

# CASE HISTORY

## SCOTTISH WATER, MALLAIG WTW

**End User** Scottish Water  
**Process** Nanofiltration  
**Application** Potable water production from coloured raw water



Dual Auto backwash filters in foreground with Nanofiltration plant in background



Front view of Nanofiltration skid

### Introduction

ACWA designed, built and commissioned a Nanofiltration plant at the Mallaig treatment works of Scottish Water. The process is capable of treating up to 1,764m<sup>3</sup>/day of raw Highland Loch Water - containing variable but generally high levels of suspended solids and colouration – and recover high quality permeate at a rate of 85%.

Description	Influent Characteristics Average	Product
Flow m <sup>3</sup> /day	1,764	1,500
Suspended Solids mg/l	Variable sometimes >20ppm	Nil
Colour	200+ Hazen	<5 Hazen
pH	8	6
Temperature °C	1-25	Unchanged

### Description

#### The Mallaig Treatment Process

The process design of the Nanofiltration plant for Scottish Water's Mallaig Treatment Works comprises pre-filtration, chemical dosing, a single pass membrane system and post treatment including remineralisation, chlorination and phosphate dosing for prevention of plumbo solvency.

#### Raw Water

The feed pressure into the plant room is in the region of 6.5 Bar and, as a precautionary measure, a surge vessel has been installed to ensure sufficient protection for the feed-water delivery pipe-work.

### **Pre-filtration**

Due to the high level of suspended solids contained in the raw feed-water, the plant incorporates an automatic backwash pre-filtration system designed to minimise operator intervention, reduce running costs and reduce fouling of the membranes in the down-stream nanofiltration plant. The system comprises two automotive 10-micron screen filtration units that can operate in parallel or duty/standby mode

### **Pressure Control**

As the membranes become progressively fouled, the pressure required to achieve the feed-water flow-rate is automatically adjusted by the PLC up to a maximum feed pressure of 8.5 bar.

### **Carbon Dioxide Dosing**

In order to reduce the risk of damage to the membranes, water from the pre-filtration system is subjected to in-line dosing with Carbon Dioxide to reduce the pH level from 7.5 to approximately 6.2

### **The Nanofiltration System**

The plant uses well-proven nanofiltration elements, specially developed to treat water with high levels of suspended solids and colouration. The membrane system, designed to accept pre-filtered water at a rate of up to 88.2m<sup>3</sup>/hour, comprises four arrays of eight pressure tubes, each containing long spiral wound elements. Pressure and flow transmitters are used to monitor the feed, concentrate and permeate sides of the system, whilst chlorine, flow, turbidity and pH meters, monitor the water quality and output.

### **Membrane Integrity**

To monitor membrane integrity, a particle counter samples five points in rotation and by continual reference to "day one" particle count, a constant indicator of membrane integrity is provided.

### **Control of Membrane Fouling**

To minimise membrane fouling the system incorporates two inverter driven re-circulation pumps (duty/standby) in order to control the membrane crossflow velocity.

The degree of cleaning necessary to maintain the system output will depend on the amount of organic content and colouration of the feed-water. High levels of these contaminants demand a full cleaning procedure by the clean in place (CIP) system.

### **Shutdown Flushing**

The treatment plant incorporates an automatic system for shut-down flush comprising a re-circulation tank and PLC controlled dosing set. From the tank, the flushing solution of 1-2ppm Sodium Hypochlorite is introduced to the feed side of the membrane system by dedicated duty/standby pumps.

### **Cleaning in Place (CIP) Procedure**

Cleaning in Place is carried out manually using the same equipment as for the shut-down flushes, but proprietary solutions are used as cleaning agents.

### **pH Correction**

Permeate leaving the membrane array is sterile but slightly acidic in pH. To correct this, the flow is passed through a stainless steel vessel containing a granular alkaline media which slowly dissolves in contact with the acidic permeate thereby raising the pH.

### **Phosphate Dosing**

In order to reduce the possibility of lead from pipework in the distribution system dissolving into the water Mono Sodium Phosphate is added to the treated water prior to it leaving the works and entering the reservoir.