Case History

Re-use of Blow-down Colling Tower

Savings at you Hand

- Reduction of fresh water consumption
- Reduction of Waste Water Discharge Costs
- Water quality assurance
- Return on investment less than 1 year

Challenge

Our costumer is a big food & beverage company, located in Portugal, with 9 evaporative condensers, used to refrigerated 15 cold compressors.

The consumption of new water in these circuits reaches an annual average of 70 m3 / h, with a combined blow-down flow of 15 m3 / h.

The water used to compensate refrigeration comes from the municipal network, with a cost of 2,10 €/m^3.

Likewise, the treatment cost of the effluent generated in the WWTP is 0,21 €/m^3, plus 0.75 €/m^3 of discharge cost to the municipal collector.

The client determined the objectives of this study to reduce operation costs.

The table below shows the blow-down water quality .

Parameter	Units	Value
Turbidity	NTU	12
Micro-organisms at 37º	Ufc/ml	> 300
TSS	mg/l	22
Conductivity	µS/cm	1 100
Phosphates	mg/l	4,5
Total Hardness	mg/l $CaCO_3$	495
Iron	mg/l	0,83
Chlorine	mg/l	158
Total Alkalinity	mg/l $CaCO_3$	147
Salt Density Index	---	> 4
pH	Esc Sorensen	8.1

Initial Solution

GreatWater E & S carried out a test with a a pilot unit, consisting of PVDF capillary type ultrafiltration membranes. This is a testing unit that GreatWater E & S has to rent.

A pilot was constructed with a HydraCap 40Max type membrane with a porosity of 0.08 µm and a filtration area of 52 m^2.

A bag filter having a porosity of 100 µm was also placed in the ultrafiltration inlet.

We used a pump with a capacity of 1000 l / h at 20 mca.

A blowing system of 15 Nm3 / h at 0.5 bar was considered for the air delivery in the cleaning process.

A dosing rack with a clean water tank was also installed, performing daily membrane cleaning with hypochlorite every 7 hours, weekly with caustic soda and citric acid, in counter flow, daily.

Results — First:

Parameter	Units	Value
Turbidity	NTU	0
Micro-organisms at 37º	Ufc/ml	0
TSS	mg/l	0
Conductivity	µS/cm	1 100
Phosphates	mg/l	4,5
Total Hardness	mg/l $CaCO_3$	495
Iron	mg/l	0,83
Chlorine	mg/l	158
Total Alkalinity	mg/l $CaCO_3$	147
Salt Density Index	---	< 3
pH	Esc Sorensen	8.1

The Ultra-filtration process allowed to verify that the purge parameters can be adjusted, in order to allow their reuse.

Note that Ultra-Filtration membranes remove 99% of the viruses and bacteria present in the water.

Additionally, in order to verify the installation's operating limit, an activated carbon filter was added to remove free chlorine and a reverse osmosis unit in order to enhance the reuse of this water again in the cooling tower make-up.

In this way, we intend to be able to reuse 60% of the blow-down, reducing the waste to be sent to the WWTP to be only 6 m3 / h.

Compensation of towers in this way would be reduced by 9 m3 / h, dropping from 70 to 61 m3 / h, minus 13%.

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Final Results

From the test, it was possible to reach 75% of conversion on the reverse osmosis unit.

Thus, we obtained a water produced by the reverse osmosis unit, which is described below .

Parameter	Units	Value
Turbidity	NTU	0
Micro-organisms at 37º	Ufc/ml	0
TSS	mg/l	0
Conductivity	µS/cm	44
Phosphates	mg/l	0,15
Total Hardness	mg/l $CaCO_3$	1,2
Iron	mg/l	0,02
Chlorine	mg/l	4,5
Total Alkalinity	mg/l $CaCO_3$	7
pH	Esc Sorensen	6,2

Make-Up before	m^3/year	571 200
Blown-dow before	m^3/year	122 400
Annualized Make-Up	m^3/year	475 320
Annualized Blow-down	m^3/year	30 600
Fresh Water Savings	m^3/year	95 880
WWTP reduction	m^3/year	91 800
Fresh Water Savings	*€/year*	*201.348,00 €*
WWTP savings	*€/year*	*88.128,00 €*
Total Annualized Savings	*€/year*	*289.476,00 €*
Return In Investment	**11,2 meses**	**187 680 m^3**
ROI / ROE		

Comments

It was possible to achieve a higher than expected degree of operation in terms of conversion of the reverse osmosis unit .

Thus, the rejection of the following unit for the WWTP was 3,75 m^3/h, being reused in the make-up of the cooling towers 11,25 m^3/h, corresponding to a reduction of fresh water consumption of 16% .

The operation of the unit presented a regular trend without any changes, having worked for 30 consecutive days without any kind of interruption .

All the water produced was added directly into the basin of the cooling tower, representing in this test a reduction of fresh water of 8 100 m^3.

Benefits and Economical Return

By annualizing, we can determine the costs in water, treatment and discharge of the effluent generated by the blow-down of the towers, which are summarized in the following table .