TECHNICAL ASPECTS MORE IMPORTANT DURING TO INCREASE IN CONCENTRATION CYCLES OF COOLING TOWERS.

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ABSTRACT

Since January of the 2006 began the treatment in cooling towers with high concentration cycles silica base (4.0) on the Petrochemical Independence Complex (CPI) to save water and to improve excess of equipment or to make it more profitable into PEMEX subsidiary as well as to satisfy the necessity of electrical energy the same sector.

Before 2006 to cover the needs of CPI it had been working only one turbo generator with 7 Megawatts of capacity. Actually are working two turbo generators with 30 Mw each one of capacity.

The consumption of water to 2 cycles of concentration silica base was of 4000 m^3/d, today to 4 cycles is of 2800 m^3/d arising a saving of the 30 % of water consumption and a capacity of 50 Mw of energy delivered.

Although the saving has to been economic substantially and satisfactory environmentally speaking, some operational problems it have been showing that's why the present work shows the more important technical considerations that it will be to make to avoid precipitation problems of inorganic salts.

First, we show the treatment during the increase to 4 concentration cycles silica base and physic-chemical results obtained in make up water, return and supply.

Later the deviations founded during the treatment that were analyzed taking into account the theoretical information of similar behaviors.

Finally we shown the technical recommendations more important to carry out efficiently a water saving without problems during treatment to high concentration cycles silica base.

SUMMARY

In the proposal of last year “Saving in water consumption in Industrial cooling towers during the application of chemical products developed by high silica”, we showed the results before and during a year of treatment of continuous operation in the cooling tower CT36A01 of the petrochemical Complex Independence.

This year we make some modifications in the treatment due to the presence of solid material in equipment of heat interchange with smaller tubes to ¼ of inch of diameter, that although has carried out works of maintenance and cleaning in the tower we considered important to assure us any possible deviation in the treatment.

In the present work after analyzing the treatment carried out and in order to diminish the presence of extraneous material in the system we began since 1º of May of this year to drop out cycles of concentration to 2.0-2.5 bases silica until to obtain satisfactory results in chemical analysis of recycling and supply water, speeds of corrosion, general cleaning of equipment of heat exchanger and the system of cooling, inhibition to the incrustation and protection against the fouling and finally to reinitiate the treatment later.

If we consider the main technical aspects for a good treatment to high cycles from concentration bases silica, we make sure satisfactory results into treatment.

DEVELOPMENT

The cooling tower CT-36-A-01 provides the service to the surface condensers of the generators TG-3501 and TG-3502, whose capacity of generation is of 30 MW each one of them.

The cooling tower is of induced shot, it has 7 ventilators of 125 HP each one, and each cell handles a volume of 10.000 gallons, counts on 5 pumps with capacity of 16500 gallons by minute.

For the chemical treatment carried out in the mentioned tower it was necessary to make a series of tests to select the main actives with the characteristics more suitable to the kind of water showed in table 1.

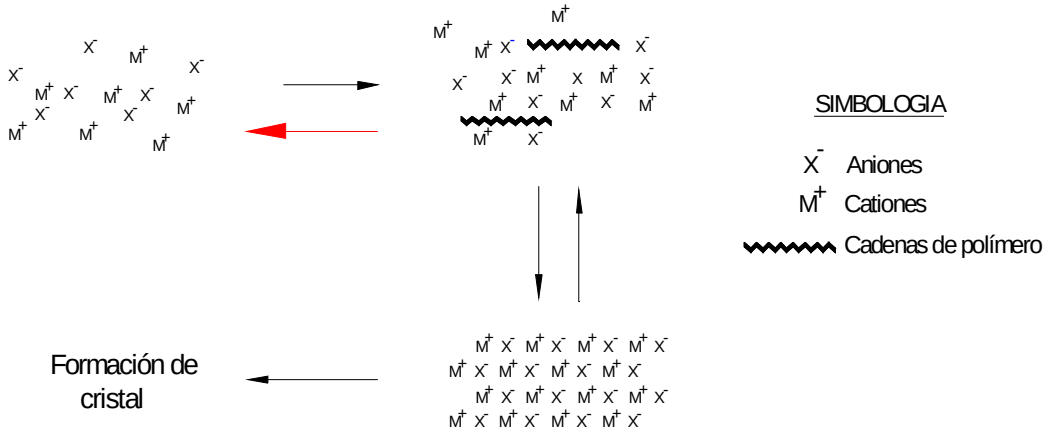
PARAMETRO	REP	REP	REP	REP	REP	REP	REP	PROMEDIO
PH, UNIDADES	7.7	7.69	7.26	7.14	7.02	7.2	7.29	7.33
CONDUCTIVIDAD, uS/cm	430	388	417	397	400	391	405	404
ALCALINIDAD M, PPM	119	256	227	227	256	236	236	222
ALCALINIDAD P, PPM	0	0	0	0	0	0	0	0
CALCIO, $CaCO_3$ PPM	48	43	40	42	41	42	41	42
DUREZA TOTAL, $CaCO_3$ PPM	158	145	147	134	138	136	137	142
MAGNESIO, $CaCO_3$ PPM	110	102	107	92	97	94	96	100
CLORUROS, Cl^- PPM	47	41	38	43	26	28	29	36
FOSFATOS, PO_4 PPM	0.79	2.35	7.25	3.92	5.4	6.15	4.9	4.4
HIERRO TOTAL, Fe PPM	0	0	0	0	0	0	0	0.0
HIERRO SOLUBLE,Fe PPM	0	0	0	0	0	0	0	0.0
SILICE, SiO_2 PPM	67	72	66	72	70	66	66	68
SULFATOS,SO_4 PPM	37	41	42	30	38	36	41	38
COBRE, Cu PPM	0.04	0.03	0.02	0	0.06	0.04	0	0.03

Tabla 1. Analysis fresh make up water.

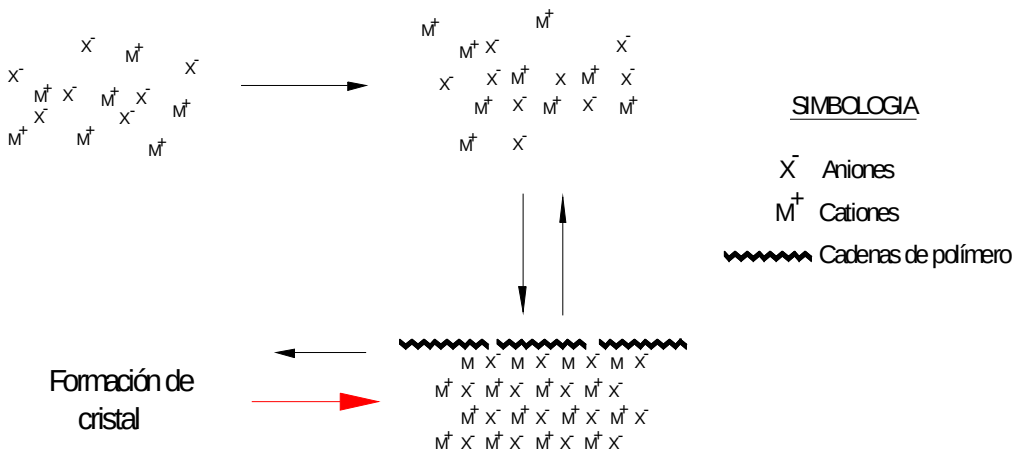
INCRUSTATION INHIBITORS AND DISPERSING PRODUCTS

Polymeric organic compounds or mixtures of them allow to inhibit the effects of the incrustation, thanks to three main mechanisms.
Threshold effect (Reduction of the precipitation potential of salts o effect that takes place when a certain system arrives at a point, its threshold, which the quantitative change becomes qualitative), Inhibition of the crystals growth and Crystals distortion.

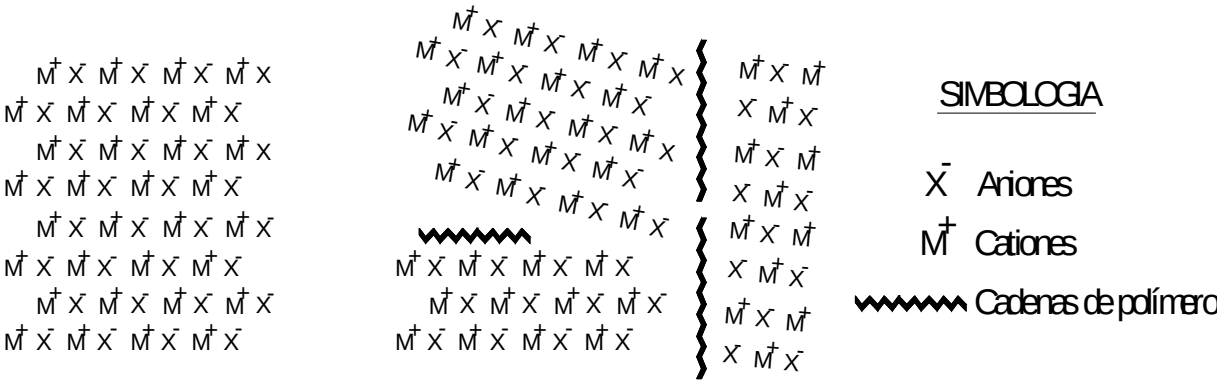
THRESHOLD EFFECT



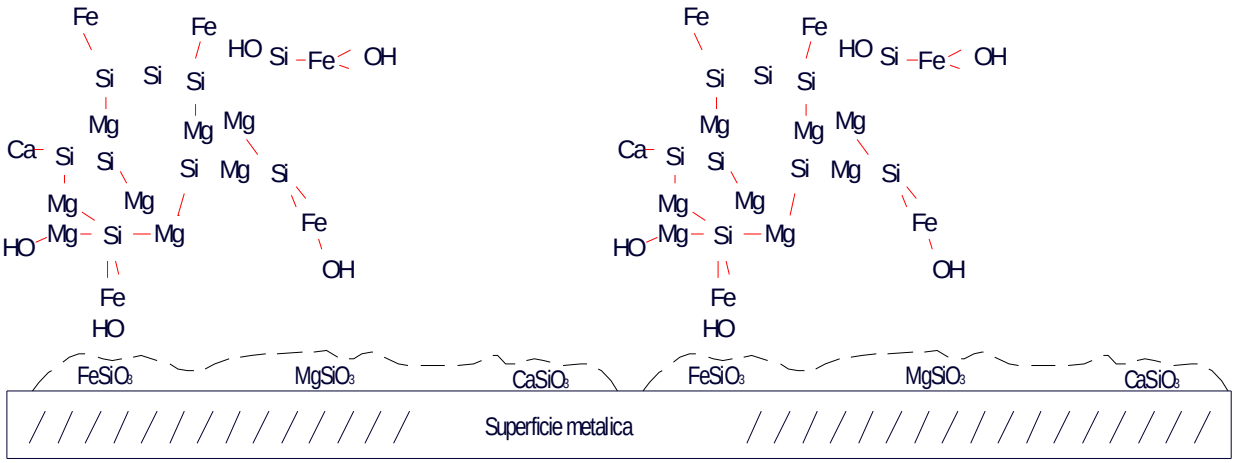
INHIBITION OF CRYSTALS GROWTH

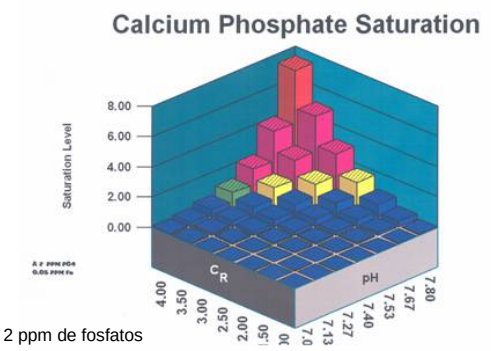


CRYSTALS DISTORTION

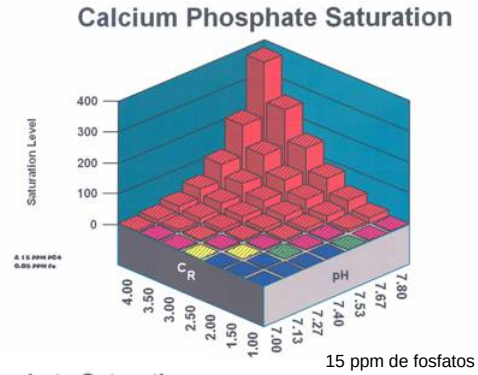


INCRUSTATION BY SILICATES

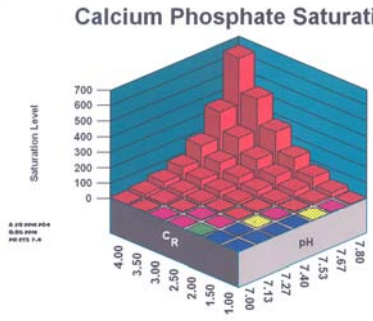




2 ppm de fosfatos



15 ppm de fosfatos



20 ppm de fosfatos

Once to have studied the behavior of the main actives we developed multifunctional additive IMP-TE-515 that in other things is, corrosion inhibitor, dispersant and incrustation inhibitor of inorganic salts mainly, as well as biocide no oxidant IMP-TE-350M, remove of biomass IMP-RB-335 and the yellow metal inhibitor and dispersant of iron IMP-TE-506.3

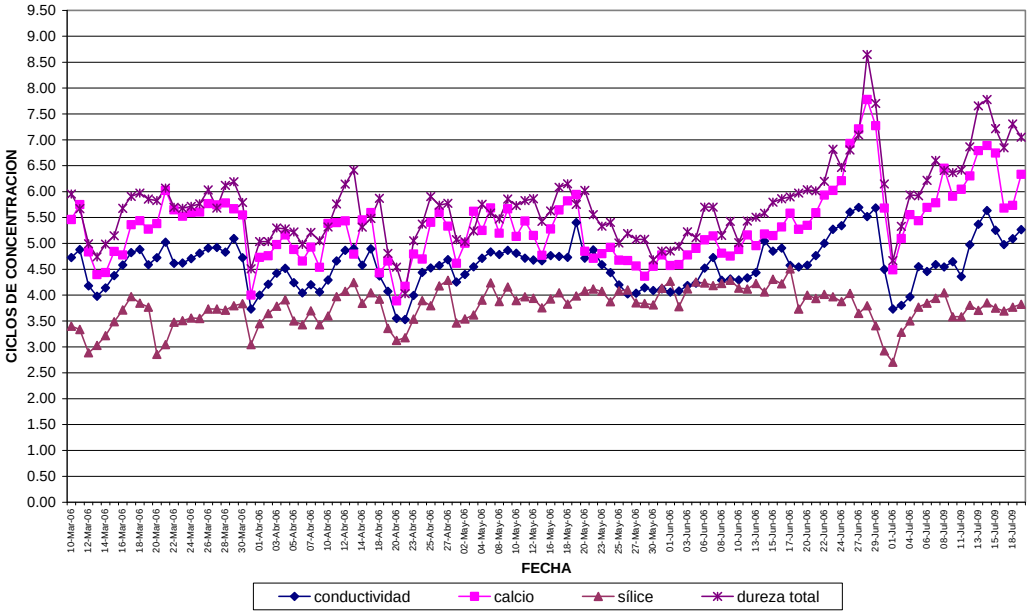
RESULTS

After the test at industrial level of January of the 2006 to March of the same year, we continue the normal treatment until May of the 2008, whose data in the cycles of concentration are described in graphics 1, 2 and 3 which they correspond to periods of January to December of the 2006, 2007 and 2008 respectively.

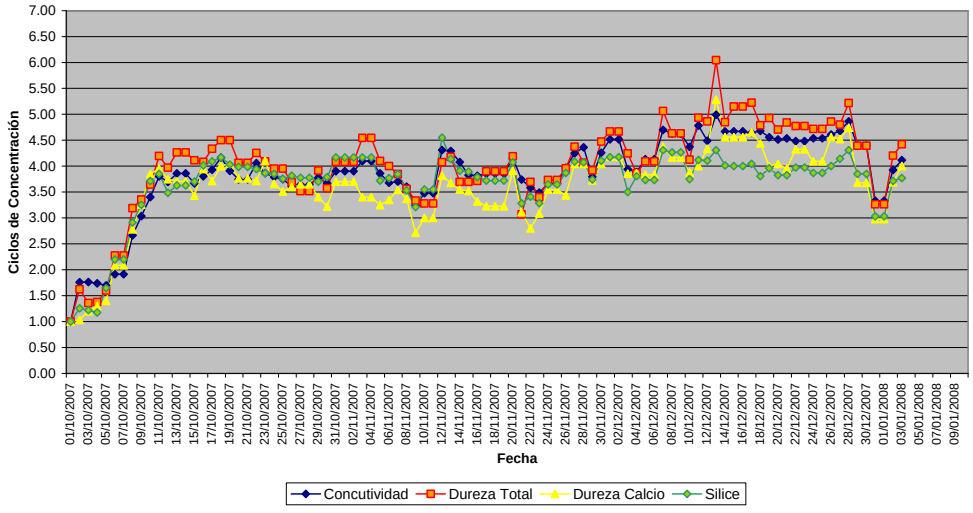
PEMEX PETROQUIMICA. COMPLEJO PETROQUIMICO INDEPENDENCIA

APLICACIÓN DEL MULTIFUNCIONAL IMP-TE-515 EN TORRE CT36A01

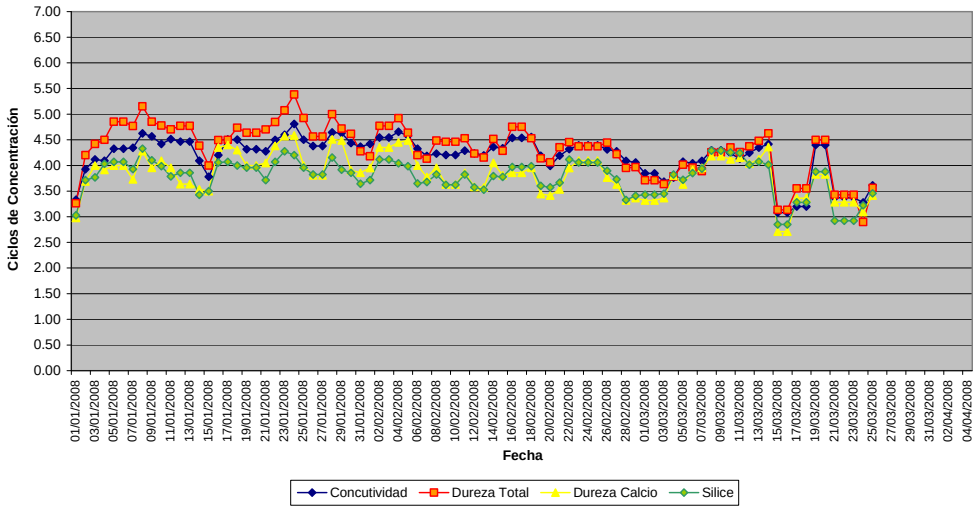
GRAFICA 1.- PERFIL DE CICLOS DE CONCENTRACION DE PARAMETROS EN AGUA DE RETORNO DE LA TORRE



PEMEX PETROQUIMICA. COMPLEJO PETROQUIMICO INDEPENDENCIA
APLICACIÓN DEL MULTIFUNCIONAL IMP-TE-515 EN TORRE CT36A01
GRAFICA 2.- PERFIL DE CICLOS DE CONCENTRACION DE PARAMETROS EN AGUA DE RETORNO DE LA TORRE 2007



PEMEX PETROQUIMICA. COMPLEJO PETROQUIMICO INDEPENDENCIA
APLICACIÓN DEL MULTIFUNCIONAL IMP-TE-515 EN TORRE CT36A01
GRAFICA 2.- PERFIL DE CICLOS DE CONCENTRACION DE PARAMETROS EN AGUA DE RETORNO DE LA TORRE 2008



It is important to mention that the curves in the graphic ones reflect the behavior of the cycles of concentration bases daily determinations of silica, total hardness, hardness by carbonates and conductivity, reason why theoretically would have being identical completely, nevertheless since beginning of the application of products and by above of the 4.5 cycles of concentration a separation between each of them was observed.

During the treatment and in spite of the previous studies realized for a good performance of products, appeared precipitation of solids easily removables in tubes of heat exchangers with diameters smaller to ¼ inch.

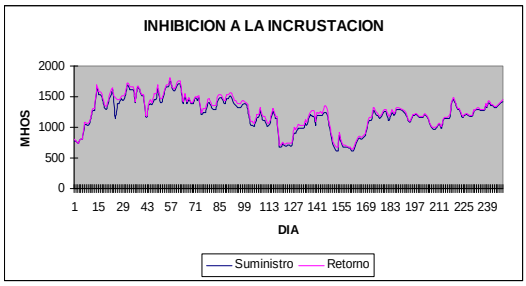
Samples of solid material were taken in different equipment and analyzed for their study. The results of some samples were:

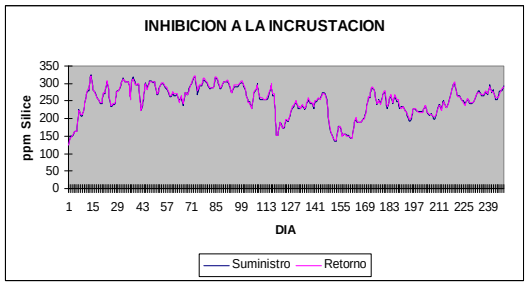
DETERMINACION ANALITICA RESULTADOS EN (%) EN MUESTRA TAL CUAL										
MUESTRA	FECHA	HUMEDAD	MATERIA ORGANICA	HIERRO Fe2O3	RESIDUO INS EN ACIDO	COBRE CuO	FOSFATOS PO4	CALCIO CaO	MAGNESIO MgO	SULFATOS SO4
ENFRIADORES DE AIRE	29-Jun-07	47.90	3.95	0.49	46.91	0.19	0.01	0.23	0.29	0.03
ROMPEDORES CHORRO	29-Jun-07	25.71	26.26	39.73	5.79	0.04	0.01	1.37	1.09	0.00
DEPOSITO TUBERIA	17-Ago-07	42.36	6.40	0.82	49.46	0.01	0.16	0.19	0.27	0.00
INTERIOR CARCAZA	27-Dic-07	1.30	9.07	6.21	81.75	0.22	0.00	0.70	0.61	0.10
EXTERIOR TUBOS	27-Dic-07	1.80	8.89	0.49	87.31	0.05	0.00	0.71	0.71	0.00
RESIDUO TUBERIA	10-Ene-08	4.43	6.30	1.84	81.04	0.18	0.15	0.58	0.40	5.04
RESIDUO AGUA SUMINIS-TRO A TURBO BOMBA	24-Ene-08	43.38	3.22	0.91	50.62	0.01	0.02	0.21	0.13	1.51
BOMBA LUBRICADORA	01-Feb-08	4.97	5.98	1.77	84.80	0.05	0.01	0.90	1.34	0.00

As we can observe of the previous table material of kind of clay and sand it has find as fundamental composition of the deposits analyzed in different dates in the period from June 2007 to febrero/2008 are of chemical nature different to fresh make up water or supplier water of cooling tower.

On the other side, it is necessary to mention that the salts found it in fresh make up water are essentially of calcium, magnesium and silica and due to these salts have not been find in any of the deposits analyzed in amounts such that allow to deduce that a precipitation of ones exists; it is possible to affirm that the deposits chemically are integrated by materials that are different to the chemical composition of fresh make up water.

Additionally to before saying, the physic and chemical analyses of fresh make up water realized like part of the technical service that IMP provides too we analyze cooling water that is sent through the pumps of recirculation or supplier water and return water; those analyses shown that the same amount of salts that are sent in the supplier water to be back with the return water, that is to say, any precipitation of salts is appraised accord of following graphics:





TECHNICAL ASPECTS MORE IMPORTANT

After carrying out the application of products to high cycles of concentration in the cooling tower CT36A01 of the plant of auxiliary services of the Petrochemical Complex Independence, we have arrived at the following recommendations to assure a effective treatment totally, not only in the results of protection to the corrosion and fouling obtained during the period of application with products IMP and showed in 2007 possible AICHE annual meeting but also to avoid to the maximum any solid precipitation possible in the system which they are:

1. - To take to high cycles of concentration the cooling tower observing any deviation between the main parameters of total hardness, conductivity and silica, these will be proportional to each other.

2. - The solubility index estimated theoretically for systems with and without chemical agents in the water will be to demonstrate the high cycles to reach without problems of precipitation of inorganic salts.

3. - Once reached the maximum cycles of operation of the plant they will have to stay with the minimum possible variation, for this we recommend an automatic control type ORP which by means of some parameter as the conductivity replaces the amount of water in the system opening or closing the discharge valve of the tower.

4. - When for some reason deposits appear such as sand, clay, etc, a general cleaning of the system will have to be realized, which can be benefitted with the aid from chemicals such as dispersant of mud and iron, as well as the use of lateral filters installed in the tower.

5. - The operation of a tower to high cycles of concentration brings himself the increase in the concentration of salts reason why it is necessary to be accustomed to the presence of these salts in the atmosphere once the water has been evaporated.

6. - The presence of turbidity in the water in cases where is easily detected is indicative of the increase of concentration of salts but not of his precipitation, nevertheless it will have to be considered as one tries visible of the increase of cycles of concentration. It is not recommended to work to cycles of high concentration if the turbidity increases considerably.

7. - It is known of procedures to eliminate silica and inorganic material by osmosis, flocculation and separation by ion exchange, etc. reason why we considered important the use of these applications to make sure a reliable operation in the plant when we have to work with high cycles of concentration.

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