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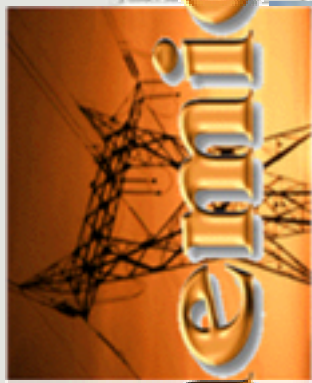
Water Services LTD

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**summary report
cooling water
treatment**

Saukem-Porbandar



Athens Sep 6, 2004

To SAURASHTRA CHEMICALS

Attn : Mr. D.N. SHARMA

Subject : Service Summary Report (file IND388CT)

Dear Mr. D.N. Sharma,

Please find attached our Service Summary report, for the analytical data of your cooling water system.

Data supplied to us on Aug 24, 2004, under the IND388CT file of daily service agreement, and are reflecting an operational period of about four months (May 1 till August 18, 2004).

The treatment during this period was a competitive local one, and the achieved protection was as low as 21,31 %.

During this period the system presented extreme instability due to high fluctuations of cycles of concentration (COC) and the make-up water quality (in use sea water without acid addition).

This is not making serious disturbances in our summary report, because statistics and moving averages could be use for the data evaluation, but creates problems in the on-the spot service reports.

Actually it is dangerous to make comments to the on-the-spot data, as they are, because due to the residence time the water analysis into the system has to be related to the history of the make-up

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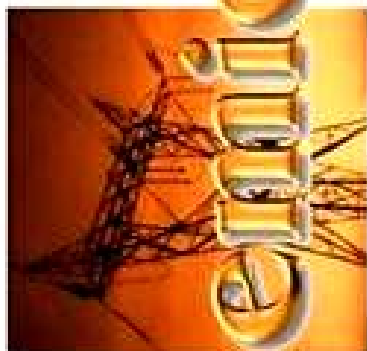
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of the previous days.

So for the daily reports we made such a correlation, but for your reference we developed also a series of completely on the spot reports.

All those reports will be uploaded within the next days at the internet address:

www.water-services.info/ind388CT.htm

as to visit and download whatever you want.

Please feel free to contact us or Mr Naik or Gmen of Aquafilsep if you or your staff need any clarification or any additional information

Truly yours

Dennis A. Arvanitakis

Power Chemicals

A Water Services division

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Basis of design

Technical data

General description

The cooling tower is a Mechanical, Induced Draft, counter flow type.

The location of the cooling tower is in industrial environment, in which hydrocarbon concentrations; acid gasses like CO₂, SO₂ or H₂S, as well as dust can be expected.

The cooling tower design data and the typical operating data are given in table below.

Cooling water system

Name	PCT-CWSystem
Type	IndDraft
Use	
Type of make up	Sea water
Make-up quantity	varies with loa
System Volume	5000 Cu M
max water temperature	45 deg.C
Cycles of Concentration	1.4 - 2.2
Treatment in use	Indian supplier (Competitive treatment)
Corrosion Inhibitor	
Antiscalent	single prod. 12 kg/day
Dispersant	
Biocides	two nos wkly alternately
Usual Problems	scaling and fouling
Frequency of chemical cleanings	once in a 8 months

The water analysis data for the period May 1, August 18, 2004 are presented at the tables at the attachment.

General data evaluation

As to have a preliminary option of the overall general operating conditions we calculated the average values of the analysis parameters of the make-up and the cooling tower.

This approach is smoothing the possible on the spot roughness of data and in most of cases is presenting an accurate image of the overall conditions during the period under examination.

The calculated average values are summarized into the table below.

Average Values

Make-up water		Cooling Tower	
pH	6,85	pH	7,89
p-Alk		p-Alk	47
M-Alk	306	M-alk	284
T-hard	7982	T-Hard	15444
Ca-Hard	1644	Ca-Hard	2844
Mg-Hard	6513	Mg-Hard	12578
Cl as Cl	19185	Cl as Cl	44569
	COC on Cl		1,98
	COC on Mg		1,93
	Difference		0,05
	Ca difference		-408,07
	mA difference		-321,10

We are seeing that the difference in the calculation of COC between Chlorides and Magnesium is negligible (only 0,05). This is showing that analysis are not numbers placed by chance, they have a certain logic, and despite minor deviations has to be further analyzed.

The difference in the material balance of Calcium (Ca in the system - Ca in Make up * COC) is **considerably high** (-408,07 ppm). The difference in the material balance of m Alkalinity is also high (-321,10 ppm), but **lower than the difference in Calcium**.

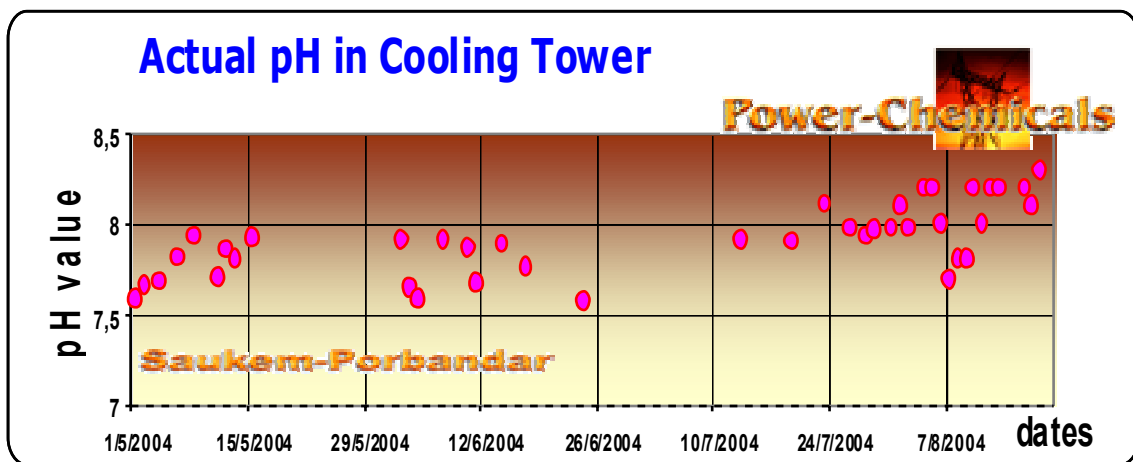
This confirms the non use of an acid, and as a preliminary comment, the -321,10 ppm of alkalinity loss has to be considered as deposition (scaling and sedimentations), while the difference (-408,07 -(-321,10) = -86,97 ppm) has to be considered as crystal distortion activity from the scale inhibitor (competitive product) in use.

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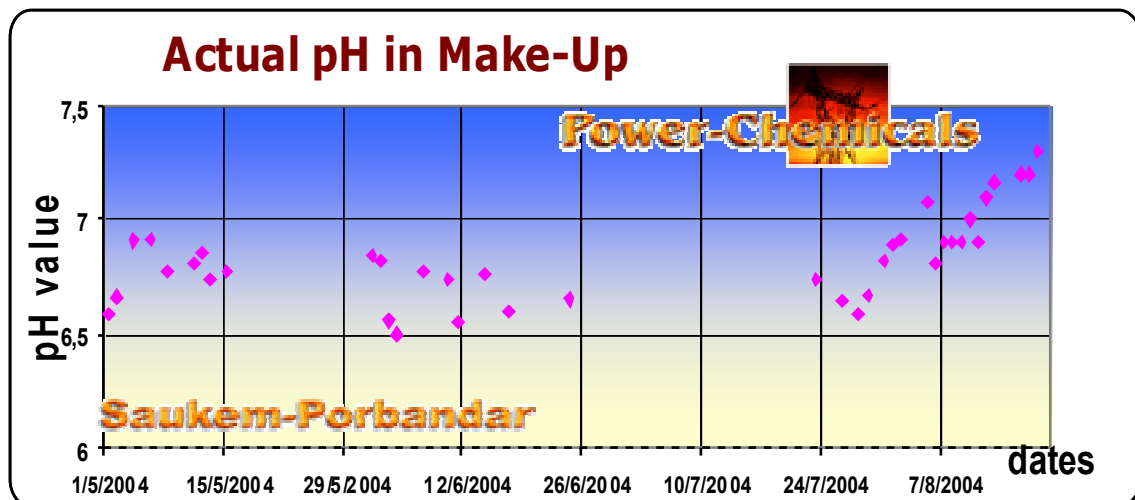
This is the only scale protection that it is offered from the current treatment, calculated as **21,31 %** ($86,97 / 408,07 * 100$).

The pH values are erroneous. It is mentioned at the data of the file "WSL-SAUKEM.doc" that **"ALSO pH of M/up remains above 8,0 hence pH indicated by auto- system in M-up is not correct due to failure of pH rod, But pH of cir-water is tested in Lab which is correct,"**, which is not true. The recirculating water analysis presents p Alkalinity, ranging from 20 to 85 ppm.

This corresponds to pH values over than 8,3 (by definition p Alkalinity starts at the reversion point of phenolphthalein, which is at pH=8,3), and especially between 8,3 to 8,9. And the actual values are far less than those figures (following graph).



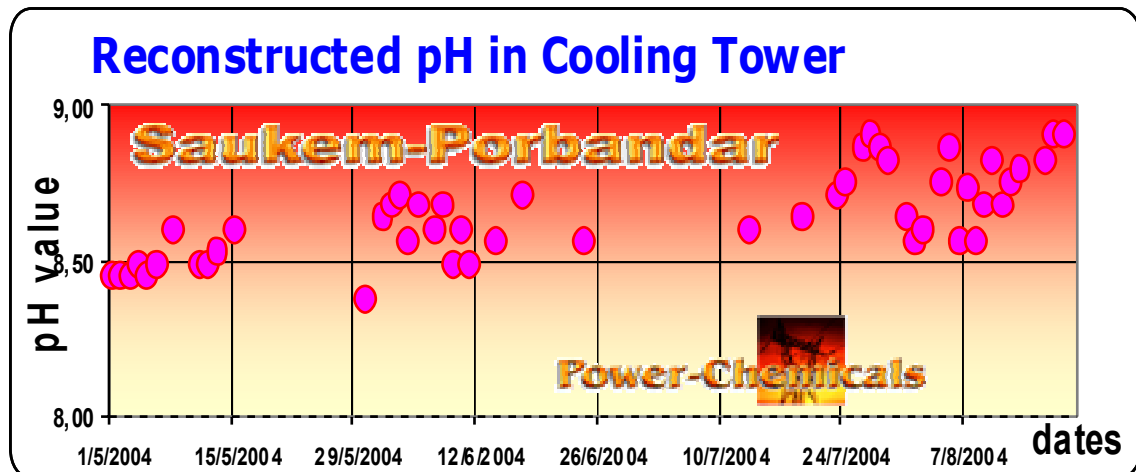
The make up pH is mentioned that is not the true one, but as long as it is not interfering our calculations (we are using the make-up m Alkalinity) we are leaving untached (the values of the following graph).



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For the values of the system pH, being critical for our calculations, we are reconstructing the values, using our software, based on the system p Alkalinity, m Alkalinity and water residence time (related to the system characteristics and COC).

The obtained so values are presented at the following graph

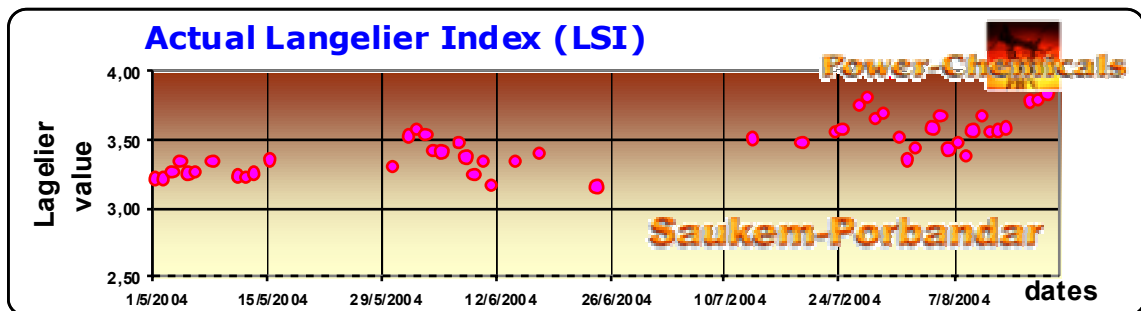


At the above pH values we are going to base further calculations.

Calculation of the Indexes

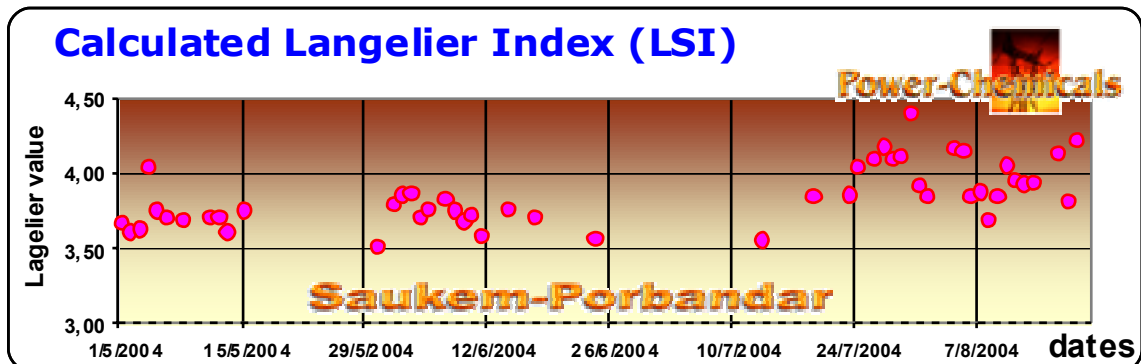
Langelier Saturation Index (LSI)

The actual data for the LSI are presented at the following graph

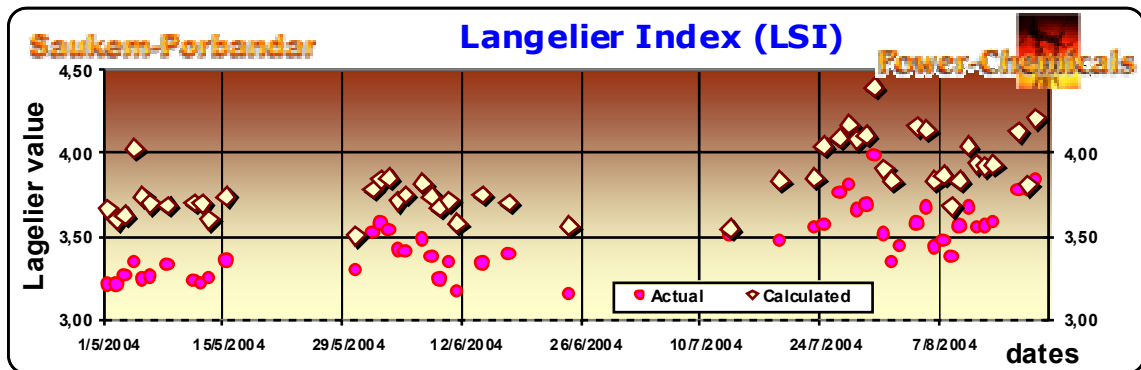


After reconstruction of system water analysis, and estimation of the pH of the system for the specified area of Cycles of concentration, we can calculate the expected water tendencies.

This is done by computer analysis, and the corresponding graph follows.



Data of both graphs (actual and calculated) are presented at the same diagram at the following.



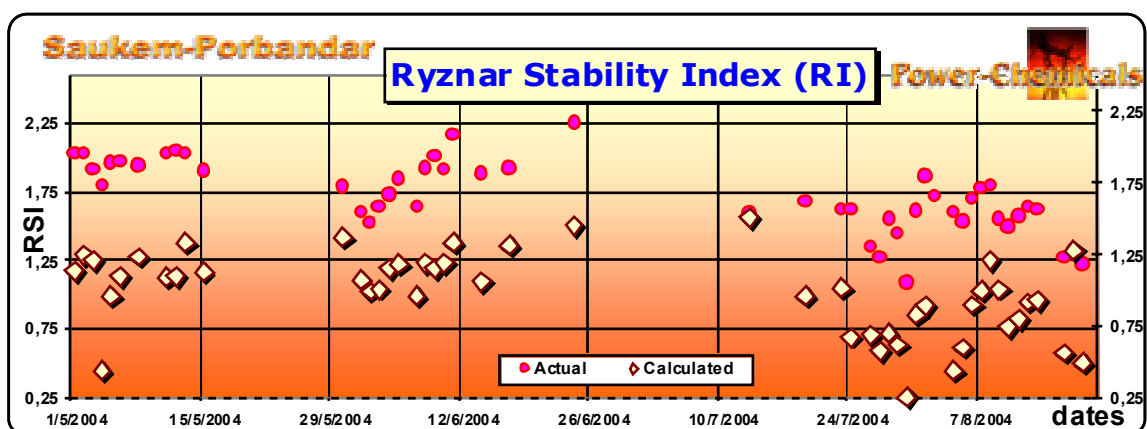
We can see that the data from the actual analysis are significantly less than the data from the reconstructed system analysis, round 0,5.

The reason is that the system presents scale forming tendencies, and being not protected in antiprecipitant, deposition occurs.

This precipitation lowers the Calcium and Alkalinity concentration, and the system is balanced in lower values.

Those lower values we are obtain in our laboratory analysis, and they are corresponding in lower LSI values.

The same image is for Ryznar Stability index (RI). The calculated values are far more scale forming than the actual ones. This is confirming that high precipitation took place, which had modified the analytical data.

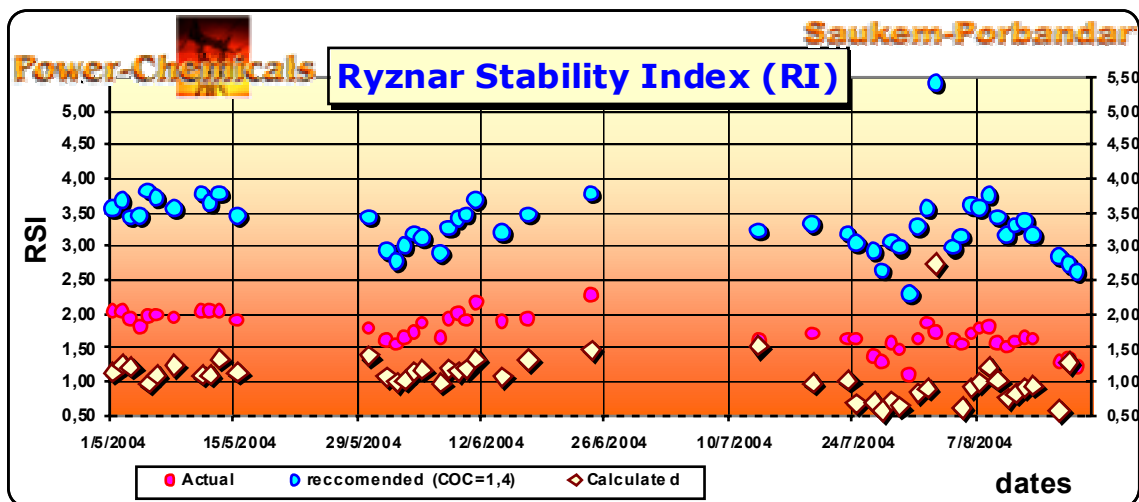


At the operating data supplied for the examined period is mentioned as recommended Cycles Of Concentration the value of 1,4.

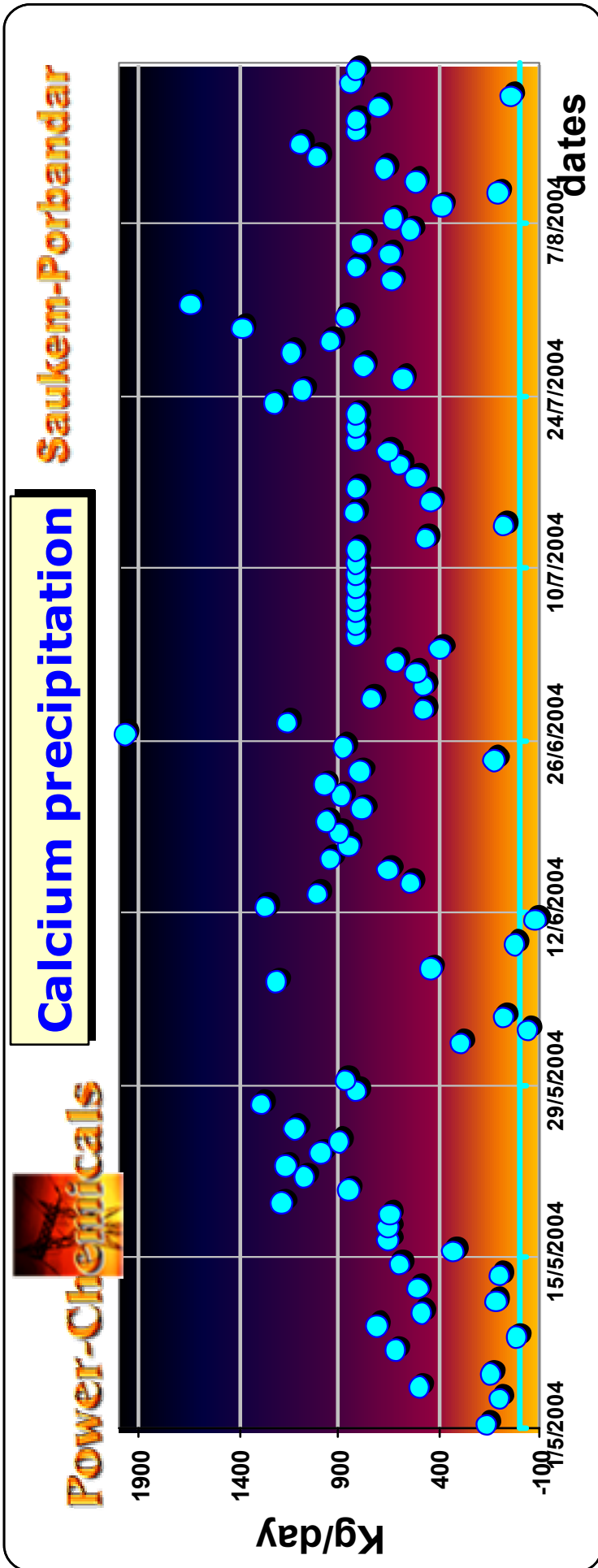
We don't know who placed this specification, Saukem or the supplier for the treatment.

Considering it as an important figure, we calculated the RI values that would be obtained into the cooling system, if this specification was followed, and no precipitation occurred.

Those values have been placed at the diagram below (blue points). We can see that are corresponding to far less scale forming conditions, which can be easily faced using conventional polymer treatments (plus some acid for pH control).



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The tendencies are tendencies, but the important is the amount of the deposited material.

So finally we calculated the loss in Calcium Hardness during the specified period.

Of course the loss varies from day to day following fluctuations of the operation of the system.

Precipitation was high, sometimes extremely high, and in some days (not too many) dissolution was also taking place.

As we mentioned earlier the average Calcium Hardness loss was 408,07 ppm.

The total Calcium Carbonate loss for the entire period has been calculated to **75136 Kg** (75,13 Tons).

We have seen far bigger figures of losses in our carrier.

But in any case, 75 tons of Calcium Carbonate production in four months operation, is an interesting score for a cooling tower.