# inge watertechnologies AG

## References

# Treatment of a Lake Water for a Swiss Municipal Water Works

**System Summary:**
164 dizzer®5000 MB Modules in 4 Racks

**Location**
Maennedorf, Lake Zurich, Switzerland

**OEM/System Integrator**
VA Tech WABAG, Switzerland

**Enduser**
Municipal Water Works Association

**Plant Capacity**
17,600 m³/day

**Market/Industry**
Municipal

**Application**
Drinking Water

**Feed water source**
Lake Water

**Commissioning Date**
December 2005

## Overview

In recent years, Switzerland has undertaken a programme of drinking water improvements, which have reflected the trend of improving drinking water standards adopted within the EU. As in Germany and France, there has been a particular concern with waterborne pathogens and a desire to reduce the dependence of water supply on chemical disinfectants. Switzerland has adopted membrane barrier technology to meet removal and disinfection targets, and has set even more exacting standards for microbial removal than those of EU countries.
This profile describes a drinking water plant installed with inge technologies Multibore® membranes in 2005 to provide a UF barrier for a surface water source at Maennedorf, Lake Zurich.The plant has achieved its treated water quality targets, and membrane integrity has been excellent with no decline in membrane integrity, and no fibre breakage. In addition, permeability has been stable since start up.

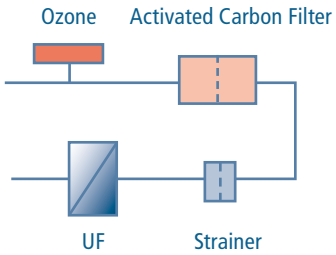
## Treatment Objectives

Lake Zurich normally operates with a relatively low turbidity of approximately 0.8 NTU, but water quality can vary particularly during the spring snow melt.
In Switzerland, the microbial treatment standard of < 20 cfu/ml (germs per milliliter) is particularly exacting, and UF membrane barriers have been utilized on numerous drinking water installations. In addition to this microbial standard, the UF system has to achieve a treated water turbidity of < 0.2 NTU. Due to occasionally algae blooms, the UF has been preceded at Maennedorf by Ozone/Granular Activated Carbon, as shown in the Process Flow Diagram in the figure.

## Performance

The plant has operated at a flux of 110 l/(m²h), with a low consistent operating pressure. Apart from a 5 ppm chlorinated backwash once or twice per day for disinfection, no chemical cleaning has been required.
Treated water quality has consistently met the < 0.2 NTU target, even during feed turbidity spikes. Of particular importance to the customer, the pressure decay test has confirmed that membrane integrity has remained consistent since the modules were installed, and no fibre breaks have been recorded.

**Process Flow Diagram**




**Customer Statement:**

*„UF provides the Drinking Water Authorities a microbial barrier to meet stringent Swiss standards. The inge membranes have shown excellent integrity and performance."*

**Victor Leimgruber**
**Operations Manager**

**Location**
Roetgen, Germany

**OEM/System Integrator**
Krueger WABAG GmbH, Germany

**Enduser**
WAG Wassergewinnungs- und -aufbereitungsgesellschaft Nordeifel mbH, Roetgen

**Plant Capacity**
14,400 m³/day

**Market/Industry**
Municipal

**Application**
Drinking Water

**Feed water source**
Backwashwater from primary membrane plant

**Commissioning Date**
October 2005

**Customer Statement:**

*„inge's UF system has shown that exceptionally high plant recoveries can be achieved without putting treated water quality at risk."*

**Walter Dautzenberg**
**Technical Director**

# Secondary Recovery for a Membrane Plant operating on a German Reservoir Source

**System Summary:**
234 dizzer®5000 SB Modules in 3 Racks

## Overview

Germany is introducing legislation and guidelines based on stringent EU drinking water standards that have been implemented in the last few years. These standards cover a wide range of water quality parameters, and there has been a particular concern with waterborne pathogens and a desire to reduce the dependence of water supply on chemical disinfectants. Germany and several other EU countries have adopted membrane barrier technology to meet removal and disinfection targets.
This profile describes a secondary recovery system, based on inge 1.5 mm fibre modules, that has been installed on Europe's largest backwash membrane plant, a 630 m³/h facility at Roetgen, near Aachen. The feed to the primary plant is a surface water feed from a reservoir. The inge watertechnologies modules treat washwater from the primary membrane plant, and returns the filtrate to the head of the works. The washwater from the secondary system is fed to a sedimentation tank, which recycles the supernatant. The recovery of the secondary system is 98.5%, and overall recovery for the whole plant is up to 99.3%.

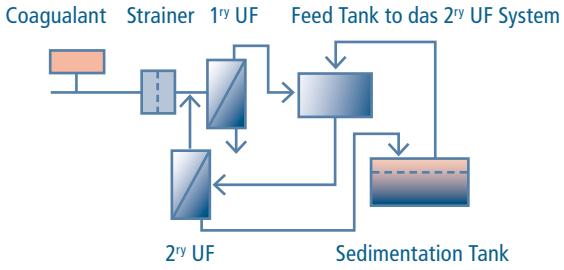
## Treatment Objectives

The turbidity of the reservoir source at Roetgen varies with season. The primary membrane plant produces a washwater with turbidity normally in the range 20 to 200 NTU. This water is combined with the supernatant from the secondary washwater to produce the secondary plant feed.
Due to the recycles employed in the system design, the feed is unchlorinated, and chlorine use in the CEB is also avoided, to minimize the potential for contamination of the treated water by tri-halomethane (THM) formation and easier discharge of the concentrate after neutralization.
The objective of the secondary membrane plant has been to provide a recovery of primary plant washwater of ≥ 98%. The treatment objective has been to reduce turbidity, and remove of water borne pathogens to prevent their concentration in the primary plant.

## Performance

The plant has operated at a design flux of 90 l/(m²h). CEB has been performed once every 3 to 14 days with caustic at pH 11.5 to 12.0, and with sulfuric acid at pH 2.0 to 2.5. Provision has been made for occasional CIP with citric acid, but so far this has not been required.
The secondary plant has achieved a recovery of 98.0%, taking into account backwash water recycling, thereby exceeding its recovery target. Treated water quality has consistently met the < 0.1 NTU target.

**Process Flow Diagram**



# Recycle of Industrial Waste Water and Surface Water


**System Summary:**
648 dizzer®5000 MB Modules in 9 Racks

**Location**
Ukraine

**OEM/System Integrator**
GE Water

**Enduser**
Chemical Industry

**Plant Capacity**
48,000 $m^3$/day

**Market/Industry**
Chemical Industry Complex

**Application**
RO pre-treatment

**Feed water source**
Industrial Wastewater
Surface Water

**Commissioning Date**
January 2005

## Overview

Industrial wastewater is potentially a valuable resource for large plant complexes, and if not re-used, can incur significant disposal costs. In addition, surface run off from rainfall can become contaminated on an industrial site, and requires treatment before discharge.
This case profile describes an installation at a large chemical plant complex in the Ukraine, at which RO has been used for some years to provide water for re-use from mixed waste sources. However, the original conventional pre-treatment resulted in high chemical cleaning frequency, downtime, and high RO replacement rates.
In 2004, pilot trials were conducted by inge to evaluate whether UF could treat the variable feed at the site. Based on the successful pilot results, inge was selected to provide their UF Multibore® technology for the facility. The system has operated well since start-up, significantly improving the performance of the RO.

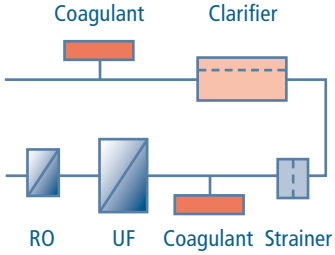
## Treatment Objectives

Prior to the installation of the UF system, the feed caused significant problems for the RO, with high use of cleaning chemicals, and frequent RO replacement. The objective of the UF system was to provide a consistent RO feed, with turbidity < 0.1 NTU and SDI < 3, whilst coping with the variability of the blended feed source.
The Process Flow Diagram for the system is shown in the figure. The run off from the site varied widely in turbidity with season and weather conditions. This was blended with a variety of waste sources in a feed pond, then flocculated and clarified prior to the UF system.

## Performance

The design flux for the UF system is 80 l/($m^2$h). The system has achieved stable performance, consistently providing an RO feed with SDI < 3. Since start up in January 2005, no fibre breaks have occurred, and membrane integrity has been maintained, despite the difficult nature of the feed.
Chemical usage has been low, with an occasional caustic CEB at pH 12, followed by an acid CEB at pH 2.5. Chlorine disinfection has not been used, and there has been no requirement for CIP.

**Process Flow Diagram**




**Customer Statement:**

*„Conventional treatment was found to be unable to cope with the variability of the wastewater feed, and caused problems for the RO. Since the UF has been installed, consistent RO performance has been achieved."*

**Alexander Ososkov**
**Regional Manager, GE Water**

# Surface Water Treatment for a Russian Power Plant

**System Summary:**
96 dizzer®5000 MB Modules in 3 Racks

**Location**
Russia

**OEM/System Integrator**
Mediana Filter

**Enduser**
Novocherkasskaya GRES

**Plant Capacity**
6,100 m³/day

**Market/Industry**
Power Plant

**Application**
RO pre-treatment

**Feed water source**
Surface Water

**Commissioning Date**
December 2006

## Overview

In 2004 a reverse osmosis (RO) system was installed at Novocherkasskaya GRES replacing the original ion exchange (IX) desalination system in order to reduce the overall operating cost by saving chemical consumption used for regeneration of the IX resin. The initial pre-treatment to RO included a clarifier (liming and coagulation) and mechanical filtration. Within short time after start-up of the RO system it was clear that the existing pre-treatment could not provide the requested feed water quality to ensure reliable performance of the RO system under extremely varying feed water conditions resulting in heavy fouling on the RO membranes.
To cope with the extremely difficult and varying surface water the installation of an ultrafiltration system was considered. A UF pilot unit was brought to site and after successful trials the decision was taken to replace the existing conventional pre-treatment system with UF.
This case profile describes the first water treatment plant installation utilizing an integrated membrane system using UF and RO at a large Russian power plant. The system has operated well since start-up, reducing RO fouling and minimizing operating cost to a large extent.

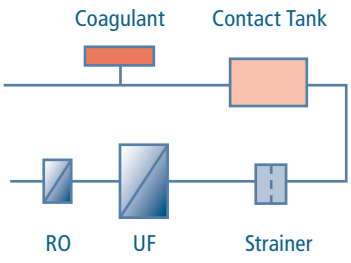
## Treatment Objectives

Before UF was installed, the flux of the RO membranes fell from 24 to 18 l/(m²h) within three weeks causing high chemical consumption due to the very frequent CIP cleanings.
The Don river water quality varies greatly with the seasons. TSS and turbidity can go up to as much as 36 mg/l and 20 NTU, respectively. The objectives were to improve the RO feed water quality significantly and to keep it at a consistent level independent of seasonal variations.

## Performance

The operating flux for the UF system is at a stable 67 l/(m²h) with no chemical enhanced backwashes at all. A caustic and acid CIP is carried out once a month. The TSS is < 0.1 mg/l and the turbidity is lower than 0.2 NTU on a continuous basis. Removal of organic matter could be increased by 40 to 50% compared with conventional treatment. No fiber breaks were detected.
As a result the flux of the RO membranes could be increased up to 29 l/(m²h) and no CIP cleaning of the RO system was necessary in 9 months of operation.

**Process Flow Diagram**




**Customer Statement:**

*„It was the first experience with UF pretreatment for RO in water treatment for Russian Power Generation. There is a substantial operating cost reduction and system reliability has been increased. Chemical waste was sharply reduced. The installation of UF resulted in a 50% higher flux in the RO system and the RO CIP frequency could be reduced by more than 12 times."*

**Sergey Lysenko**
**Water Treatment Department Supervisor**

# Reclamation of Municipal Wastewater for a Chinese Petrochemical Complex

**System Summary:**
**Phase 1:** 82 dizzer®5000 MB Modules in 2 Racks
**Phase 2:** 416 dizzer®5000plus Modules in 8 T-Rack® lines

**Location**
Dalian, China

**OEM/System Integrator**
Dasmart (Beijing) Environmental Technology Co., LTD
Consulting Co. Georgi Water Treatment

**Enduser**
CNPC Dalian Petrochemical Company Limited

**Plant Capacity**
Phase 1: 6,500 m³/day
Phase 2: 30,000 m³/day

**Market/Industry**
Petrochemical/Refinery

**Application**
RO pre-treatment

**Feed water source**
Municipal effluent

**Commissioning Date**
Phase 1: December 2005
Phase 2: May 2009

**Customer Statement:**

*„The inge watertechnologies membranes have shown that a challenging feed, such as municipal effluent, can successfully be treated by UF, with minimal chemical usage. This plant demonstrates that wastewater reclamation provides a feasible alternative for industrial water requirements."*

**Joachim Georgi**
**Managing Director, GWT**

## Overview

The growth in Chinese industry has led to consideration of alternative water sources to meet demand. The CNPC Dalian Petrochemical Company Limited decided that their best supply option would be to reclaim treated secondary municipal wastewater for their refinery needs, which included an RO system. UF pre-treatment prior to RO is often specified for boiler feedwater projects in China due to its excellent technical performance and competitive economics.
This profile describes the phase 2 Dalian project by GWT, commissioned in May 2009 utilizing inge watertechnologies Multibore® membranes with 416 dizzer®5000plus modules in 8 T-Rack® lines. The 82 dizzer®5000 MB modules in 2 Racks of phase 1 have been in successful operation since December 2005. The GWT system comprises a biological stage (MBBR = Moving Bed Biofilm Reactor), primarily for nitrification, followed by alum flocculation and a combined Dissolved Air Flotation (DAF), to provide feedwater to the UF-RO and also for the Cooling Tower make-up.

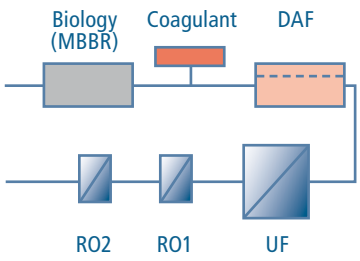
## Treatment Objectives

For RO to treat a wastewater feed, it is particularly important to reduce turbidity, SDI, and TOC, in order to control fouling, and minimize chemical cleaning. At Dalian the secondary effluent feed from the local municipality is biologically treated, and flocculated with alum, prior to flotation and filtration, as shown in the Process Flow Diagram. This ensures that the UF-RO has a consistent feed quality, with reduced concentration of the dissolved organics and ammonia. The objective of the UF system was to achieve a treated water quality with an SDI < 3.0, to give stable RO operation.
The feed quality at Dalian is somewhat variable; however, the bioreactor and DAF/DMF provided a consistent low turbidity feed for the UF, with BOD < 5 ppm, and COD < 20 ppm.

## Performance

The design flux of the UF is 66 l/(m²h), with typical operating pressure stable at 0.2 to 0.3 bar across the membrane (Transmembrane Pressure). Once a day a 5 ppm Cl2 CEB is conducted with a 5 minute soak time, to control bio-growth. A CIP system has been provided, but has not yet been required. It is expected that a CIP would only be needed on a 1 to 2 year interval.
Treated water quality has exceeded the treatment objectives, with a SDI of 0.5 to 3.0, with no fibre breaks or other integrity issues experienced since start up.

**Process Flow Diagram**



# RO Pre-treatment of a River Water for a Chinese Power Plant

**System Summary:**
208 dizzer®5000 MB Modules in 4 Racks

**Location**
Guangzhou, China

**OEM/System Integrator**
Kaidi, China

**Enduser**
Heng Yun Heat and Power Plant

**Plant Capacity**
18,240 m³/day

**Market/Industry**
Power Plant

**Application**
RO pre-treatment

**Feed water source**
Tidal River Water

**Commissioning Date**
March 2006

## Overview

China is currently engaged in a major expansion of its power infrastructure, and the Heng Yun Heat and Power Plant has recently decided to upgrade its facility at Guangzhou. The two stage RO system, which is followed by EDI, formerly used conventional pre-treatment. This has now been upgraded to UF pre-treatment with inge watertechnologies Multibore® membranes, to improve RO performance and on-stream time. The 760 m³/h facility uses an abstraction from a river estuary, where seawater influences the water quality, particularly during the winter. UF pre-treatment prior to RO/EDI is often specified for power plant water supply projects in China due to its excellent technical performance and competitive economics.
This profile describes the installation at Guangzhou. The design specification for the UF system was to provide an RO feedwater quality with SDI well below 3.0, and turbidity below 0.1 NTU.

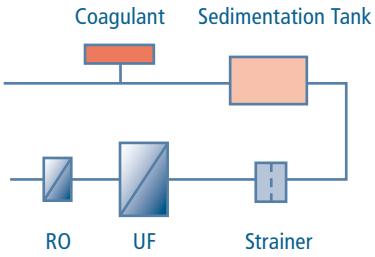
## Treatment Objectives

UF pre-treatment improves the performance of RO by allowing higher fluxes with lower chemical cleaning requirements. The objective of the UF system is to achieve a treated water quality of < 0.1 NTU, with a SDI < 3.0, to enhance the RO operation.
The river estuary abstraction at Heng Yun gives a variable and highly turbid feed ranging from 20 to 50 NTU. To provide a more consistent feed to the UF, the river water is flocculated with ferric chloride and settled. The normal feed turbidity to the UF is expected to be around 5 NTU.

## Performance

The design flux for the UF system is 82 l/(m²h). The typical transmembrane pressure (TMP) is 0.15 bar, corresponding to a permeability of 550 l/(m²h) bar. Chemical usage has been minimal, with a chlorine CEB once every 3 to 4 days, and no CIP required.
Treated water quality met the treatment objectives with no integrity issues experienced.

**Process Flow Diagram**




**Customer Statement:**

*„We have seen a good improvement in the performance of our RO system since we installed the UF pre-treatment. We are cleaning the RO less, and expect to see better membrane life."*

**Han Xianbin**
**Senior Technical Advisor**
**Water Treatment**

inge References 2(2009-05) E wt-AG

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