Evaluation of the Energy Recovery, Inc.
Pressure Exchanger

Evaluation performed by
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Seven Seas Water received a production Pressure Exchanger for evaluation in conjunction with the ADA workshop held in St. Croix, USVI in October of 1998.

A paper dealing with the performance of the device was delivered by Mr. Leif J. Hauge, President of Energy Recovery Inc. at the workshop. Tours were conducted at the test facility where the Pressure Exchanger was in operation.

TESTING PARAMETERS

It was decided, in discussions with Mr. Hauge, to deviate from the standard system design and determine if the Pressure Exchanger could be used to increase the capacity of an existing plant by utilizing the available waste energy. The pressure boost pump would also be eliminated to further simplify installation and evaluation. The Exchanger would act as a stand-alone pump using only waste energy to operate a separate bank of membranes. The Exchanger would be supplied with a separate source of filtered seawater.

INSTALLATION

The first impression of the Pressure Exchanger is the compact size and the simplicity of external design. The simplest way of mounting the system was to fabricate a mounting system that would allow a horizontal, wall mount of the device. This was completed and piping fabricated to meet installation requirements. Instrumentation was added to allow evaluation of the performance.

START-UP OF THE SYSTEM

The pre-existing membrane system was being operated at 940 PSI with a feed flow of 39 GPM. Recovery rate was at 39%. Pre-treated seawater feed pressure was 25-32 PSI depending upon state of filters.

Without displaying the math, we had available 23.8 gallons per minute at 930 PSI (10 PSI differential) to operate a bank of three, eight-inch membranes, a very marginal feed supply. Also the Exchanger was designed for an optimum flow rate of 40 GPM.

Since the Pressure Exchanger is primarily centrifugal in design, it was expected that some portion of the feed water pressure would translate to the discharge of the pump.

In starting the system, it took the Pressure Exchanger several minutes to 'wind up' as it does any turbine device. Within 15 minutes, the entire system had stabilized. Because the Exchanger had taken the place of our concentrate control valve (and was oversized for the application) the feed pressure to the primary bank of membranes was only 855 PSI. Using the installed valve on the Exchanger we slowly increased the back-pressure to allow the primary bank to operate at 940 PSI feed inlet.

The secondary set of membranes, powered only by the Exchanger, was then adjusted by slowly closing the concentrate control valve.

David Laker, also with Seven Seas Water, and well-known as a pioneering reverse osmosis engineer with over 30 years of experience in the field, described the results as being as close as he had ever seen to "a perpetual motion machine".

Within the limitations of the instrumentation we were now making 8,900 gallons per day of "free" water. The secondary set of membranes was operating at a calculated 23 GPM at 935-940 PSI and producing 6.2 GPM at 400 TDS. It was later determined that cross leakage within the Exchanger was less than 2% and the actual overall efficiency of the Exchanger was 96% allowing for feed water pressure.

PROBLEMS IN PARADISE

After a short time running, it was noted that the seawater break tank was going down. The seawater feed pump was not large enough to continually feed the plant with the additional feed requirement.

A larger pump was purchased and installed, but the feed flow did not increase sufficiently to allow the plant to run without interruption. It became clear that marine growth in the intake pipe was the root problem. The plant continued to operate in a "batch" mode for a short period of time. The plant was subjected to repeated starts and stops, without incident. All starts and stops were automatic and very smooth in nature.

Within a few days, the product water storage tank was at capacity and the plant shut down. Due to the difficulty and expense of installing in a new seawater intake

system, it was concluded that long term testing of the Pressure Exchanger was not practical at this location.

During the week of running, the Exchanger membrane system produced 62,000 gallons of water. Overall recovery was 20 %, including multiple shutdowns. The only kilowatts consumed were associated with the seawater feed pump and increased pumping requirement of the post-treatment of the permeate.

SUMMARY

The testing carried out indicates that utilizing the Pressure Exchanger for plant expansion is not only feasible, but is extremely practical.

A 40,000 GPD plant without energy recovery would produce sufficient waste energy to allow easy expansion to 60,000 GPD using the Pressure Exchanger. If boosting the membrane feed pressure became a necessity, utilizing a small energy recovery turbine and the waste energy of the secondary membrane system is certainly possible, and should be explored. Seven Seas Water currently has such a system designed and installed, waiting for the client to order start-up.

This seems to be a truly amazing device that allows several potential applications in our industry. We have no doubts of the viability of the Pressure Exchanger in the seawater reverse osmosis industry. We only have one question:

How fast can an eight-inch model of the Pressure Exchanger be available for use on very large-scale plants?

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