

An economic miracle

Esmil Process Systems has developed a unique 'zero discharge' treatment and recovery plant for the treatment of effluent from the manufacture of MDF. Esmil's technical development and marketing manager Steve Finnemore describes the plant and the process

Over the past 20 years, Esmil Process Systems Ltd has designed and built effluent treatment plants for a wide range of industrial sectors throughout the world.

However, customer feedback has indicated that conventional biological systems designed for the treatment of industrial effluent are coming to the end of their lifecycle, as in many cases they no longer satisfy the demands of either company accountants or environmental agencies.

Consequently, Esmil established a research programme whereby it aimed to 'exceed the environmental and financial expectations of clients by the design of proven state-of-the-art treatment plants for the most challenging industrial effluents'.

The company achieved this by developing a unique process system to meet the following criteria:

- Low capital cost/rapid investment pay back.

- Optimum product/resource recovery.
- Effluent reduction, recycling and re-use.
- Long-term environmental compliance.
- Easy to upgrade modular systems.

Innovation

The resulting Esmil plant combines the advantages of conventional physico-chemical treatment processes with those of proven membrane technology. Membrane technology is now well established in the fields of filtration and fluid separation, increasingly replacing conventional filtration and separation technologies. Industrial applications include complex effluent treatment, recycling and re-using the product, purification and recovery.

By a process known as 'cross flow' filtration and separation, 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 filters so that it flows parallel to the membrane surface, a percentage of the effluent filters through the membrane (known as the permeate) and the balance, containing the pollutant species, discharges out of the system (known as concentrate).

Membrane systems are classified as ultra-filtration, nanofiltration, or reverse osmosis (RO) depending on

the pore diameter of the membrane which determines the degree of selectivity.

Initial process development took nearly 18 months and resulted in Esmil and Wales-based MDF manufacturer Kronospan Ltd developing this unique sustainable solution.

Innovation was key in the following two areas:

- The formulation of a new poly-electrolyte that was suitable for the cheap and efficient flocculation of MDF effluent.
- The process development of the reverse osmosis membrane plant which was carried out in association with the international research and development expertise of Desalination Systems Inc of the US, the world's largest supplier of speciality membranes.

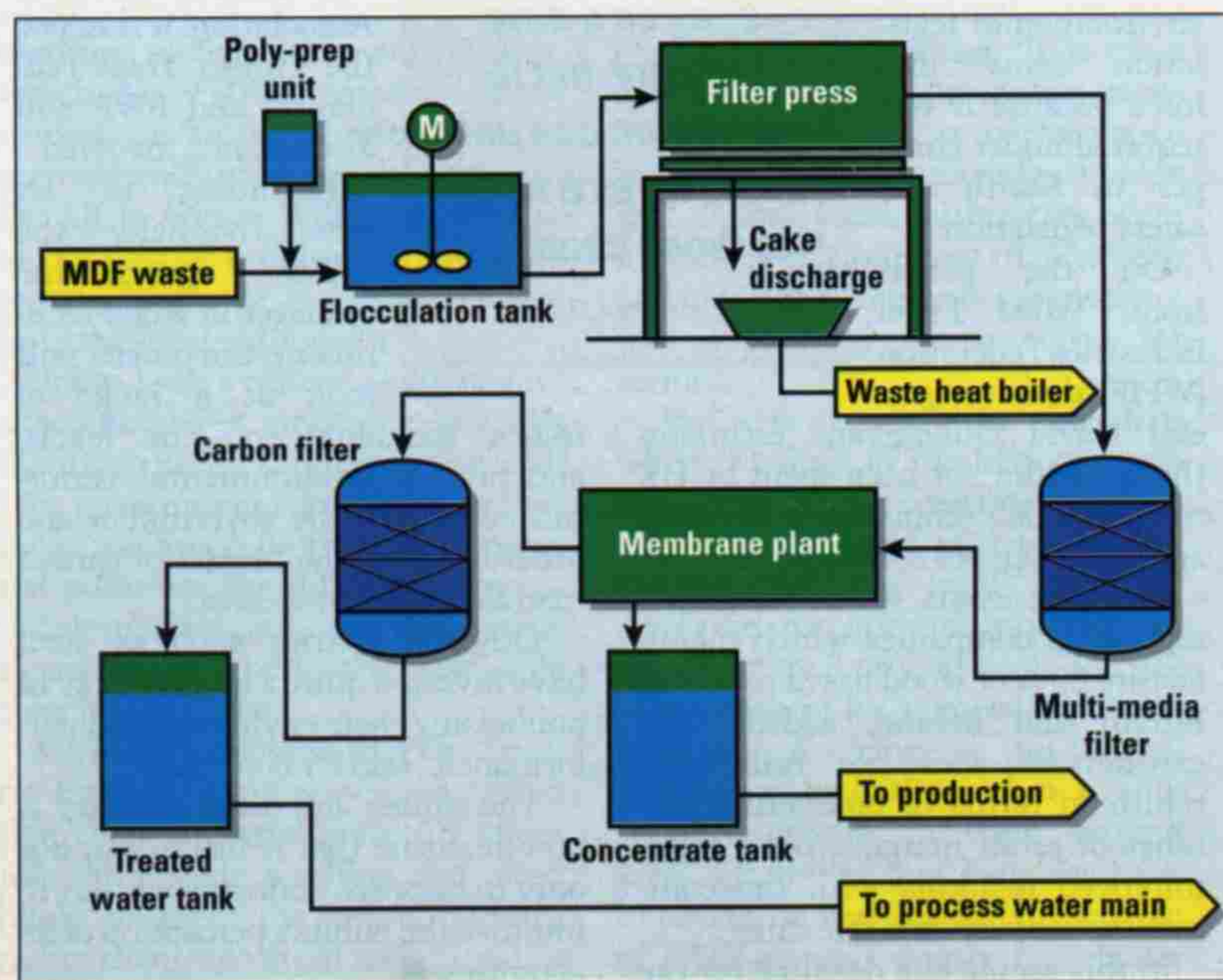
Theory in practice

The first plant applying this process to MDF effluent worldwide was ordered in June 1995 and installed at Kronospan's Chirk factory. Construction with full process commissioning was completed over a period of seven months, and a second effluent treatment and recovery plant has now been installed at Kronospan's new development at Sanem, Luxembourg.

The initial plant has been in service for over 12 months and, since commissioning, each plant has treated all the MDF effluent generated on site by operating up to 24 hours per day.

Each plant comprises modular process units, therefore facilitating

The flow chart below shows the Esmil process as it relates to MDF, although the system is also suitable for handling wood pulp effluents





easy upgrades in the event of additional treatment requirements.

MDF effluent leaving the refining process line is stored initially in a balancing tank prior to being pumped into the Esmil plant where it is dosed with polyelectrolyte, mixed, then flocculated in a dedicated tank. Flocculated effluent is then pumped into a plate-type filter press to produce a filter cake with a dry solids content of over 50%.

Filtrate is fed, by gravity, to a holding tank, from where it is pumped through a dual media sand-anthracite filter. 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/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, thereby resulting in a 'zero emission' plant.

The plant can be substantially automated and an operator can be fully trained within a matter of weeks. Routine operation, depending on the degree of automation, involves process monitoring, supervision of dry filter cake discharge from the filter press and initiating automatic backwash/cleaning cycles on the dual media filter and the RO membrane plant.

The Esmil plant should exceed the financial expectations of the

company accountant. Not only does Esmil offer 'lease purchase' contracts but the plant has a relatively low capital cost and produces outputs that can be recycled or re-used thereby reducing the volume of effluent produced and generating a financial pay back from:

- Reduced effluent disposal costs.
- Reduced towns water/natural water intake requirement.
- Reduced manpower requirement.
- No generation of treatment by product such as waste activated sludge.

Historically, MDF producers have used capital-intensive conventional biological systems comprising a primary settlement tank, a biologically active aeration tank followed by a sec-

ondary settlement tank and sometimes a batch of sand filters. Each process unit is constructed from concrete, requiring a substantial civil engineering and earth moving input. Also, the biological processes are vulnerable to toxic and thermal shocks due to the changing feedstocks and wastewater composition.

Reduce, reuse, recycle

Twelve months' operating data confirms that the Esmil MDF product recovery and effluent treatment plant can achieve zero discharge:

- Process water recovery (90-95%) for re-use as chip wash water, boiler

feed or general process water.

- RO concentrate recovery (remaining 5-10% of flow) for reuse as chemical make up water.
- Solids recovery (100%) for reuse as fuel.

Biological treatment processes rely on the degradation of organic pollutants by naturally occurring bacteria. While this may be perceived as environmentally friendly, it is really a destructive process which produces two outputs: a low-quality effluent containing traces of inert solids, organic substances and residual biomass, and waste activated sludge known as biomass. Neither can be recovered or re-used.

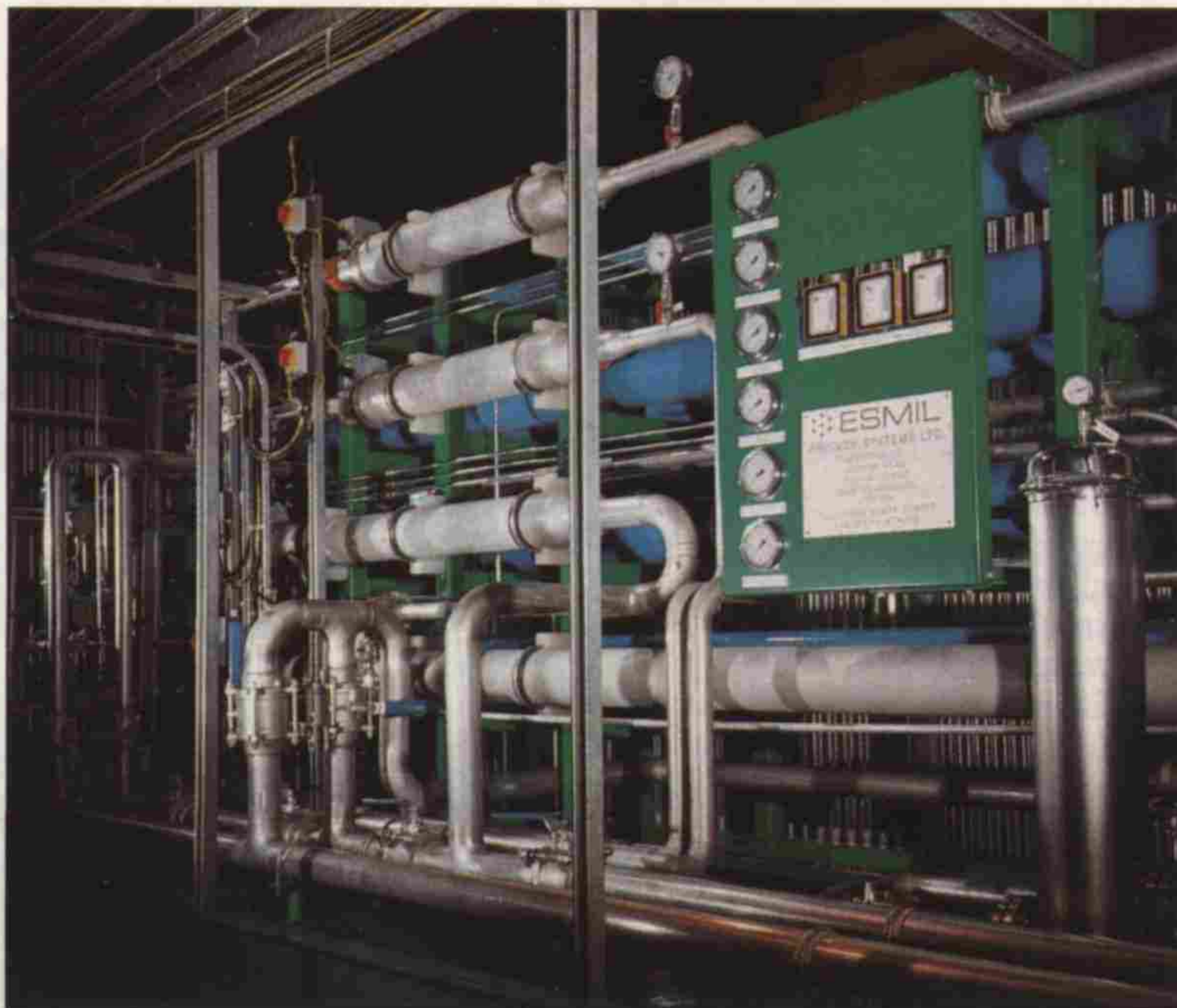
Regulatory compliance

The regulatory authorities, in particular the Environment Agency, are increasingly demanding that during the consent process industry specifies manufacturing and resource management procedures with a view to minimising waste – known as integrated pollution control (IPC).

The pulp and paper industry, for example, has been defined as a priority industry by the European Union and all plants producing more than 25,000 tonnes of paper pulp per year are subject to the Environmental Protection (Prescribed Process and Substances) Regulations.

Under the Environmental Protection Act, preferred environmental solutions are based on Best Available Technology Not Entailing Excessive Cost (BATNEEC).

With zero discharge and a fixed physical barrier through which the effluent must pass, the Esmil plant guarantees long-term confidence of environmental compliance not obtainable by alternative treatment process. The plant does not result in the emission of green house gases or objectionable odours. ■



Benefit summary

Based in the UK, Esmil Process Systems Ltd offers:

- Full pilot plant evaluation to confirm process efficiency, product recovery potential and environmental compliance prior to capital outlay.
- Turnkey contracts comprising full process, mechanical and electrical design, followed by construction and commissioning.
- Long-term comprehensive service back-up including routine maintenance and system upgrade.
- Optional lease purchase schemes with full operational and maintenance contracts.

Left and top: photos of the Esmil plant installed at Kronospan Ltd in Chirk, the first MDF manufacturer in the UK to invest in the process