CASE STUDY

Oil on the water

Melanie Brown looks at a new technique from the US for treating oily waste waters

Virtually all oil or gas extraction has water as a by-product. It is separated from the oil or gas at the surface, but remains contaminated with small quantities of free and dissolved oils and heavy metals.

The quantity of water produced tends to increase with the age of the well. In the US, eight times more water is produced than oil. Strict consent limits for co-produced water discharges mean that further treatment is often necessary prior to disposal.

Membrane qualities

Esmil is introducing an innovative ultrafiltration (UF) membrane for the treatment of oily wastewaters into the UK. The membrane, which was developed recently by US firm Osmonics, is made from a chemically-modified polyacrylonitrile (PAN) polymer and is more oleophobic than any other available membrane material, making it resistant to free-oil fouling. The membrane has asymmetric pores and is extremely hydrophilic, which allows water to permeate readily while oil is repelled. Oil rolls off the membrane surface and is collected and reclaimed.

Osmonics has developed the membrane for use in a spiral-wound element, which has a much higher packing density than other membrane filtration devices. The company has conducted a series of pilot schemes treating oilfield-produced waters in the Bakersfield area, near Los Angeles, using a process combining UF with nanofiltration and reverse osmosis. The UF membrane typically reduced oil concentrations in the feed from 10-50ppm to <1ppm.

European applications

The PAN UF membrane has been selected as best available technology for treating wastewater at a new gas condensate development in Ireland, which is expected to begin operation later this year. Esmil has designed and engineered the site's wastewater treatment system and will build and commission the plant once operations commence.

The plant will treat all produced and surface run-off waters, removing free and dissolved oils, trace organics and heavy metals *(see table)*. The treatment process has been designed to handle varying flow rates and large fluctuations in pollutant concentrations.

Results below detection limits

Produced and surface run-off water will be treated separately. Gross separation of water and oil arriving from a network of remote sub-sea gas wells will be achieved using conventional equipment, such as corrugated plate separation, hydrocyclones, air flotation or sand filtration.

Residual free and emulsified oil and suspended solids will be separated from the water using a PAN UF membrane, which will reduce oil concentration to less than 0.3mg/litre and suspended solids to below detection limits.

Treatment specification (mg/l)

Contaminant	Feed	Treated Water
Suspended solids	100	<0.1
Oils, fats and grease	15	<0.3
Mercury	1	0.0005
Lead	0.5	0.005
PAH	1	0.0002
Iron	185	1
Sulphate	4093	<50
Chromium	0.5	0.1
Zinc	25	0.1

Heavy metals, divalent ions and organic compounds will be removed by nanofiltration. As the membrane provides no resistance to monovalent ions such as chloride, it is able to treat very saline waters, which could not be tackled economically by reverse osmosis.

Finally, the water will be polished by passing it through an activated carbon bed, followed by a highly specific ion exchange resin, which will remove trace organics and heavy metals from the nanofiltration permeate. The surface water, which is much less contaminated, will be treated with conventional separators and UF alone.

Rejected fluids will be recycled to the front-end of the process and concentrated oil will be reclaimed onsite. Sludges and aqueous waste will be combined, precipitated, flocculated and filtered to produce a dry lime cake for landfill disposal and a filtrate that can be recycled through the process. Separated material, backwash and cleaning waters will be returned for treatment. Treated water will be discharged to sea. Concentrations of oil, suspended solids and mercury should be reduced to undetectable levels.

A world-first application

Stefan Massingham, sales and marketing manager at Esmil, believes that this is the first full-scale application of membranes and ion exchange resins to treat produced water from oil and gas extraction. The technology is most applicable to the onshore production of gas condensate and smaller, onshore oil-producing sites – the membranes would not be practical for large-scale, offshore oil production platforms. ■

Further information:
Esmil www.esmil.co.uk
Osmonics www.osmonics.com