

Green Technology

“**B**uzzwords such as ‘zero discharge,’ ‘sustainable sciences’ and ‘green technology’ are becoming more commonly used within the manufacturing industry,” says Tom Troyer, pulp and paper market manager for Osmonics, Inc. “These terms focus on the increasing demands of society and environmental protection agencies to minimize and in some cases completely eliminate environmental pollution.”

Osmonics, Inc. and Esmil Process Systems Ltd. developed a zero discharge effluent treatment and water recovery system for the niche timber market.

Esmil, designer of effluent treatment plants, and Osmonics, originator of spiral-

Queen's Award Winner

Dev Chabba (left), managing director of Esmil, receives the Queen's Award 1999 from Mr. Nigel Nobbs, Lord Lieutenant Queen's representative of Buckinghamshire.

The Queen's Award is the highest honor that can be bestowed on a United Kingdom company and recognizes a company's significant advances in the development of a product, technology or process that is commercially successful and that offers major benefits to society.



wound membrane technology, developed a turn-key effluent treatment system for the paper and pulp industry that combined an improved polyelectrolyte physico-chemical treatment process with the environmental benefits of membrane technology.

Installed at the Kronospan plant in Chirk, North Wales, the system is the first zero discharge effluent treatment and water recovery system specifically designed for the manufacturer of timber material known as medium density fiberboard (MDF). (See “What is MDF?” for further details.)

What is MDF?

Medium density fiberboard (MDF) is a manufactured lumber product that utilizes whole trees without creating a by-product waste. MDF has started replacing plywood as an environmentally friendly building material. Its high load-bearing capability, cross-dimensional stability and versatility have made it popular within the construction industry. Its attractive appearance and environmental friendliness has begun to raise MDF's profile with end users.

Technology Development

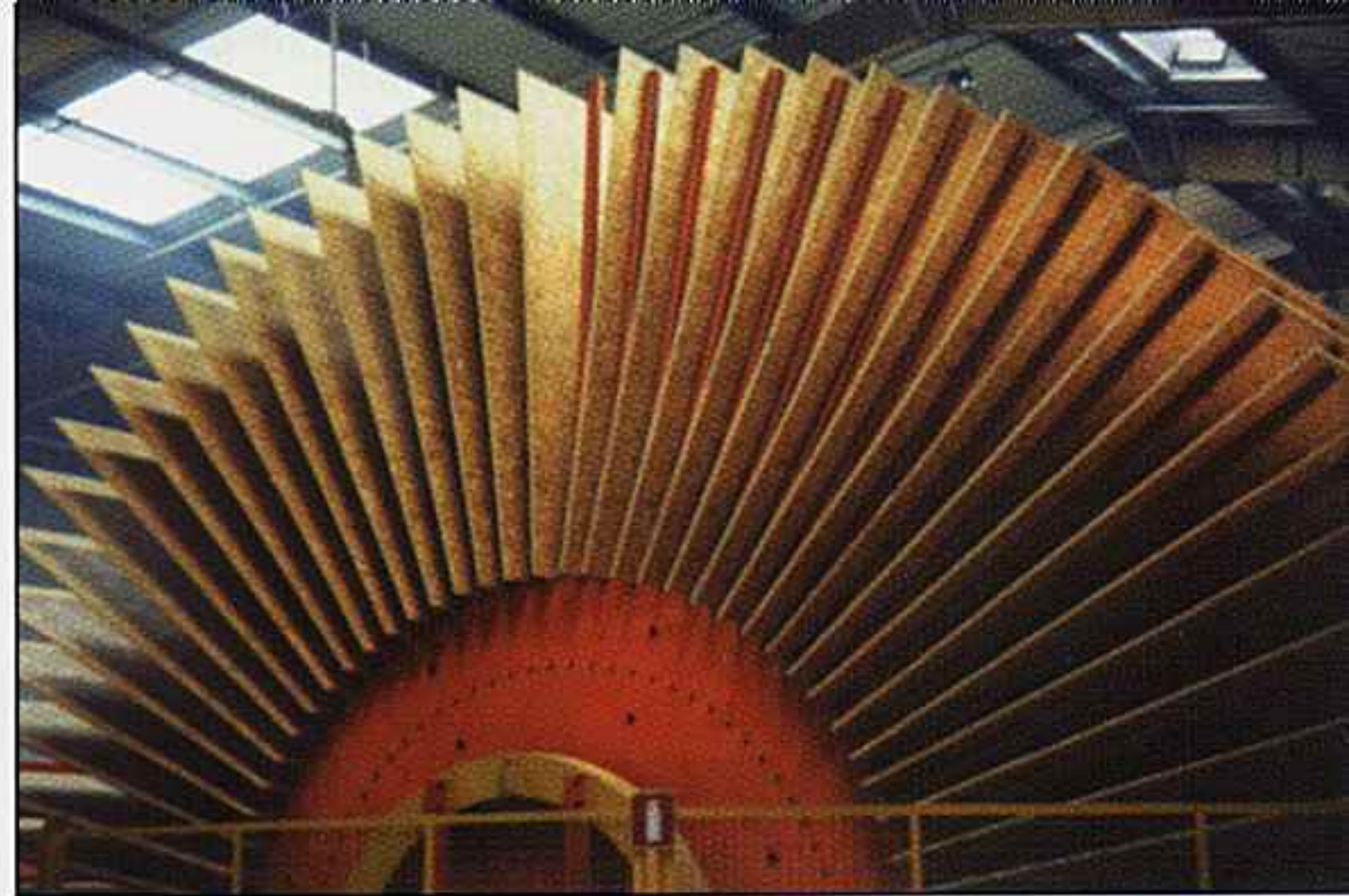
According to Markus Kyburz, marketing manager for Osmonics' Euro/Africa Operations, the European Union is focusing on the paper and pulp industry as an environmental priority. He says that the manufacturing industry will continue to pursue what is known as “green technology.”

“Conventional waste management within the timber industry no longer satisfied the demands of environmental protection agencies or the public,” he continues. “Osmonics has introduced this industry to membrane technology, a technology well established in the fields of filtration and fluid separation, which is increasingly replacing conventional waste treatment technologies. The acceptance of MDF in the consumer marketplace and the MDF manufacturers’ recognition of an improved treatment of its effluent, signify a large step in advancing sustainable sciences in manufacturing.”

Kronospan’s Chirk factory in Wales was the first MDF plant to apply spiral membrane technology to effluent treatment.

According to D. N. Chabba, managing director for Esmil, Kronospan’s effluent treatment system had to address environmental issues such as odors, sludge dumping and sewage disposal as well

A zero discharge effluent treatment and water recovery system was specifically designed for the manufacturer of this medium density fiberboard.



as industry concerns about the long- and short-term costs associated with waste disposal.

Esmil and Osmonics developed a substitute for Kronospan’s costly conventional biological processing (Figure 1) with an effluent treatment system, requiring low capital costs while providing maximum recovery and complying with long-term environmental regulations, Chabba explains .

“Our goal was to develop a solution that exceeded both environmental and financial

expectations,” he says. “And the only way we could do that was by achieving total environmental cost recovery-zero discharge, effluent treatment with total product recovery.”

Tackling one of the most challenging industrial effluents, the two companies designed a new, smaller footprint treatment process to meet the following criteria.

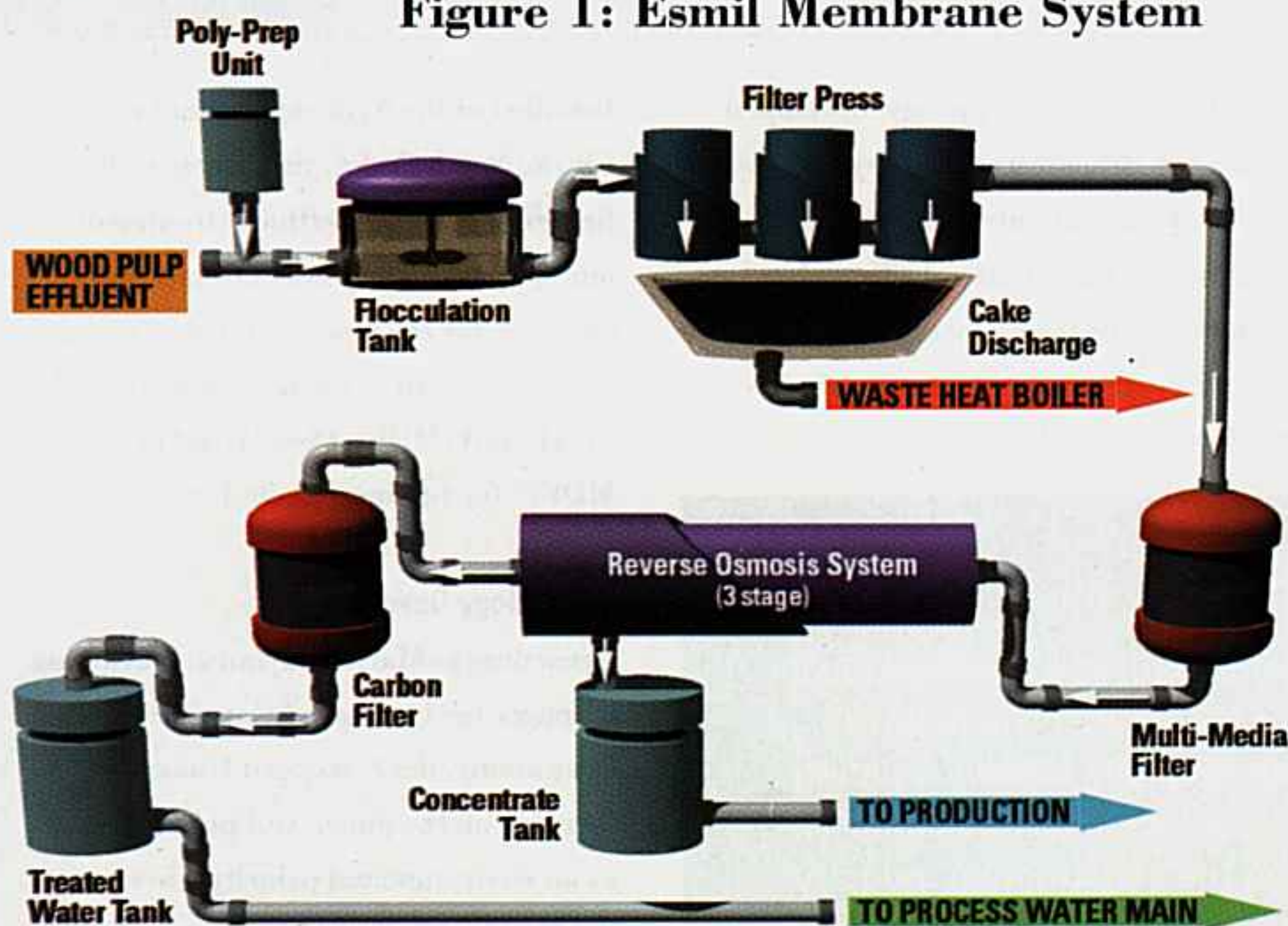
- Low capital cost with rapid investment payback.
- Optimum products/water recovery.
- Effluent reduction, recycle and re-use.
- Long-term environmental compliance.
- Easy-to-upgrade modular systems.

After an intensive 18-month research and development program, the final zero discharge treatment and recovery system was constructed in seven months. Kronospan’s completed system allowed the Chirk plant to re-use all waste—both liquid and solid—from the manufacturing process.

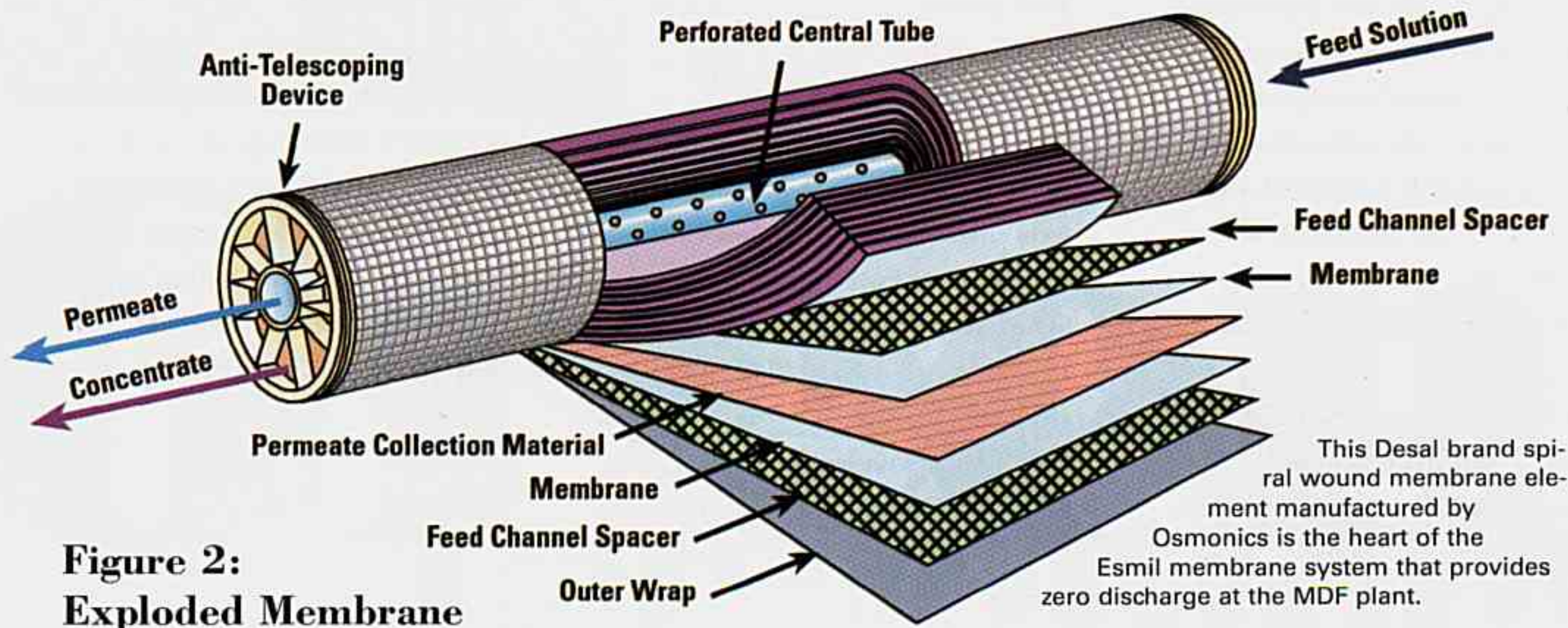
The Process

MDF effluent is the first dose with Esmil’s proprietary polyelectrolyte chemical treatment. (See Figure 2.) The MDF effluent then is mixed and flocculated in a dedicated tank. The flocculated effluent then is pumped into

Figure 1: Esmil Membrane System



This process flow diagram of the Esmil membrane system shows how wood pulp effluent is treated with reverse osmosis technology to create a concentrate suitable for use in the MDF product, and permeate water suitable for re-use in the plant.



**Figure 2:
Exploded Membrane**

a plate-type filter that produces suspended and dissolved solids recovered in the form of a dewatered cake-like substance that is 50 percent dry solid. The filtrate then is put in a separate tank where it is drawn through a dual media sand filter.

The cake is fed as fuel into a waste heat recovery boiler generating steam production and the liquid waste is purified through the reverse osmosis (RO) plant and is re-used in the manufacturing process.

This treatment process simultaneously applies a process known as cross-flow filtration and separation. Utilizing Osmonics' RO spiral membrane

technology, a membrane creates a fixed barrier that selectively separates specific ionic and/or non-ionic species from the effluent. The MDF effluent is fed through the RO membrane filters so it flows parallel to the membrane surface. While in contact with the membrane surface, a percentage of the effluent filters through the membrane, referred to as permeate, and the balance of the effluent containing the polluted species discharges out of the system, known as the concentrate.

The high quality permeate is recycled into the manufacturing process as either general site process water or boiler feed water to produce process steam.

The concentrate from the RO membrane then is stored in a dedicated holding tank for re-use as chemical make-up water. The concentrate contains all the naturally occurring soluble organics such as lignin, cellulose and extractives that are naturally occurring resins in the tree. By recovering these and re-introducing them into the board, quality and stability may be improved, with synthetic resin supplemented with natural resins.

The dirty backwash/cleaning waters from the filter press, dual media filter and RO membrane are returned to the head of the works where they are combined with incoming MDF effluent.

Zero Discharge

At the end of a 24-month period, the Chirk plant concluded there was zero discharge, resulting in total medium density fiberboard (MDF) product recovery and effluent treatment. Some of the data reported included the following.

- A 90 to 95 percent process water recovery for re-use as MDF wash water, boiler feed or general process water.
- Reverse osmosis concentrate recovery (5 to 10 percent of remaining flow) re-use as make-up water for the resin binder.
- A 100 percent solid recovery, incinerated on-site for steam production.

By recovering all solid and liquid phase outputs from MDF manufacturing, the effluent treatment system results in zero discharge. The plant also has become substantially automated, with fewer process stages and less manual labor, reducing capital costs required with conventional biological treatment.

After a 24-month period, the Chirk plant conducted an analysis that confirmed "zero discharge"—total

MDF product recovery and effluent treatment. (See "Zero Discharge" for results.)

Rapid investment payback and long-term environmental compliance bolstered Kronospan to install another system in Luxembourg and in its new plant in Poland. Another four effluent treatment systems, under the guidance of Esmil and Osmonics, are under construction in Scotland, Wales, Germany and France.

About the Author

D.J. Gordon is an active freelance writer for various consumer, financial trade and technology publications. Gordon's professional background includes non-profit and state government communications, as well as agency experience with consumer and business-to-business clients.