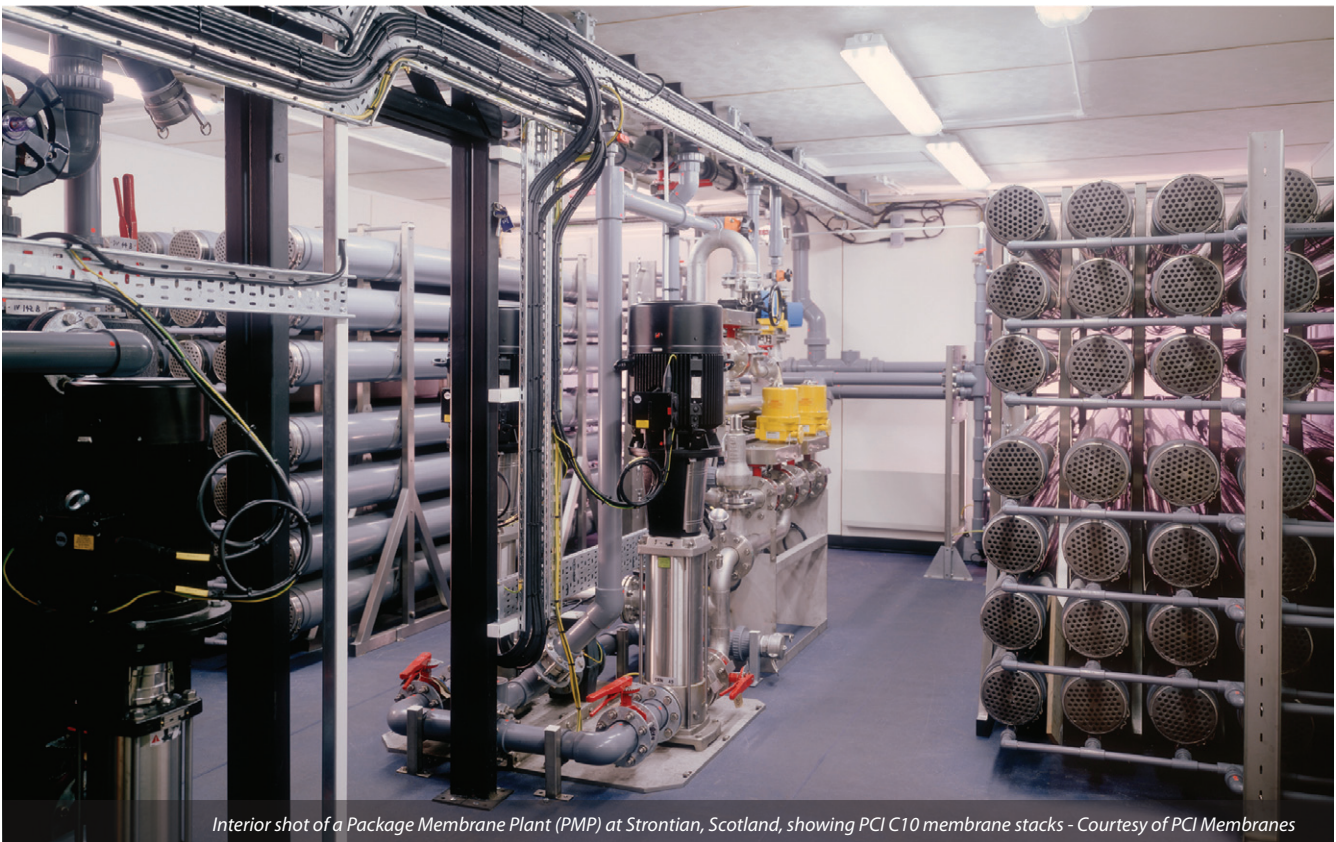


Package Membrane Plants For Remote Areas

Fyne process removes colour and impurities from raw surface water with no environmental impact

Scottish Water covers some very remote areas of the Scottish Highlands and faces the problem of supplying high-quality potable water to meet standards laid down under the Water Supply (Water Quality) (Scotland) Regulations 2001. The company continuously monitors water at major treatment works, frequently carrying out laboratory tests and sampling for regulatory purposes and for operational reasons. The percentage of Scottish Water regulatory samples which are compliant with prescribed standards is over 99%. Maintaining this high quality level is crucial and Scottish Water faces some unusual problems due to the geography of its region, the wide area it covers and the dispersed nature of the population served.



Interior shot of a Package Membrane Plant (PMP) at Strontian, Scotland, showing PCI C10 membrane stacks - Courtesy of PCI Membranes

Principles of pressure-driven membrane filtration

In membrane separation processes, a membrane provides an interface between two phases. This interface is a physical barrier that is permeable to some of the species present in one of the streams. In order to carry out the process, a driving force is necessary, in this case pressure. There are in essence four overlapping pressure-driven, cross-flow membrane technologies:

- Reverse Osmosis (RO)
- Nanofiltration (NF)
- Ultrafiltration (UF)
- Microfiltration (MF)

RO uses a tight membrane that retains most dissolved species. The resistance to flow across the membrane is mainly the osmotic pressures of the solution being processed. NF is similar to RO, but allows small inorganic molecules to pass through the membrane. Osmotic pressure is still the major resistance to solvent flow. UF membranes are porous but surface porosity is low at <5% of the surface area. Fractionates dissolved molecules on the basis of size. MF membranes are truly porous with surface porosity >50% in some cases.

Raw water

Raw water drawn from surface sources in Scotland is mostly coloured yellow or brown prior to treatment due to dissolved organic matter naturally present in the soil. Colour intensity varies depending on time of year and rainfall level, with heavier rainfall producing more intensely coloured raw water. In Northern and Western parts of Scotland, the reddish-brown colour is due to high concentrations of carbonaceous organic colour from soil by the acidic upland surface waters. Although Scottish Water treats all raw surface water and makes every effort to reduce this colour, trace colouration has previously remained in certain areas. In an effort to solve this problem, Scottish Water has invested in water treatment plants in places that are particularly affected.

Fyne process

PCI Membranes was selected to provide a unique and completely environmentally-friendly solution to the problem in a number of such areas. The company's technology utilises the unique nanofiltration Fyne process, which has been proven at sites across Scotland as well as throughout mainland Europe, Canada and



A PCI C10 series tubular membrane module
Courtesy of PCI Membranes

Alaska. Following successful installations in a number of sites starting in 1994, including Achnasheen in Wester Ross in January 2004 and Out Skerries in the Shetland Islands, Scottish Water decided to further invest in PCI Membranes' technology and expand the number of Package Membrane Plant (PMP) installations. With the added investment expansion of the PMPs now includes the areas of Stronachlachar, Loch Katrine, Sheildaig, Kinlochewe, Kilchoan, Raasay, Unst and Loch Carron.

The plants themselves are engineered by strategic and long-term partner Ross-Shire Engineering of Muir of Ord near Inverness, with membrane stacks from PCI Membranes.

The advanced membrane filtration technology treats water from sources that are poor, or of variable quality, including those containing carbonaceous organic colour from humic or fulvic acids common in peat-rich areas. This technology, together with coarse screening, post conditioning and disinfection, treats water sources for municipal drinking water supply in small rural communities of up to 2,000 people.

PCI Membranes' C10 Series modules and 12mm diameter tubular membranes are used in the Fyne process due to their ability to handle suspended solids without blocking, unlike spiral membranes.

The tubular membranes retain contaminants on the raw water side and allow potable water to permeate through. The deposition of impurities on the membrane's surface is minimised by maintaining a high cross-flow velocity using a partial re-cycle flow, which sustains high filtration efficiency. As the waste stream contains nothing other than the naturally-occurring minerals and deposits, which are present in the water before treatment and is simply concentrated raw water, there are no environmental concerns to prevent its return back into the local water course.

The Fyne process is more environmentally sensitive than any conventional treatment, as conventional treatment processes often remove fine contamination (such as colour and pathogens) using chemical coagulants, which have various drawbacks, including:

- Delayed response to changes in raw water quality, causing process performance failure.
- Health and safety concerns for operational staff and the environment.
- Produce large volumes of chemical bearing sludge, requiring costly removal, re-processing and disposal.

The process does not require coagulants as the membranes operate at a molecular level. Consequently, the process does not generate sludge and maintains a high quality of treated water in spite of both sudden and substantial changes in raw water quality. Eliminating coagulants delivers very significant cost-savings. As an example, the chemical cost of the Fyne process is typically a mere £200 a year, compared to over £38,000 a year for conventional coagulation chemistry. This saving provides a direct cost benefit to the people of Scotland.

PMPs are supplied complete and incorporate all necessary peripheral items. They are simply positioned within a building and connected to services prior to final performance validation. Smaller sites can be run from a single phase electrical supply, simplifying installation in remote locations. Performance testing is carried out before shipping; minimising on site commissioning. Full instrumentation can be incorporated to enable unattended monitoring and limited site attendance. Custom engineered plants are offered for larger capacities and/or specific customer requirements.

The Fyne process and the PMP system were selected by Scottish Water as it afforded them considerable cost savings, reduced delivery time and minimised any visual or environmental impact in areas of outstanding scenic beauty. A customer-centred approach, advanced technological expertise and low whole of life product cost means PCI Membranes continues to be Scottish Water's preferred supplier for treating coloured raw water and providing optimum quality drinking water to remote rural communities in Scotland.

The editor & publishers would like to thank Darren Reed, Business Development Manager at PCI Membranes, Andy Sealey, Marketing Communications Manager at Xylem, and Ross-Shire Engineering, for preparing the above article for publication.

A **SOLUTION** FOR
RURAL WATER
SUPPLIES WITH
**DIFFICULT
SOURCES**

A valley view in Wester Ross, Scotland.
Home to one of our Fyne Process sites.

C10 Series tubular membranes
with UF & NF Modules



The Fyne Process

'Fyne process and Package Membrane Plants (PMP's) are well suited for water systems for small rural communities'