, found an optimum time for solids settling that would allow the most efficient and cost-effective use of standard cartridge filters to remove remaining solids and further purify the liquid downstream.

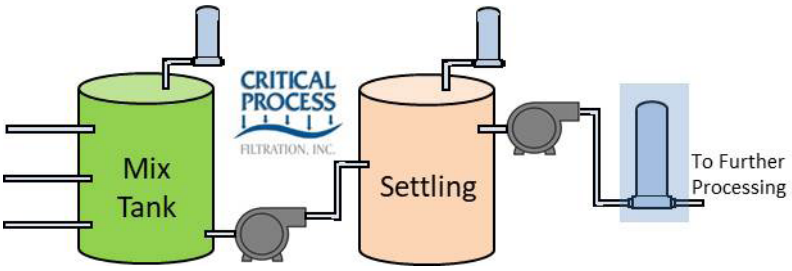
Solution Implementation

The Customer chose to install an upstream solids settling tank after the mix tank. Once the solids settle, the high value liquid can be removed using a decanting pump and the solids sent for further processing or disposed of according to the customer's waste control policies and procedures.

Figure 2 shows a simplified diagram of the final process chosen by the customer. The solids are removed by a process requiring minimal investment, reducing the number of filtration steps and reducing the amount of filtration media required.

With the help of the Critical Process Filtration Technical Services Team, the customer developed an economical and efficient process that delivers the high purity liquid product their customers require.

Figure 2 - Final Filter Process Design



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