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CASE STUDY

sofi
FILTRATION

AUTOMATED SELF-CLEANING FILTRATION OF FLOWBACK AND PRODUCED WATER



INTRODUCTION

The outlook for US crude oil is expected to grow through 2022 from 10 MMbpd in 2018 to 11-12 MMbpd. Similarly, Natural gas production is expected to grow at 5% per year from 29 to 34 Tcf. The growth of this industry is often in regions of water shortages. The large amount of Produced and Flowback water can be reused or disposed of in salt water disposal wells. In either case, filtration is a required operation, in particular, at levels less than 20 and often less than 5 microns. Salt water disposal wells need to maintain permeability to keep operating and to minimize seismic disruptions. Similarly, water reuse requires filtration solutions for to protect downstream membranes and equipment.

These operations need robust filtration solutions to handle flows of 2000 to 30,000 bpd or more.

GENERAL FILTRATION TECHNOLOGIES

The most common filtration technology is simply a bag filter for this application. At the rate of use and Total Suspended Solids Concentrations in the 100s of mg/l, a 5000 bpd operation can average 160 kg (dry weight) of solids a day making it a messy, sometimes hazardous and costly expense not to mention the logistics and potential environmental concerns about disposal. There are also a host of filtration technologies including those using ceramic or polymeric micro and ultrafiltration each with their own challenges around lifetime, fouling, temperature and the ability to manage widely varying stream compositions. The filter deployed in this test, from Sofi filtration, is reported on here in the first trial in this application for such a filter.

ADVANCED SELF-CLEANING FILTRATION OPERATION

Sofi Filtration is a water filtration company founded in Finland that specializes in automated and self-cleaning micro-filtration technologies that increase water recirculation rates at production sites. Sofi Filtration provides state-of-the-art industrial water filtration technology for global clients in the mining, metal, plastics, oil and gas, and power industries. It is a patented cross flow filter with several “levers” to maintain filtration rates without the use of chemical additives or chemical cleaning.

The filter element itself is a steel (various grades are available including Hastelloy C, 904L and 316L) cylindrical, multilayered woven screen with pore sizes ranging from 0.5 to 10 microns.

The Sofi filter continuously accelerates the cross-flow velocity on the filter element to assist in maintaining a clean surface. Eventually, solids impinged on the surface of the filter accumulate and restrict flow. The module then turns on high powered ultrasound from the filtrate side of the filter to dislodge and loosen the entrapped particulates. For a short period of time, at least a 100psi back pulse is applied on the filtrate side to flush the particulates back into the cross-flow stream. A portion of the crossflow stream is always flowing to control the buildup of solids concentration.

Encotech, an established systems integrator, has partnered with Sofi to combine their patent-pending, cross-flow filtration system integration with Sofi’s advanced micro-filter. The system integration has sophisticated sensing and controls for determining the state of material fouling on a filter membrane, with automated operations that limit membrane fouling and automatically initiate intelligent yet simple processes to restore operating flux.

Applicable with any cross-flow filtration technologies, Encotech is finding its best operational success in the field when deploying in conjunction with Sofi filtration.

MEETING THE CHALLENGE

A piloted trial was recently completed at a BNN/Tallgrass energy facility in the Denver Julesberg basin in Wyoming. This facility takes trucks around the clock from flow-back, drilling and produced water in the region and evaporates as well as injects it into a salt water disposal well. Over the course of the 3 day trial, a 0.5 micron element was utilized as the water was expected to have very fine particles.

The operational flow was stable between 2 and 3 bbl/min with optimized flow closer to 3 bbl/min for a single 1.2 m² filter. Since many different trucks were offloading to tanks directly connected to the filter apparatus, the quality varied and thus detailed, aggregate analytical was not pursued; instead, filtration efficiencies and performance were the goal of the project.

At one point, the filtrate from the skid was plumbed directly to a pipe connected to tanks at the head of the salt water disposal well. At the time, the operator closed the reject water valve far away from the skid during piping change-over, and it was left in that position unintentionally.

During this period, the Sofi filtrate flow dropped gradually while the cleaning cycles increased in frequency. The filter element was simply collecting solids in the system’s recycle loop with no outlet. When this error was noticed and the valve re-opened, the self-cleaning mechanisms of the Sofi and the Encotech system automatically and steadily brought filter flux back up to operational levels and there was no need for manual intervention. A three hour run time chart, during which data were collected manually, is shown below (note the steadily increasing, though variable, flow rates as the Sofi and Encotech system found optimum flux vs cleaning cycle operations automatically):

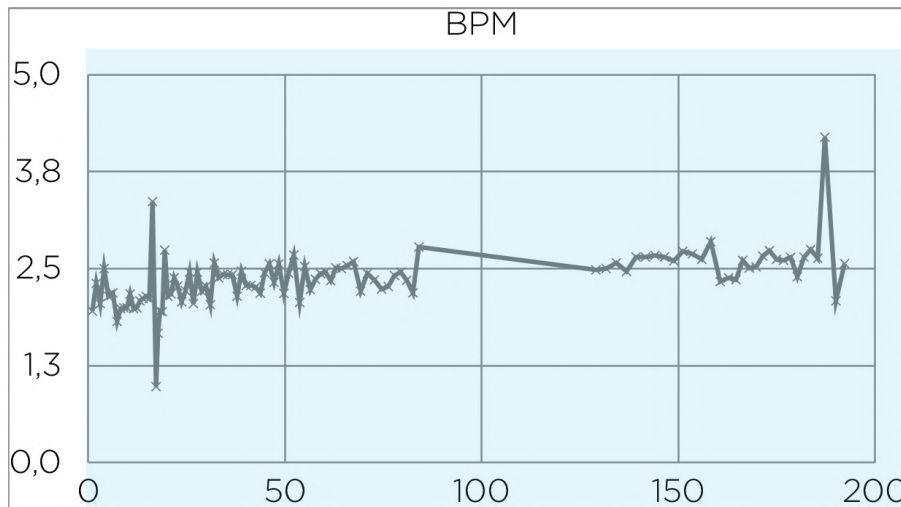


Figure 2. Elapsed time for a 3 hour segment versus Barrels per Minute flow

The client, Sofi and Encotech are looking forward to more deployments of this technology in the upstream oil and gas industry.

“The intelligent operation of the Encotech skid along with the robust Sofi filter showed great promise for utility in this application”, said Eric Gopsill, Director of Water Solutions for BNN-Tall Grass Energy.

AUTHOR'S NOTE

Steve Gluck is an independent application and research consultant supporting Sofi Filtration and other companies across the water and wastewater spectrum.

He also is a Technology Associate with BlueTech Research where he regularly delivers specific market and technology assessments. He was a Research Fellow for Dow Chemical where he worked for 37 years. He serves on the WEF Industrial Wastes and WEFTEC Program Committee.

CONTACT US

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