HYDROCARBON PRODUCT PURIFICATION

Upgrade existing hardware to use novel technology specifically designed to improve overall process performance thereby increasing throughput and reducing operating expense and waste

BACKGROUND. Refineries convert crude oil into hydrocarbon products such as gasoline, jet fuel and diesel. When these products are sold, or transferred via pipeline, there are specifications associated with the quality of the fuel. These specifications include total sulfur content, mercaptan sulfur content, freeze point, acidity, water content, and particulate content among others. The water and particulate content are important parameters because they have a great effect on the visual appearance of the product, and because the product can be easily contaminated with water or particulate matter.

Many refineries and pipeline custody transfer locations utilize filters to remove particulate contamination, and filter-coalescers to remove the bulk of the water contamination.

OPPORTUNITY A large refinery in North America sent gasoline to a "gasoline blending unit" prior to custody transfer from the refinery to pipelines. As part of the custody transfer, the unit used a filter vessel and a filter-coalescer vessel to remove contaminants. The product flow rate varied between 6000 – 7000 bph (4200 – 4900 gpm). The refiner was experiencing very high filter replacement rates, and was dissatisfied with the performance of the filters.

These filter vessels used conventional cored filters. Each filter had thirty-four (34) filter elements conventionally referred to as "644" style elements. These elements were approximately 6" in diameter and 44" long. The flow occurred from the exterior to the interior of the element. The elements were a "sock-type" design, with a metal center-core for support. Both ends of the filter element were open with flat gaskets. The flat gasket on one end was designed to seal on the tubesheet. The other end of the element was designed to seal on a "center-plate" that was tightened down on a threaded center-post by means of a washer and nut. Figure 1 is a picture of a typical "644" housing illustrating the "center-plate", washer, nut and center post.

Figure 1 Typical 644 Filter Housing, showing installed elements. The threaded rod, "center-plate" and nut that is required to be tightened on the threaded center post is also visible.

The unit had 31 change-outs of elements in an entire year, averaging a change-out every 10 days or so. A typical change-out required at least 4 man-hours of labor time, for two operators. In addition, the gaskets from the elements would fall off into the housing and would have to be fished out. Most critical of all, the filters would be damaged in the presence of caustic carryover.

Typical "644" applications also encounter the danger of crushing an element in service as differential pressure climbs. Figure 2 is a picture of the elements in a trash receptacle. A collapsed element can be seen in this container.

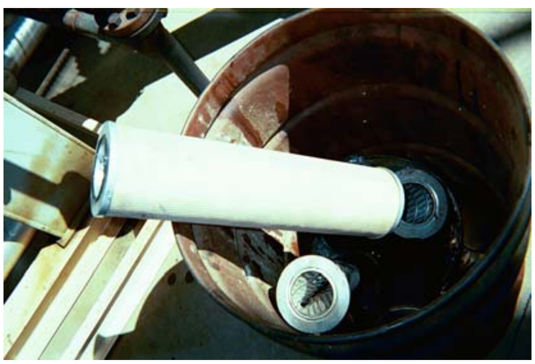

Figure 2. Typical "644" Filters in the waste drum. One new element is seen on top, and a collapsed element is visible at the bottom.

These 44" elements cost around \$35 – 40 per element.

The plant personnel were interested in utilizing the existing hardware to improve the fluid quality of the gasoline, with a view to improving the overall system reliability, while increasing online life and reducing operating costs.

COMPAX® The COMPAX® Coreless Filter System was developed by Porous Media in response to an ever increasing awareness and desire by users to obtain reliable and improved fluid quality in their systems while simultaneously reducing operating costs and minimizing waste. The COMPAX® Coreless Filter System utilizes a COMPAX® coreless filter element and a semi-permanent reusable core within the housing. As a result, spent COMPAX® coreless filters compact from 1/3rd to 1/5th their original volume, thereby, providing substantially lower disposal volumes than conventional cored filters.

COMPAX® enables the use of high performance media in an extended surface area configuration. This enhanced surface area configuration enables COMPAX® to provide greater contact area for the selective removal of contaminants from the fluid stream. Since the media is configured in a *locked pore matrix*™, the fibers are spatially fixed, so that contaminants are not released back into the system during high differential pressure conditions.

Figure 3. Schematic of COMPAX® technology, illustrating the element installed on a semi-permanent core. The element merely consists of two polymeric end-caps that retain the high performance media.

Figure 3 indicates that the element seals onto the core by means of a positive O-ring seal. This eliminates the bypass typically found around conventional gaskets or other "knife-edge" seals. The COMPAX® element has only a single open end. This, combined with the positive sealing O-ring, ensures effective filtration and stops bypass.

The installation process consists of holding the element by a convenient integral handle and pushing on the core in the housing until the O-ring engages. This process is considerably easier for operations personnel compared to the cumbersome installation process associated with the center-plate, washer and nuts or "cap-and-spring". In addition, since the COMPAX® elements do not have a core; they offer lower disposal volumes of between 50 – 95% less than cored elements.

Figure 4. Picture of a typical COMPAX® Coreless element being installed. The integral handle facilitates the ergonomics of installation.

Most importantly, the semi-permanent center-core could be designed to accommodate the maximum expected differential pressure that was anticipated for this application.

COMPAX® UPGRADE. In upgrading to the COMPAX® Coreless Filter System, the filter housings semi-permanent cores were custom fit into the housings. The technology represented an opportunity to meet the challenge of element collapse caused by elevated differential pressure situations, while simultaneously utilizing the *locked-pore matrix* ™ media. Figure 4 illustrates the semi-permanent stainless steel center cores that were installed in the housing.

RESULTS. The COMPAX® coreless elements were installed and were observed to build differential pressure. Unlike in the past, the elements did not collapse since semi-permanent cores do not collapse, and the elements have successfully survived the operational methodology. In addition, the elements have proven compatible in the presence of caustic carryover. Most importantly, the unit has consistently obtained 5 – 7 week run times (i.e., an increase in run life of approximately ***300%***).

The preliminary analysis of the savings accruing to the refinery as a result of the COMPAX® upgrade found that savings in excess of 30% a year could be attributed to the improved COMPAX filtration system. This savings estimate did not take into consideration the value of the poor fluid quality when the gasoline did not meet acceptable specifications, labor costs, or disposal costs associated with disposing filter elements with metal components. In addition, all of these savings were obtained without any capital expenditure on the part of the end user.

In summary, by upgrading to COMPAX® coreless technology, the refinery was able to:

1. Obtain reliable fluid quality,
2. Eliminate fluid quality failure caused by the collapse of the cored filters,
3. Obtain better fluid quality, which reduced incidents of off-spec product,
4. Improve ergonomics of change-out by eliminating cumbersome center-plate, washer and bolt design; and
5. Reduce Disposal costs by 50 – 95%.

TABLE: SUMMARY OF SAVINGS

BEFORE	AFTER
Short Run Life, averaging 10 days per run	Longer Run Life averaging 5-7 weeks per run
Difficult to change elements, requiring "center-plate", washer and nut removal prior to filter replacement, and reinstallation after new element installation	Ergonomic change-out. Elements are gripped by the integral handle and pulled out. New elements are gripped by the integral handle and pushed on core until O-ring engages
Unable to obtain reliable fluid quality due to element collapse	COMPAX® elements are resistant to caustic carryover, and are supported by a high-pressure core that resists collapse.
High Disposal Volume	Disposal Volume Reduction by 50 – 95%
Filtration costs of filter and filter-coalescer were greater than $200,000	Cost of filtration reduced by 30%

For more information on how your company could benefit from Porous Media's advanced separation technologies for refinery system optimization, please contact the Fluid Process Technologies Division at 936-788-1000, or by email at fpt@porous.com.

POROUS MEDIA
ADVANCED SEPARATIONS TECHNOLOGIES GROUP
Conroe Texas ● St. Paul Minnesota
936-788-1000 ● 651-653-2000
www.porous.com