Construction and first operational experiences of the ultrafiltration plant Roetgen

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TWA Roetgen
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Data of the enlarged plant

- Purpose: elimination of particles, iron and manganese, hardening
- Process principle: UF membrane filtration followed by hardening
- Drinking water production: max. 6,000 m³/h, 100,000 m³/d, 30 Mio m³/a
- Membrane surface: 70,000 m²
- Filtration surface: 1170 m² (FS I) und 720 m² (FS II)
- Years of construction: 1953, 1972 und 2005
Treatment line of the enlarged TWA Roetgen

- Feed tower
- Turbine / RW pumps
- Pre-filtration
- Flocculation: Alum, NaOH
- UF-Pressurized membrane
- Limestone filter step 1: CO₂
- Limestone filter step 2
- Disinfection (opt): NaOH
- Storage and network feeding

*red = new components
Treatmentsystem of the enlarged TWA Roetgen
Layout plan with the new buildings

- Backwash Water treatment plant
- UF-Membrane Plant
- Flocculation
- Limestone Filtration Step 1
- Limestone Filtration Step 2
- UF-Membrane Plant
- Flocculation
- Limestone Filtration Step 1
- Limestone Filtration Step 2
- Backwash Water treatment plant
- UF-Membrane Plant
Selected pressurized membrane technology

- Consisting of X-Flow Membrane insert
  - 1.50 m length and 8“ diameter
  - +/- 12,000 membrane fibers per insert
    (0.8 mm diameter – capillary fiber)
  - 40 m² membrane surface per insert

- The membrane inserts are installed in
  - 6 m length horizontal pressure vessels (DN 200).
  - 4 inserts per pressure vessel
  - each pressure vessel has 2 raw water feed ports and 2 filtrate ports
View of a filtration skid

- Each skid is equipped with 36 pressure vessels
- 5,760 m² membrane surface per skid
- Maximum flow rate 585 m³/h or 160 l/s
Complete DW UF Membrane plant

- The complete DW UF membrane plant consists of 12 skids
- +/- 70,000 m² membrane surface
- Max. flow rate 7,000 m³/h or 1,940 l/s
- Largest membrane plant in Germany
Operating data UF Plant

Flux, TMP and Permeability

Backwash every 70 min

- Permeability at 20 °C in l/m²h bar
- Flux in l/m² h
- TMP in bar
Operating data UF Plant
Effect of chemical enhanced backwash

Permeability at 20 °C in l/m²h bar

BW with caustic soda
BW with acid
Operating data UF Plant

Long-term value TMP, Flux

UF-Trinkwasser Rack 1
Operating data UF Plant

Long-term value Permeability

UF1-Trinkwasser Rack 1

Operating data UF Plant
Long-term value Permeability

UF1-Trinkwasser Rack 1
Operating data UF Plant

Performance data and adjustment of UF plant:

• Permeability (20 °C) = ca. 450 l/m² h bar

• Flux average = 60 l/m² h

• TMP average = 0.13 bar

• Backwash every 60 – 70 minutes

• Chemical enhanced backwash: every 24 h backwash with caustic soda (pH > 12) and backwash with acid (pH < 2,2)
Operating data UF Plant
Measurement of particles (Target value: < 1 P/ml)

1,0 = Target value
Backwash every 70 min
Concentration of particles (2-20 µm) in 1/ml
Average concentration of particles 0.2 – 0.4 P/ml (2-20 µm)
Operating data UF plant

Comparison particle removal UF versus sand filtration

raw water
12,000 P/ml (> 2 µm)

Filtrat UF

TWA Roetgen particle measuring - cumulative

Median (>0.7 µm) ▲ Median (>1 µm) △ Median (>2 µm)
Operating data UF Plant

Membrane integrity

Before starting up (Dec. 2005) each rack has been tested by air pressure decay testing:

- 4 racks had too much pressure drop.
- 4 connectors were defect.
- 1 membrane defect was detected.

In may and septembre 2006 the racks were tested with spike testing by dosing chalk particles into the feed.

- There was no further detection of defects.