FEASIBILITY STUDY FOR TECHNICAL AND ECONOMIC RECOVERY OF WATER FROM METAL PROCESSING OPERATIONS

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INTRODUCTION

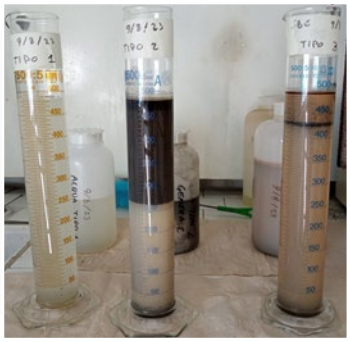
Due to climate change, companies increasingly need to reduce water consumption. One approach involves recovering purified wastewater in a circular economy perspective. Therefore, treatment processes must ensure not only compliance with discharge limits but also water quality sufficient for reuse within the facility, where feasible.

This is the objective set by **SBE Varvit di Monfalcone (Gorizia - Italy)** a leading European producer of bolts. The project presented here aimed to improve existing wastewater treatment to reduce disposal volumes and recover part of the treated water.

The water studied originates from degreasing and washing processes for steel components, characterized by alkaline pH and varying concentrations of surfactants, metals, and oily substances. The flows were grouped into three types (Type 1, Type 2, and Type 3) based on their characteristics.

TABLE WITH CHARACTERISTICS OF THE WATER TO BE TREATED

Wastewater	Capacity	Characteristics
Type 1	10-15 m^3/h continuous	Conductivity 1500 µS/cm, COD 200 mg/L
Type 2	120 m^3/m discontinuous	Conductivity 33.000 µS/cm, COD 50.000 mg/L
Type 3	80 m^3/m discontinuous	Conductivity 35.000 µS/cm, COD 30.000 mg/L



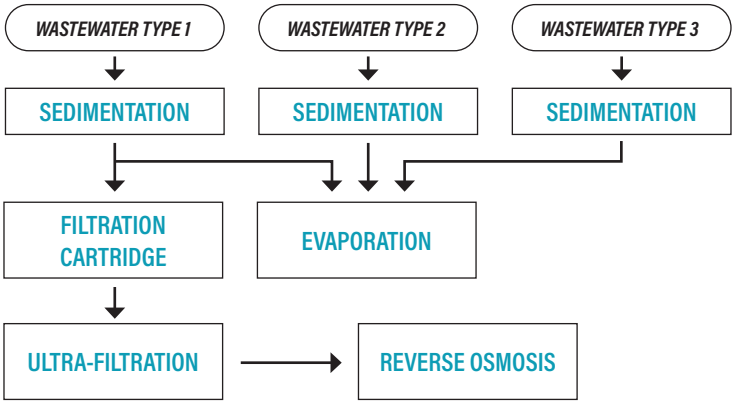
ACTIVITIES CARRIED OUT

The first phase involved a meticulous analytical assessment of the produced water in order to be fully aware of it. They were also integrated in order to complete the analytical picture of the process and determine the best sequence of the treatment process in order to optimise it. The appropriateness and convenience of segregating particular flows from production was then assessed.

The second phase involved conducting an experiment with pilot plants for ultrafiltration and reverse osmosis (for Type 1 water) and evaporation (for all Types 1, 2 and 3). The duration of the trial was approximately 6 weeks.

During the trial, numerous samples were taken and sent to the laboratory for analysis, which also allowed treatment modifications to be carried out during the trial, resulting in process efficiencies.

TESTS CARRIED OUT



SAMPLES FROM EVAPORATION TESTS

WASTEWATER TYPE 1 *WASTEWATER TYPE 2* *WASTEWATER TYPE 3*

ULTRAFILTRATION AND REVERSE OSMOSIS TEST SAMPLES

RESULTS AND CONCLUSIONS

Tests with the existing plants achieved a volumetric reduction of waste water > 90%. The treated Type 1 water was of suitable quality for recovery at the plant, while the treated Type 2 and Type 3 water had to be further purified.

From the results obtained, it was then possible to size the plants on an industrial scale and estimate the investment and operating costs.

For Type 1, the industrial-scale process involves ultrafiltration, reverse osmosis and evaporation of the concentrates from the first two treatments, with a dedicated evaporator. For Type 2 and Type 3, the treatment involves a single evaporator receiving both types of water.

ULTRA-FILTRATION TESTS	
Pilot System	ULTRA-FILTRATION
Membrane type	CERAMIC UF
Cut-Off	50 nm
Membrane surface area	0.53 m^3
Transmembrane pressure	1 - 3 BAR
Temperature range	20° C - 35° C
Tested pH	10 and 7-8
Recovery rate	Up to 90%

REVERSE OSMOSIS TESTS	
Pilot System	REVERSE OSMOSIS
Membrane type	SPIRAL WOUND RO
NaCl Rejection	99,5 %
Membrane surface area	2.5 m^2
Feed pressure	9 - 10 BAR
Temperature	20° C - 30° C
Tested pH	6-8
Recovery rate	Up to 85%

EVAPORATION TESTS	TYPE 1	TYPE 2	TYPE 3
Cycle hours (h)	295	275	45
Boiler volume (liters)	275	275	275
Distillate produced (liters)	18340	4500	2500
Processed volume (liters)	18615	4775	2775
Evaporative yield (l/h)	~ 60	~ 60	~ 60
Concentration factor	67 times	17,3 times	10 times
Distillate percentage	98,5 %	94,7 %	90,0 %