Achieving zero output

Conventional methods of treating the effluent from MDF manufacture often fail to meet environmental requirements. Advances in polymer chemistry, combined with membrane technology, have enabled the recovery of water and, more recently, soluble organic compounds, resulting in a zero discharge system, claims Steve Finnemore, marketing manager for Esmil Process Systems

Effluent is generated in many processes during the manufacture of MDF, typically in the refiner, glue kitchen, boiler and air treatment systems.

Conventional systems for the treatment of this effluent are coming to the end of their product life cycle, as in many cases they no longer satisfy the demands of either works managers, company accountants or environmental agencies.

Most European MDF mills include a chip washing system in the refiner process to remove gross extraneous debris such as sand and grit, thereby improving the quality of the MDF and also extending the operating life of the refiner.

The quantity of excess water generated during this process depends on the moisture content of the raw wood and the temperature at which the refiner is operated. Historical treatment options included transporting the waste water off-site by tanker, or sewer disposal, both of which are expensive and non-sustainable solutions.

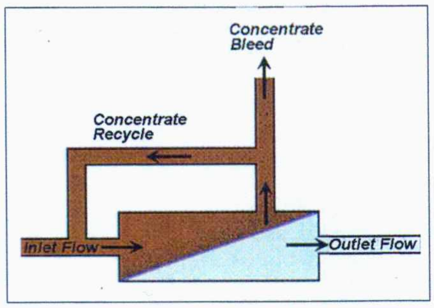
Biological treatment has high capital cost associated with solids removal, biological oxidation, clarification and filtration, and has inconsistent performance caused by toxins, pollutant overloading, adverse temperature and low nutrient levels. Resource recovery is limited, due to the poor quality of treated effluent and production of biological sludges, therefore there are continued waste water disposal and water supply charges.

With the onset of environmental quality standards such as BS 7570 in the UK, international standard ISO 14000 and the EU equivalent, EMAS, there is an industry need to improve environmental performance by optimising the recovery and re-use of waste streams.

Recent advances in effluent treatment technology include the development of high performance polymers which can efficiently coagulate high strength effluents.

Membrane technology is also now well established in the fields of filtration and fluid separation, increasingly replacing conventional technologies.

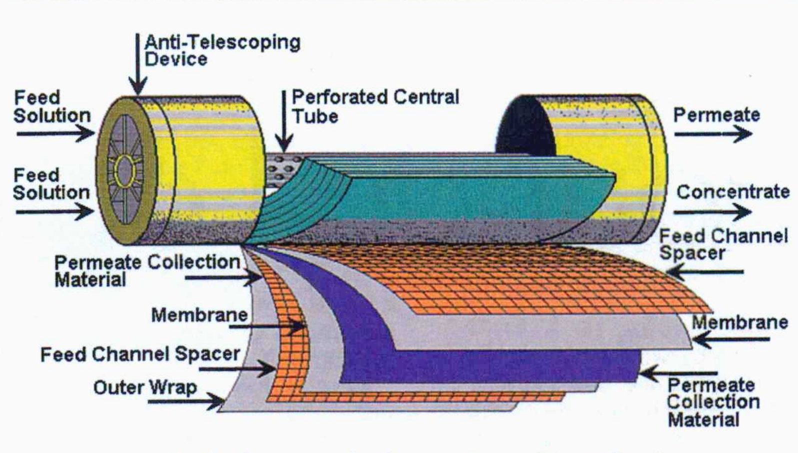
Since the development of membranes 40 years ago, applications have become more challenging with both inorganic and organic feeds being successfully treated.



for the treatment of effluent have matured over the past 10 years.

By a process known as 'cross flow filtration', the membrane acts as a fixed physical barrier which selectively separates specific ionic and/or non-ionic species from the solvent.

Effluent is fed into the membrane cartridge so that it flows parallel to the membrane surface. While in contact



Spiral-wound element: a closer look

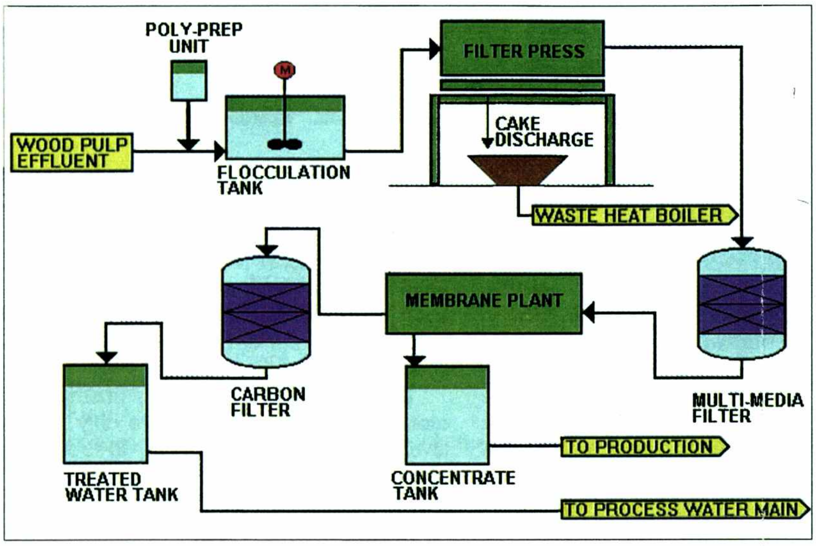
Initially, industrial applications were limited to the desalination of seawater (removal of inorganics) and then the removal of colour (organics) from surface water. Membranes have been developed to meet new industrial demands such as the requirement for ultra-pure water in the manufacture of semiconductors, the concentration of protein in the dairy industry and product concentration and recovery of pharmaceuticals. Membrane systems

with the membrane surface, a percentage of the effluent filters through the membrane (called permeate) and the balance, containing the pollutant species, discharges out of the system (called concentrate).

Membrane systems are classified as Microfiltration (MF), Ultrafiltration (UF), Nanofiltration (NF) or Reverse Osmosis (RO), depending on the pore diameter of the membrane, which determines the degree of selectivity.

Pore size (microns)	1 E-04	0.001	0.01	0.1	1
Molecular weight cut off	~25	~100	~1,000	~10,000	
	Reverse Osmosis				
		Nanofiltration			
Separation process			Ultrafiltration		
				Microfiltration	

Table 1: the filtration spectrum



The smaller the pore diameter, the smaller the species that can be separated and the higher the operating pressure required to drive the separation process. Membrane applications can be summarised as follows:

MF – removal of suspended solids
UF – removal of high molecular weight organics/inorganics
NF – removal of low molecular weight organics/divalent ions
RO – removal of lower molecular weight organics/univalent ions

The advantages the membranes offer include: contaminated effluent to pure water in one process stage; soluble product recovery in the form of dissolved metals, organics and inorganics; and it is a robust process, not susceptible to thermal and toxic shocks.

In collaboration with Kronospan UK, Esmil Process Systems agreed the criteria for the success of a new treatment process based on membrane filtration, for which the company claims four main advantages:

- low capital cost with rapid investment payback
- optimum product/water recovery
- long term environmental compliance
- easy to upgrade modular systems

Each plant comprises modular process units, therefore facilitating easy upgrades to mirror changes in effluent volume, composition and water quality requirements.

Wood pulping effluent leaving the refining process is dosed with polyelectrolyte, mixed and then flocculated in a dedicated tank.

Flocculated effluent is then pumped in to a plate-type filter press, which produces a filter cake with a dry solids content in excess of 50%.

Filtrate is then fed through a sand filter and the filtered effluent is then fed into the RO membrane and finally an optional carbon filter.

Concentrate from the RO membrane is stored in a dedicated holding tank prior to recycling.

All dirty backwash and cleaning waters from the filter press, dual media filter and RO membrane system are recovered and returned to the head of the works, being combined with the incoming MDF effluent.

All solid and liquid phase outputs are recoverable, resulting in a zero emission plant.

The plant can be substantially automated and an operator can be fully trained within a matter of weeks.

The first plant world-wide applying this process to MDF effluent was installed in February 1996 at Kronospan's Chirk factory in North Wales. A second was subsequently installed in Kronospan's new development at Sanem, Luxembourg, followed by a third plant in Poland. A further four are currently under construction in Scotland, Wales, Germany and France.

The Esmil Plant is mechanical with few process stages, so reducing the capital investment which other systems, such as biological treatment, require.

Parameter	Influent	After Filter Press	Permeate	Percentage Removal
Suspended Solids (mg/l)	~6000	~150	<0.1	~100%
COD (mg/l)	~24,000	~7000	~100	~99.5%

Table 2: typical treatment plant efficiency

Operating costs are substantially lower than historical treatment technologies as outputs can be recycled or re-used, thereby reducing the volumes and generating financial benefits from reduced effluent disposal costs and reduced town water or natural water intake requirement.

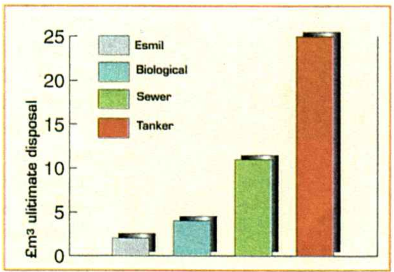
Analysis of 12 months' operating data are presented below in Table 2.

The Esmil Plant produces three outputs, all of them recoverable. The first is process water recovery (90-95%) for recycling as general process water, chip-wash water or boiler feed water. As the permeate has a low hardness it is ideal for use as boiler feed water, realising savings in boiler feed chemicals. As the organics present are of low molecular mass, they do not foul the ion exchange resin, and flash off in the boiler, thus not accumulating in the boiler water or boiler blow-down. Permeate is currently being used as boiler feed water at Chirk.

The second recovery is RO concentrate (remaining 5-10% of flow) for re-use as chemical make-up water. This contains all the naturally occurring soluble organics, such as lignins, celluloses and extractives which are naturally occurring resins in the tree. By recovering these and re-introducing them into the board, quality may be improved, with synthetic resin supplemented with natural resins.

Membrane technology is now well established in the fields of filtration and fluid separation, replacing conventional technologies

The third recovery item is solids (100%) for re-use as feed for waste recovery boilers. ■



Parameter	Quality
COD	75,000mg/l
Total solids	1 - 4%
Lignins	13.5%
Extractives	18%
Resin acids	4%
Celluloses	43%

Table 3: typical concentrate quality

Note: Concentrations of lignins, extractives, resin acids and celluloses are expressed as a percentage of total solids.