Changing of basic physical-chemical properties of water after its magnetic treatment

Parameter (Process)	Measuring Method	Range of Changing, %
Ion hydration	Proton-magnetic resonance	30-36
Magnetic susceptibility	Measuring of traveling of liquid column in magnetic field (Kwinke's method)	200-450
Electric conductivity	Phase-metric and dielectric	7-26
Viscosity	Viscosity-meter	3-4
Kinetics of chemical reactions	Photometric, H_2O_2 decomposition	30-200
Surface tension	Measuring of maximal pressure in bubbles	10-13
Solvent strength	Phasometric	20-70
Crystallization	Crystal-optical	30-250
Polymerization	Gas chromotografy, nuclear- magnetic resonance, infra red spectroscopy	15-20
Coagulation	Vaksmudsky's method, ultrasonic method	20-90
Moistening	Measuring of hysteresis edge angles	10-15
Evaporation velocity	Measuring of water volume and mass	10-40
Specific heat	Calorimetry	3-8
Corrosion (velocity)	Method of electric-kinetic potential	20-210
Ion exchange	Method of limited volume with potential-metric control	26-35

Some applications of magnetic systems in technological processes

Technological process (stage)	The changeable characteristics	Effects
Boiler-water conditioning (De aeration).	Solubility of gases.	Scum formation reduction. Corrosion reduction.
Boiler-water conditioning (Filtration).	Viscosity of water.	*Resources saving:* Increasing the work duration of ion-exchange filters between regenerations in 1.5 - 3 times. The decrease of reagents expenses (ion-exchange pitch, chloride, acid, alkali). Decrease the expenses of water on washing. The volume decrease of salted drains in 1.5 - 3 times. *Energy saving:* Decrease the energy expenses.
Boiler-water conditioning (Preliminary softening of crude or circulating water).	Heat capacity of water.	*Resources saving:* The expenses of steam decrease on heating of crude water. The quality of clarified previously of softened water is increasing. The prevention of salts sediment on surfaces of heat exchange.

Some applications of magnetic systems in technological processes

Technological process (stage)	**The changeable characteristics**	**Effects**
Boiler-water conditioning (Clarifying previously softened water).	Viscosity of water.	*Resources saving:* The productivity of clarifying equipment increasing on 10-15 %
Having warmed up waters, manufacture of thermal energy.	Heat capacity of water.	*Energy saving:* The prevention of salts sediment. Decrease of specific expenses of fuel on 8 - 15 %. Decrease the general energy expenses.
Warming up water, manufacture of thermal energy (Turnaround water supply).	Heat capacity of water.	*Energy saving:* The prevention of salts sediment on pipelines and heat exchange equipment. The temperature of the heat-carrier on an input of heating system is increasing.

Some applications of magnetic systems in technological processes

Technological process (stage)	The changeable characteristics	Effects
Manufacture of steam.	Heat of evaporation.	*Energy saving:* Decrease the energy expenses. The fuel expenses decrease on 10 - 20 %. The prevention of salts sediment.
Steam out of solutions.	Heat of evaporation.	*Energy saving:* The energy expenses decrease on 20-30%.
Burning liquid hydrocarbons.	Viscosity, heat of evaporation, superficial tension.	*Energy saving:* The economy of fuel. *Resources saving:* Increase of the equipment resource. The improvement of ecological parameters of manufacture.
Cooling.	Heat capacity of cooling water.	*Resources saving:* The prevention of salts sediment on pipelines and heat exchange equipment. The productivity of compressors and pumps is increasing. Increase of the equipment resource.

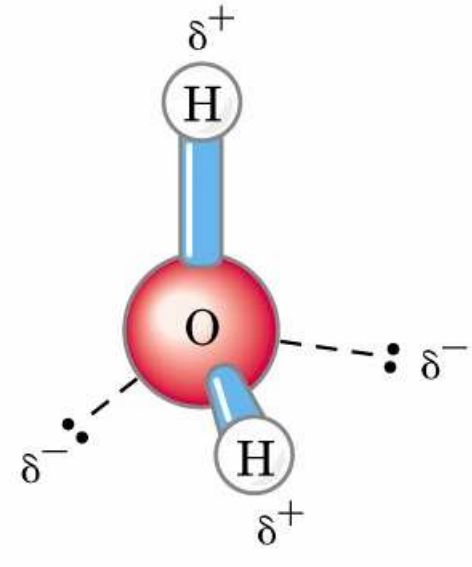
Some applications of magnetic systems in technological processes

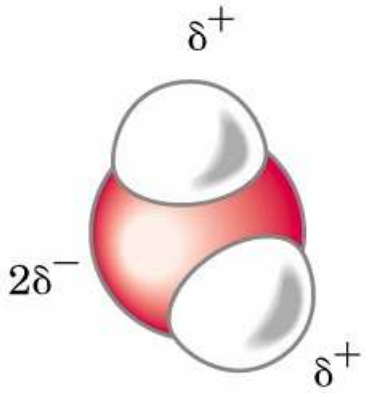
Technological process (stage)	The changeable characteristics	Effects
Division suspension (settling, clarification, filtration, centrifuging).	Ions hydration and viscosity of water.	The division speed is increasing on 20 - 30 %. The productivity of equipment is increasing.
The hetero phase chemical and physic-chemical processes on border solid-liquid.	Ions hydration and viscosity of water.	*Resources saving:* The speed of lime slaking is increasing and the lime slaking process's wastage is decreasing. The speed of dissolution and crystallization is increasing. The exchange capacity of ions exchange filters is increasing on 50 - 100 %.
Manufacture of "lime milk".	Structure of water.	The speed of processes increase. The concentration of "lime milk" increases.

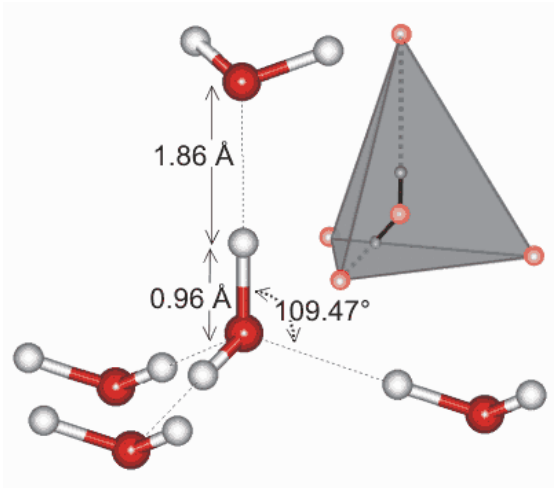
Some applications of magnetic systems in technological processes

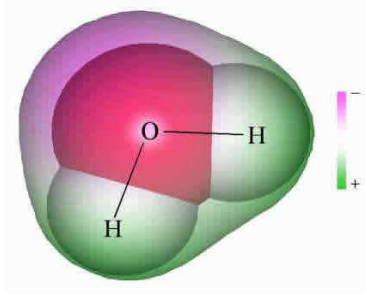
Technological process (stage)	The changeable characteristics	Effects
Chemical purification of water.	Structure of water.	The speed of processes increase. *Resources saving:* The increasing the work duration of filters between regenerations in 2 - 4 times. Decrease of reagents expenses. *Energy saving:* The energy expenses decrease.
Absorption of SO2 or CO2	Structure of water.	Decrease of expenses sulfur. The prevention of salts sediment on pipelines and heat exchange equipment.
Utensils washing.	Structure of water.	*Resources saving:* The speed of processes increase. The prevention of salts sediment on pipelines, pumps and heat exchange equipment. The decrease of reagents expenses.

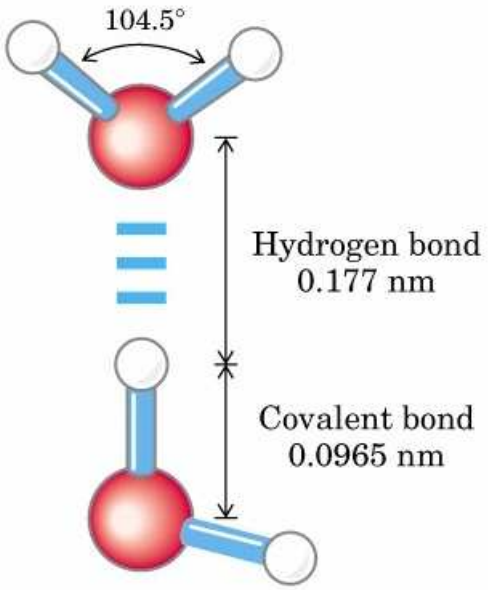
WATER MOLECULA, HYDROGEN BONDS AND WATER CLUSTERS

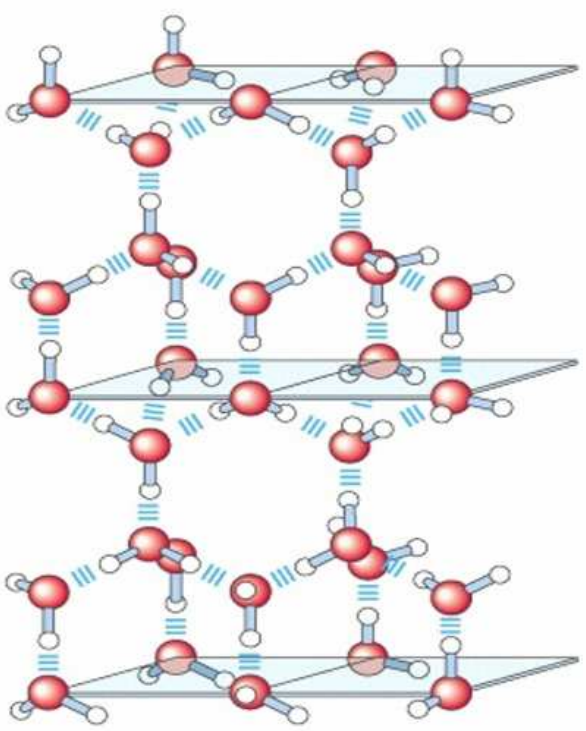






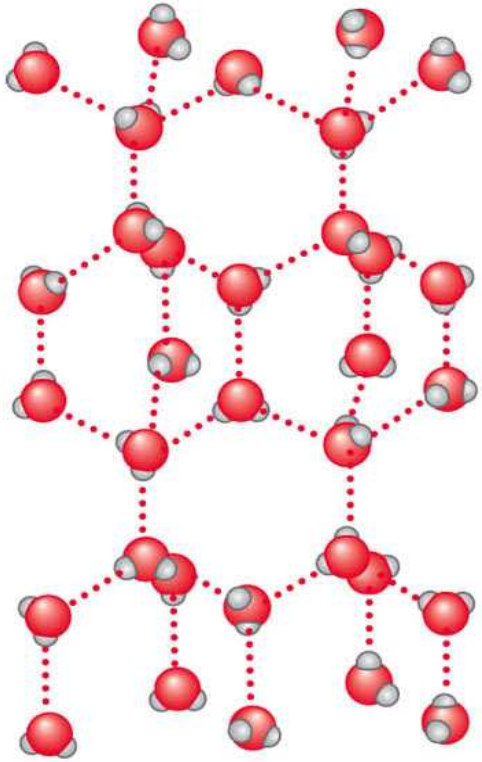




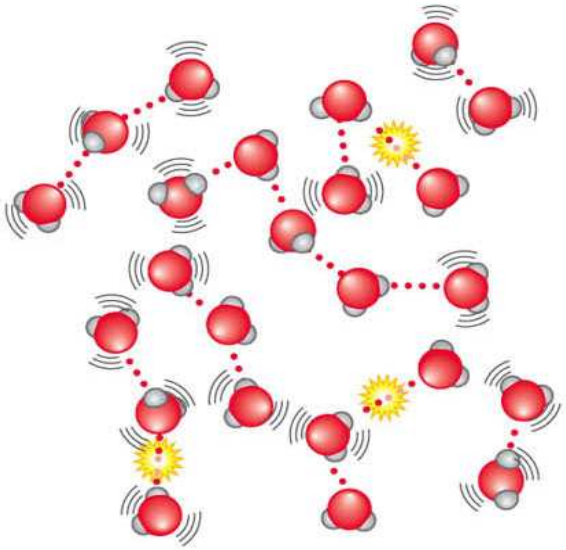


HYDROGEN BONDS AND AGREGATIVE STATE OF WATER

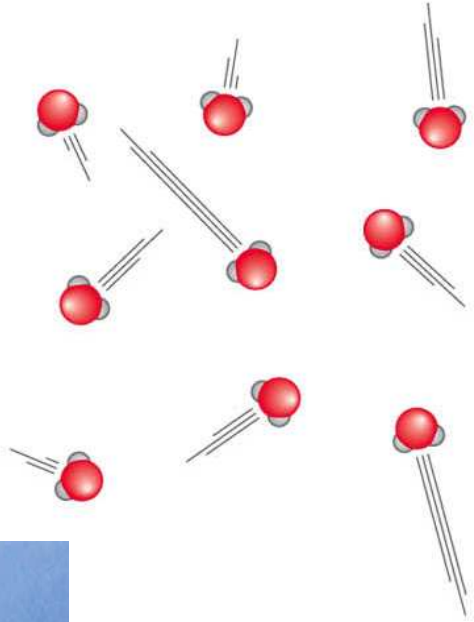
(*a*) **Solid water**



(*b*) **Liquid water**

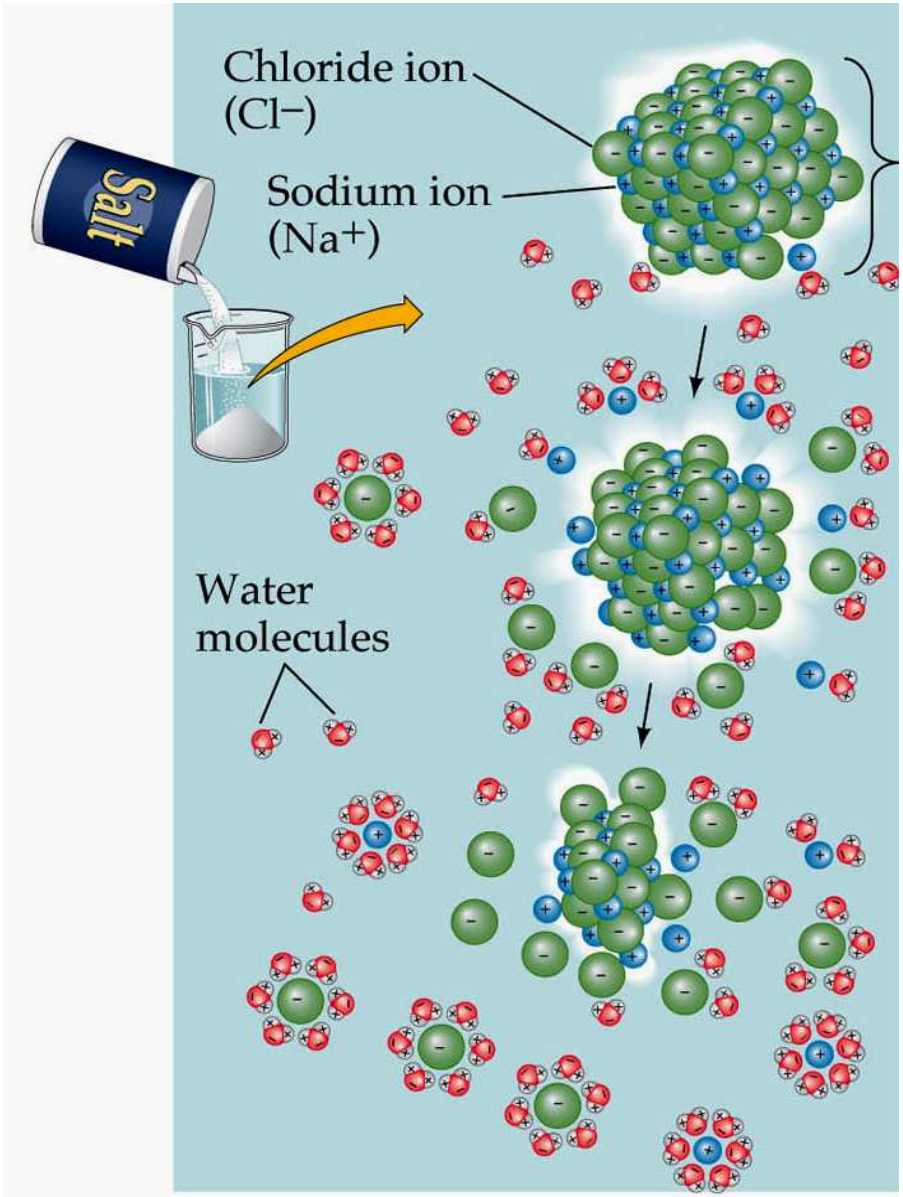


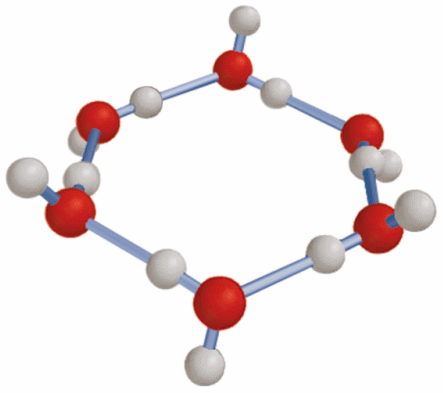
(*c*) **Gaseous water**

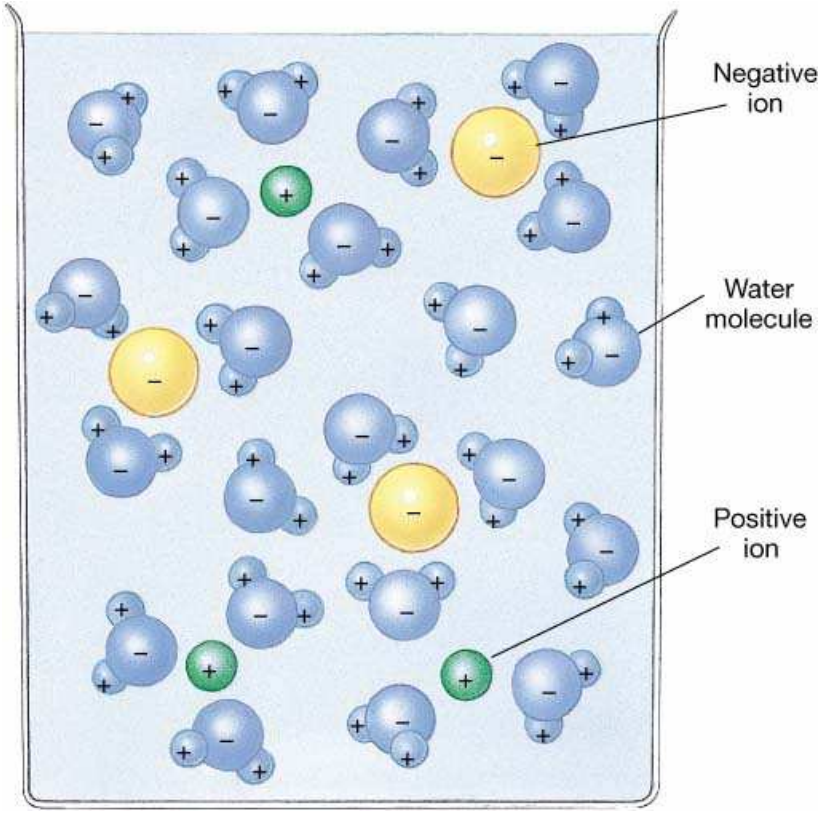




WATER MOLECULA, HYDROGEN BONDS AND WATER CLUSTERS



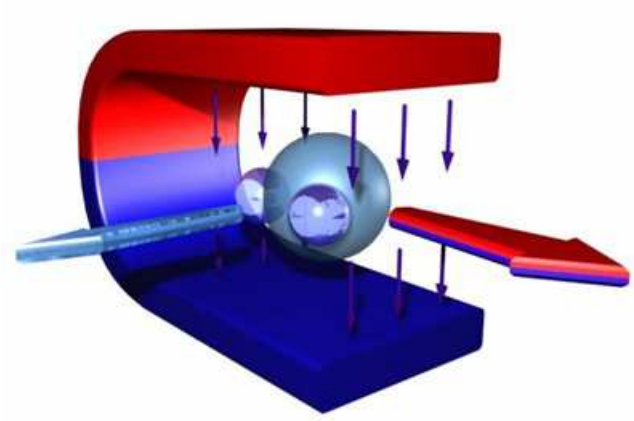




MAGNETIC TREATMENT OF WATER

In 1936 T.I.C. Vermeiren, a Belgian engineer, discovered that in the process of heating water having traversed the lines of force of a magnetic field no scale (deposit, incrustation) formed on the heat-exchange surface. The world's first apparatus for magnetic treatment of water [10] was patented to T. Vermeiren's name on January 10, 1946.

$$\vec{F} = q \times [\vec{B} \times \vec{v}]$$

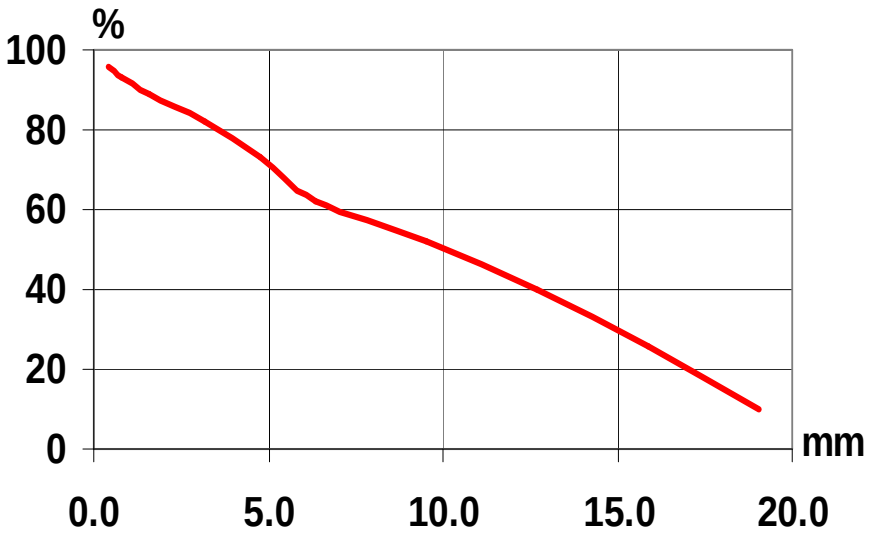


According to theory of magneto-hydrodynamic (MHD) resonance, the Lorentz force resulting from a liquid traveling across magnetic lines of force can bring about restructuring (entropy change) when it comes to resonance with the inherent oscillations of electrically charged particles (e.g. molecules, solid dust particles, ions, and free radicals) present in the liquid. A change in entropy affects not only the rate of nucleation in the supersaturated salt solutions, but can also trigger crystallization of the salt in the form of some of the crystallographic modifications typical for that salt.

SCALE AND HEAT EXCHANGE EFFICIENCY

Scale Thickness		Average Efficiency Loss, %
inch	mm	
1/64	0.4	4
1/32	0.8	7
1/16	1.6	11
1/8	3.2	18
3/16	4.8	27
1/4	6.4	38
3/8	9.5	48
1/2	12.7	60
5/8	15.9	74
3/4	19.1	90





CRYSTALLIZATION

- Crystallization is a typical example of the first-order phase transition attended with a change of the aggregative state of substance. Crystallization leads to formation of solid phase in solutions, melts, and gases.
- The driving force of crystallization process is supersaturation. Lack of supersaturation would stop the crystallization process.
- Crystallization consists of two stages: formation of crystal nuclei and their subsequent growth to visible dimensions. Rate of crystallization is, in general, limited by the rate of nucleation.
- In relation to the substance getting crystallized, inclusions, such as dust particles, the surfaces of process equipment, the walls of blood vessels, electrically charged particles, etc., the rate of nucleation is 1000 to 100000 times higher than in the body of the liquid proper.
- Thermodynamic state of a system determines its entropy (structure). We can vary the kinetics of crystallization process by changing the entropy.
- If a salt has different crystallographic modifications, by changing the structure of the initial solution it is possible to make it predominantly crystallize in one of said modification forms.

SOLUBILITY AND SUPERSATURATION

Solubility of calcium carbonate S_{CaCo3} in the range of solution temperatures of 20°C to 200°C

$$S_{CaCo3} = \left[2{,}684 \times 10^{-3} t \times \exp\left(-0{,}05054 \times t\right)\right]^{0,5} \times 10^{3}$$

where t is the temperature, ^{0}C.

Supersaturation

$$Ss = \frac{C_{CaCO3}}{S_{CaCO3}}$$

where C_{CaCO3} is the actual concentration of calcium carbonate in the solution, ppm

Table 1.

Solubility (S_{CaCO3}) and supersaturation (S_S) of CaCO3 in water at various temperatures, but at fixed initial concentration of 250 ppm

t, ^{0} C	20	40	60	80	100	120	140	160	180	200
S_{CaCO3}, ppm	6.99	5.96	4.40	3.06	2.07	1.37	0.89	0.57	0.37	0.23
S_S	36	42	57	82	121	183	282	439	685	1087

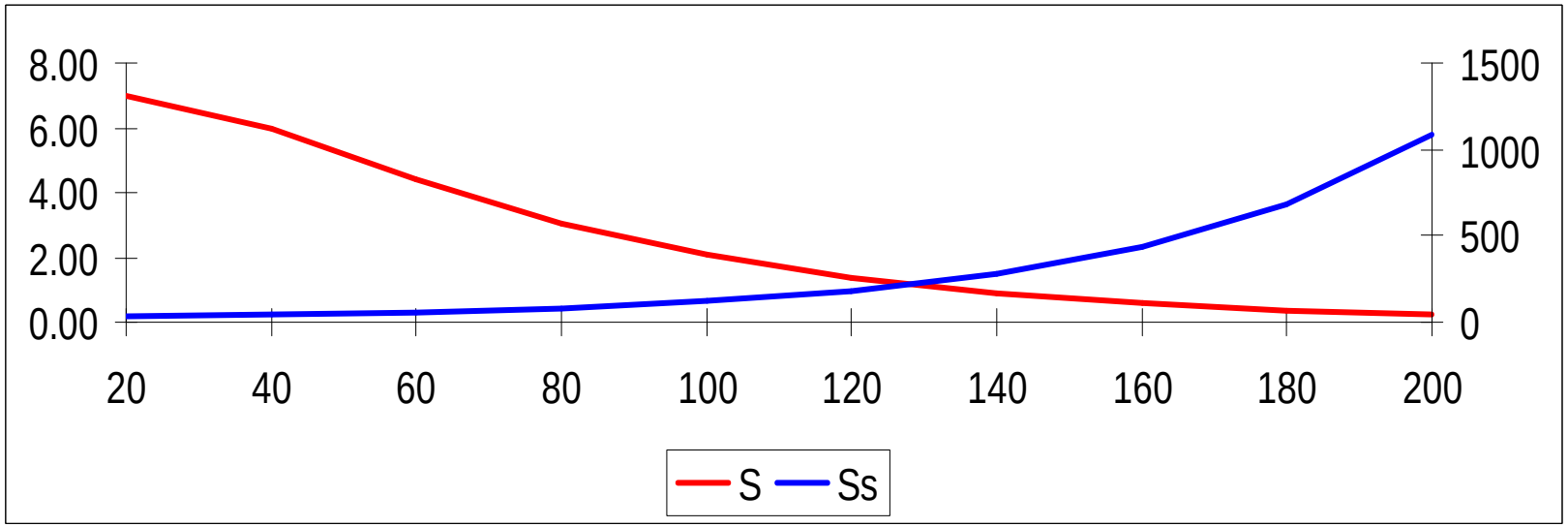


Fig.1 Solubility (S_{CaCO3}) and supersaturation (S_S) of CaCO3 in water at various temperatures, but at fixed initial concentration of 250 ppm

CRYSTALLIZATION ON SURFACES

A heterogeneous surface can serve as a matrix forming a crystal of a salt getting crystallized. It occurs when the syngonies (configurations of elementary cell) of the crystal of the surface material and the substance crystallized on the surface coincide, and parameters of their lattices ***differ by not more than 20%.***

The absolute value of crystallographic misfit is used as a criterion of seeding activity of a surface:

$$\delta = \left| a_{sf} - a_{cr} \right| / a_{cr} = \left| a_{sf} / a_{cr} - 1 \right| = \left| 1 - a_{cr} / a_{sf} \right|$$

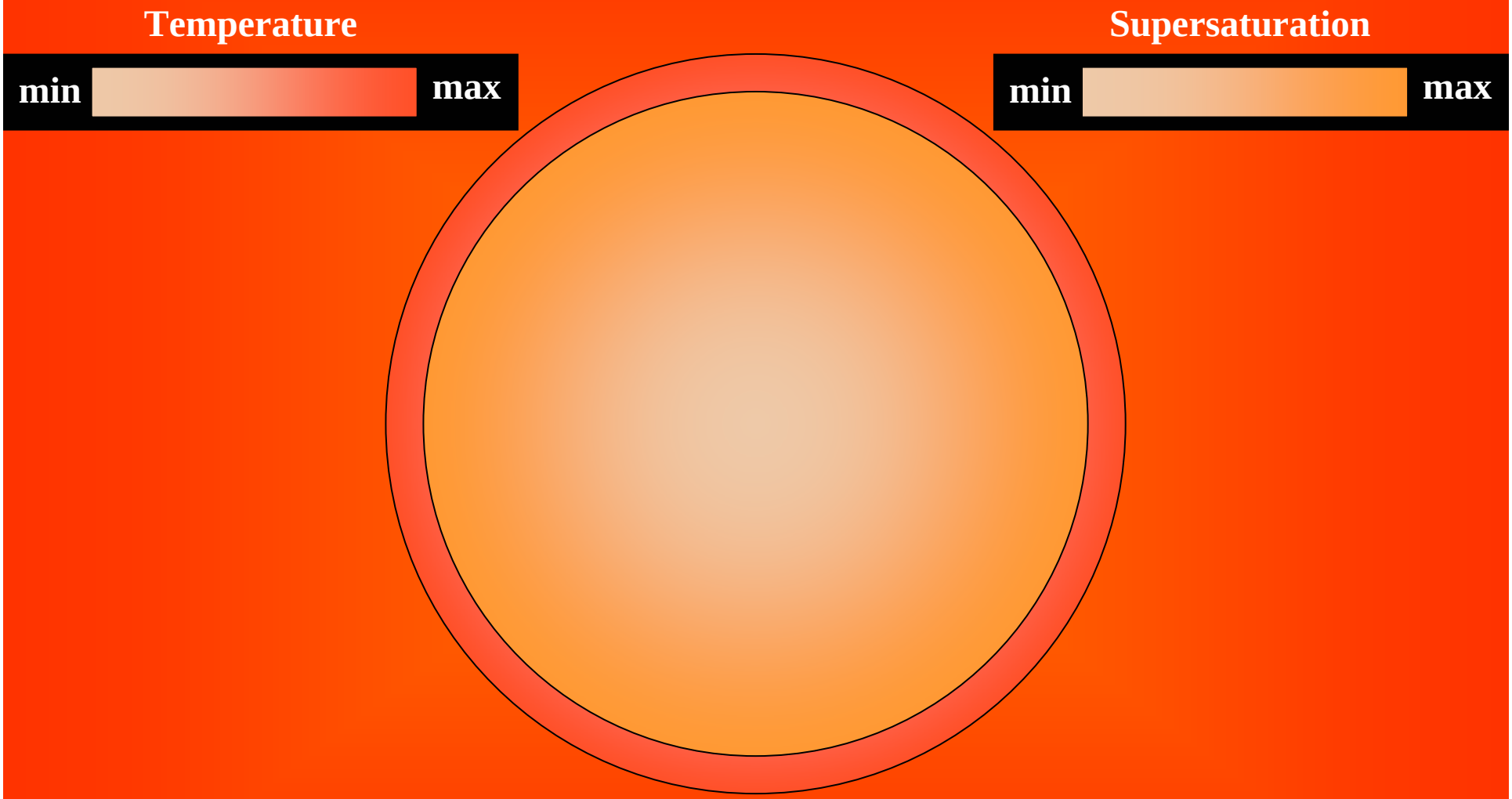
where:

a_{sf} is the value of parameter ***a*** of the crystal lattice of the material of the heat-exchange surface;

a_{cr} is the value of parameter ***a*** of the crystal lattice of the calcium carbonate.

The less is the crystallographic misfit, the more intensively does the surface initiate nucleation of the substance getting crystallized, and the lower is the supersaturation at which that occurs.

ZONATION OF TEMPERATURE AND SUPERSATURATION



The supersaturation level necessary to ensure a high rate of nucleation on the surface is known to be proportional to crystallographic misfit

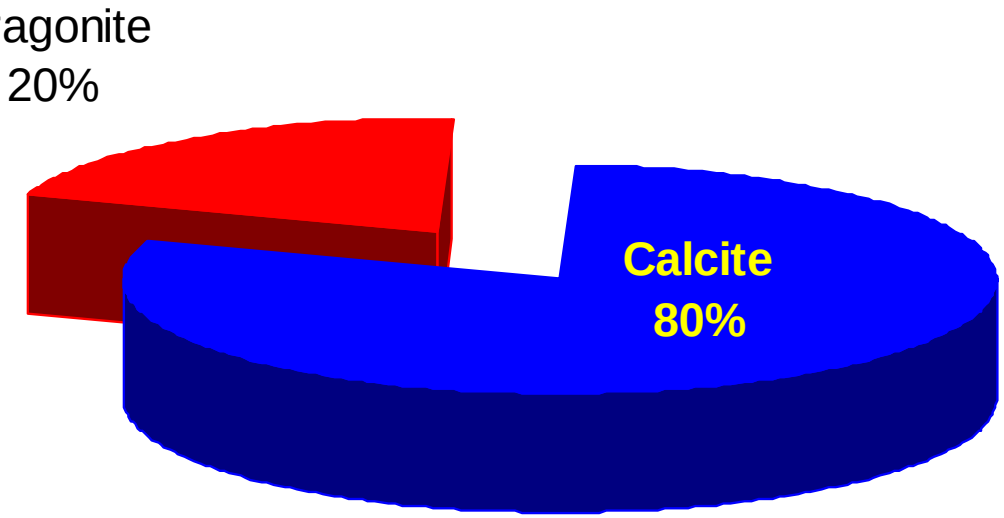
Table 2.

Data on crystal lattice parameters and mutual crystallographic misfit of some crystals

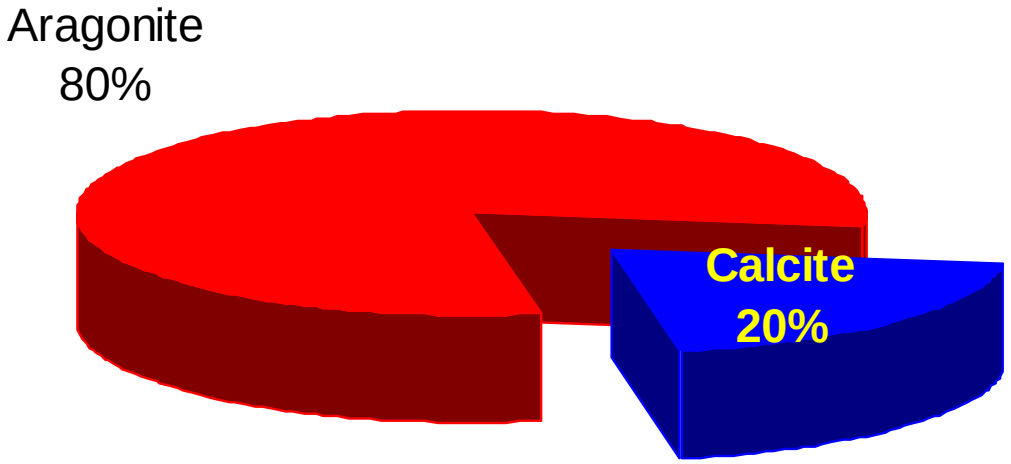
Chemical formula	Crystallographic modification	Parameter **a** of the crystal lattice, Angstrem	Crystallographic misfit
$CaCO_3$	***Aragonite***	***5.72***	***0***
α-Fe		2.866	0.499
$FeCO_3$	***Siderite***	***4.627***	***0.191***
$Fe(OH)_2$		3.24	0.434
Fe_2O_3	***Hematite***	***5.42***	***0.052***
Fe_2O_3		***5.025***	***0.122***
$CaCO_3$	***Calcite***	***4.983***	***0***
α-Fe		2.866	0.425
$FeCO_3$	***Siderite***	***4.627***	***0.071***
$Fe(OH)_2$		3.24	0.35
Fe_2O_3	***Hematite***	***5.42***	***0.081***
Fe_2O_3		***5.025***	***0.008***

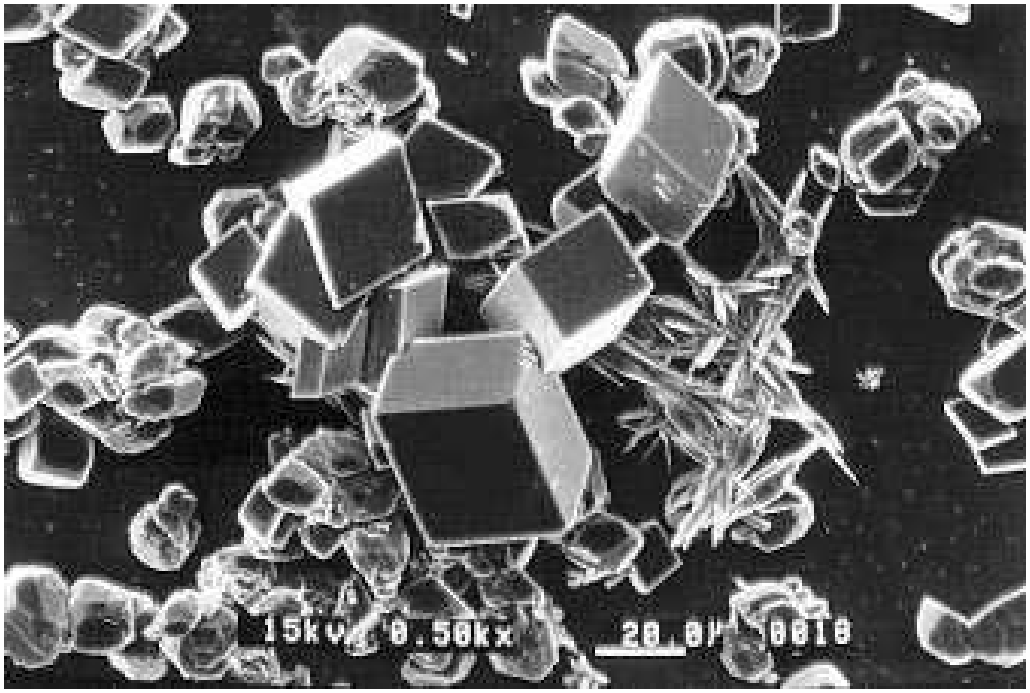
$CaCO_3$ crystallization on heat exchange surface (calcites and aragonites sharing)

ordinary water



magnetic treated water



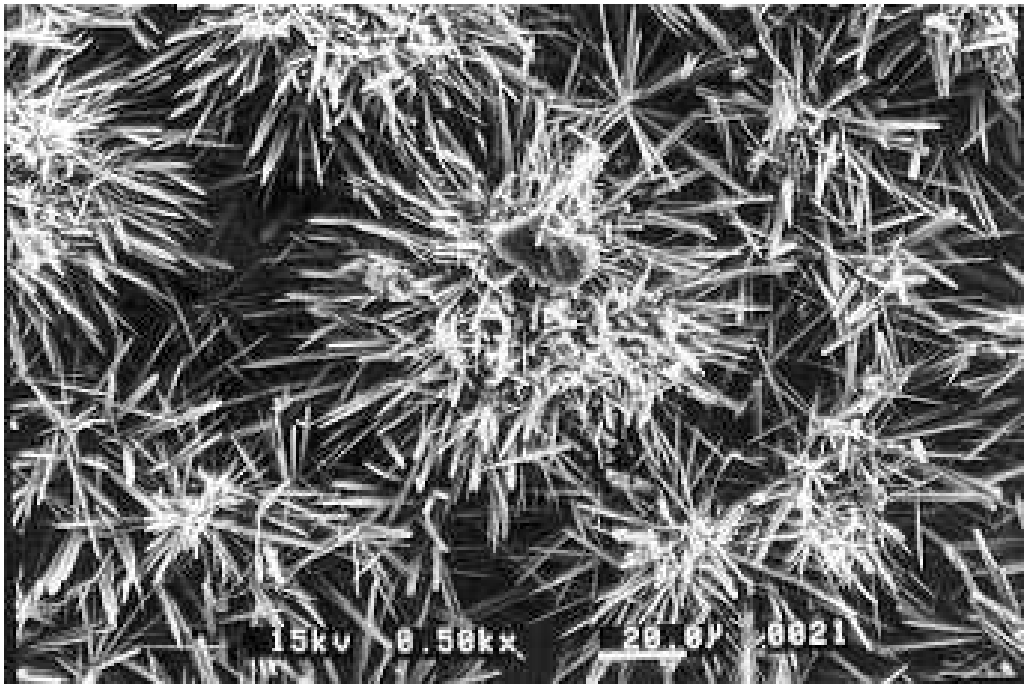


Calcite:

- adhesion to the material of the heat-exchange surface or the substrate is higher
- cohesion between the crystals is more strong
- δ ($FeCO_3$, Fe_2O_3) are lower

Aragonite:

- adhesion to the material of the heat-exchange surface or the substrate is lower
- cohesion between the crystals is poorer
- δ ($FeCO_3$, Fe_2O_3) are higher



CRISTALLIZATION ⇔ DISSOLUTION

1. Temperature ↑ ⇒ Supersaturation ↑

⇓

2. Supersaturation ↑ ⇒ Crystal nuclei formation ↑

⇓

3. Crystal nuclei formation ↑ ⇒ Crystal growth ↑

⇓

4. Crystal growth ↑ ⇒ Temperature ↓

⇓

5. Temperature ↓ ⇒ Crystal dissolution ↑

⇓

6. Crystal dissolution ↑ ⇒ Temperature ↑

⇓

back to step 1

CONCLUSIONS

- The key factors of scale formation are supersaturation and crystallographic misfit.

- $CaCO_3$ supersaturation is growing with temperature increasing.

- MHD resonance initiates restructuring of liquid and as result its properties are changing.

- From magnetic treated water $CaCO_3$ basically would start crystallizing in aragonite modification.

- Aragonite would start crystallizing on Fe_2O_3 and $FeCO_3$ at supersaturation levels of, respectively, 15 and 2.7 times higher than calcite would.

- The magnetic treated water can destroy existing scale deposit.




SIHIO BX1-250
27/09/2003






98 2 10


CITYSEA HOTEL


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8 19'03



Magnetic technologies for saving

1. magnetic treatment of fuel:

reduces fuel consumption by 3-5%

reduces HC, CO content in outgoing gases

2. magnetic treatment of water:

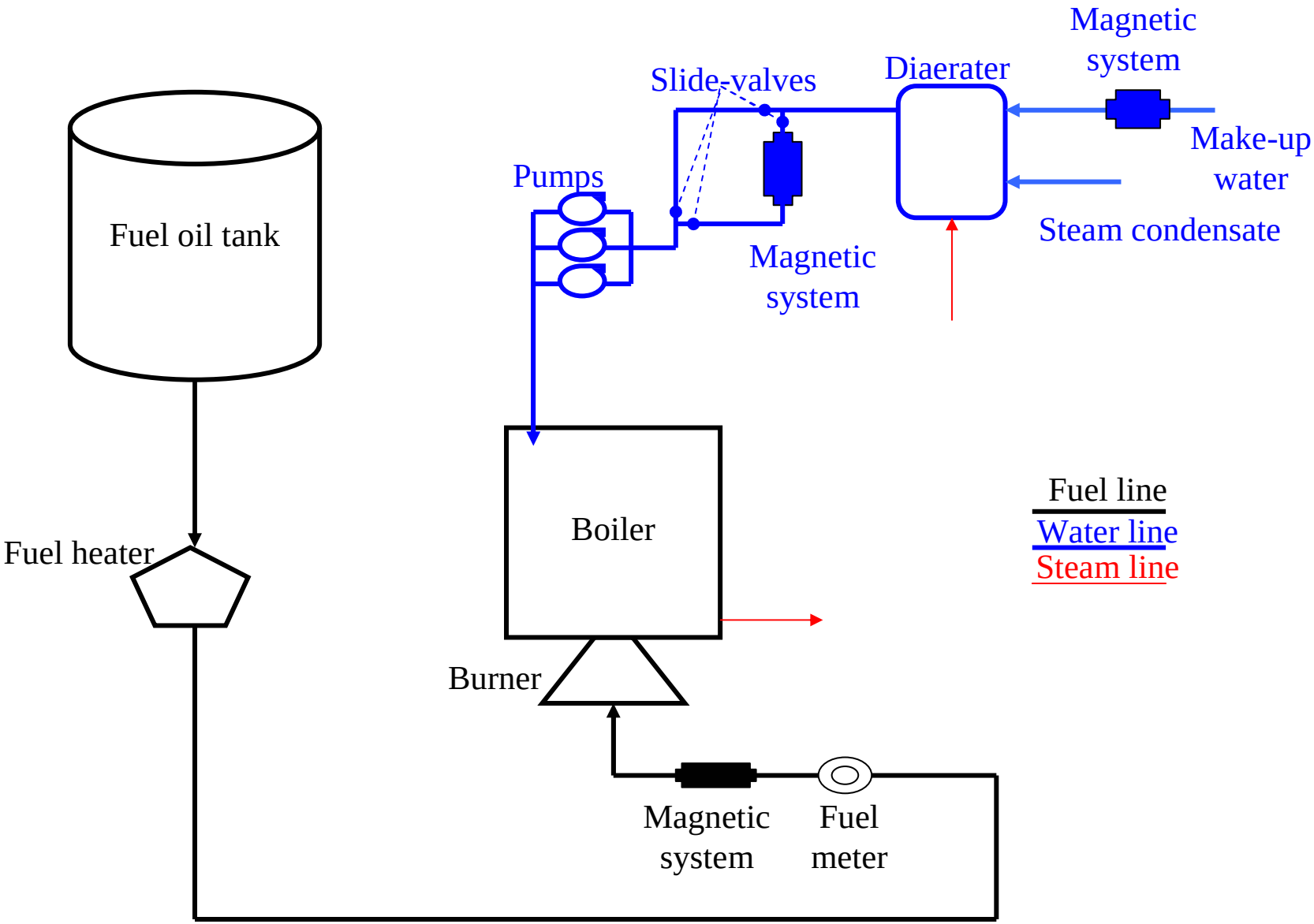
reduces fuel consumption 7-10%

reduces chemicals consumption 25-100%

reduces maintenance cost and time

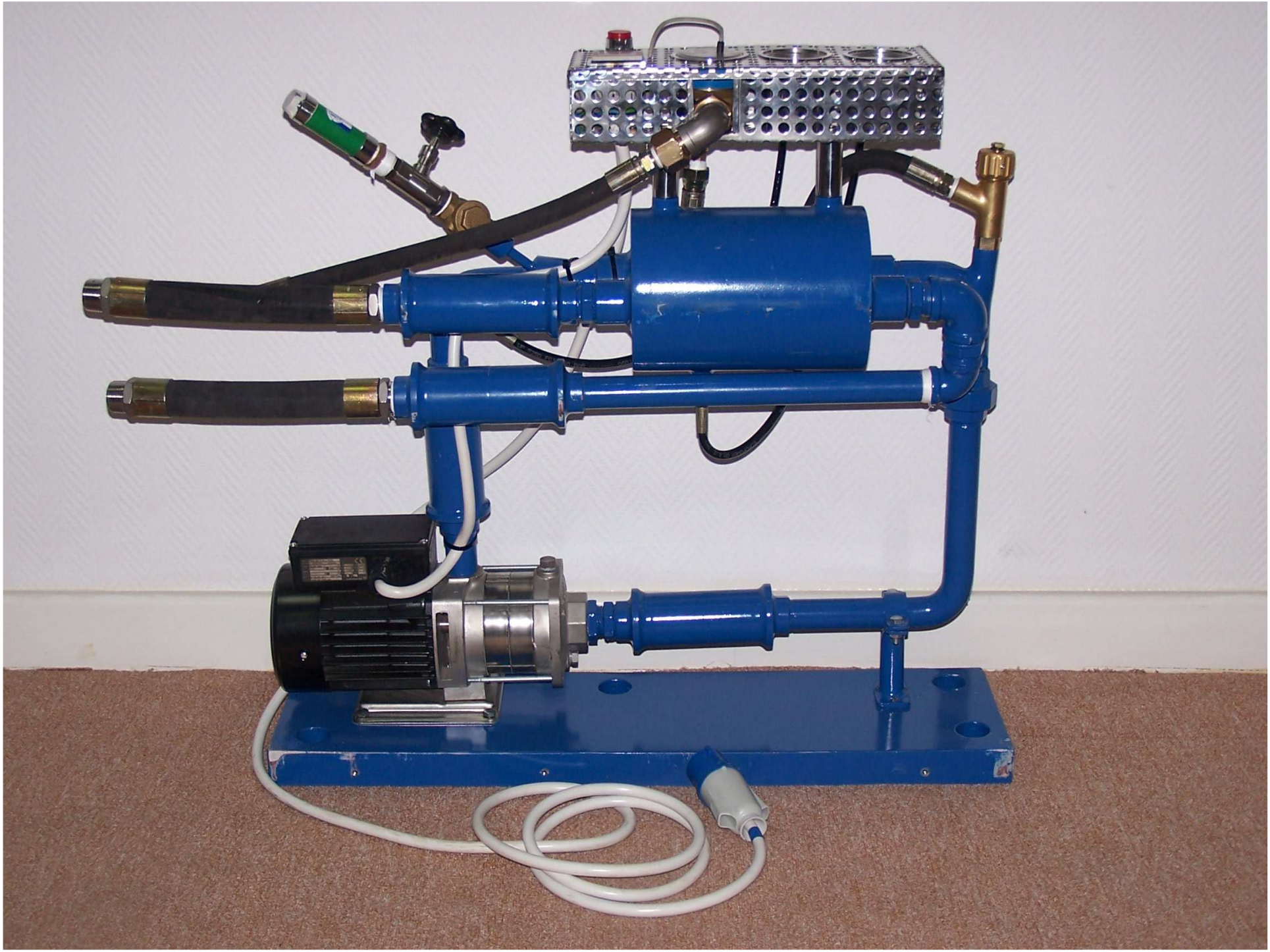
increases efficiency of heat exchange

The boilers site
Location of the magnetic systems (*example*)




HIGH SPEED TURBULENT
MAGNETIC FUEL MODIFIER
The Latest Magnetic Technology
MAGISTRAL MAGNETIC SYSTEM
MAGNETIC TECHNOLOGIES LLC





ULTRASOUND + ULTRAVIOLET + MAGNET = HEALTHY WATER

	Concentration prior to treatment (number / ml)	Concentration after treatment (number / ml)
Test: e-coli	1.96×10^5 1.80×10^6 4.80×10^6	0 22 700
Test: aspergollus niger (the most hardy species of mould spores known so far). This kind of mould spores can not be killed by either ultraviolet or ozone.	8×10^6	6.6×10^3

Station for Sewage Water Disinfection







From: CMay@dubaigolf.com
To: magtech@emirates.net.ae
Cc: CHaldane@Dubaigolf.com
Sent: 17 February, 2009 14:26
Subject: Installation at Emirates GC

Dear Sir,
I can confirm that MTC installed a magnetic water treatment system in to our main irrigation lake on the Faldo course at Emirates GC.The irataion lake has a mix of desal water and treated sewage water.Prior to installation we suffered from significant algae formation and a bad smell around the lake,which caused complaints from golfers and residents.Since installation the algae problem has reduced and the smell has disappeared.
We are now likely to proceed with installing at our other property and another location within Emirates GC.

Best Regards

Christopher May
General Manager

Emirates Golf Club
P.O. Box - 24040, Dubai, U.A.E.
Tel: +971 (0)4 3802222
Fax: +971 (0)4 3801707
Website: www.dubaigolf.com
Location: Emirates Golf Club












HONDA



REPORT* ON MAGNETIC TREATMENT OF LAKE

(Voskresenskoe village, Moscow region, Russia)

№	Parameter	Unit	Standard	Value	
				Before magnetic treatment 8 June 2009	After magnetic treatment 9 June 2009
1	pH	-	6.5 - 8.5	6.4	7.5
2	Hardness	mg-equ / l	0 - 7	1	1
3	Odour	point	0 - 2	3	2
4	Turbidity	NTU	-	1.78	0.96
5	Colour	degree	-	47	34
6	Solid residue	mg / l	0 - 1000	90	87
7	Dissolved oxygen	mg / l	> 4	5.25	7.03
8	BOD_5	mg / l	0 - 2	5.7	2
9	Total bacterial count (37^oC)	per 1ml	-	1300	590
10	Total coliforms	per 100ml	0 - 500	32000	620

* The first water sample (control) was taken at 8th June 2009 directly before the magnetic treatment. The magnetic treatment was carry out within 20 minutes. The second sample was taken 24 hours after of the control sample. Water samples analysis was carry out at Analitical Center of Water Quality ("ROSA" private company, Moscow, Russia)




МОСВОДОСТОК

REPORT* ON MAGNETIC TREATMENT OF POND

(Yasenevo community, Moscow, Russia)

№	Parameter	Unit	Standard	Value	
				Before magnetic treatment (7 July 2009)	After magnetic treatment (8 July 2009)
1	pH	-	6.5 - 8.5	6.4	7.5
2	Colour	-	-	greenish	colorless
3	Suspender solids	mg / l	0 - 10.75	244	< 3
4	Dissolved oxygen	mg / l	> 4	6.67	7.62
5	BOD_5	mg / l	0 - 2	6.32	2.89
6	Petrochemicals	mg / l	0 - 0.1	0.13	0.03
7	Total bacterial count (22° C)	per 1ml	-	3200	310
8	Total bacterial count (37° C)	per 1ml	-	1400	190
9	Total coliforms	per 100ml	0 - 500	300	210
10	Total thermotolerant coliforms	per 100ml	0 - 100	180	140

* The first water sample (control) was taket 7th July 2009 directly before the magnetic treatment. The magnetic treatment was carry out within 120 minutes. The second sample was taken at 24 hours after of the control sample.
Water samples phisicochemical analysis (parameters 1 - 6) was carry out at laboratory "MOSVODOSTOK", Moscow, Russia.
Water samples microbiological analysis (parameters 7 - 10) was carry out at Analitical Center of Water Quality "ROSA", Moscow, Russia.







ANALYSIS REPORT OF SAMPLES FROM IRRIGATIN NET WORK COLLECTED BY NETWORK DEPARTMENT

SAMPLES SUBMITTED ON 14/01/2010

PARAMETER	SAMPLE 63-A-BEFORE	SAMPLE 63-B-AFTER
p.H	6.9	7.0
E.C.(Micromhos/cm)	1782	1766
T.D.S.(mg/l)	879	870
Chlorides (mg/l)	340	330
T.Alkalinity (mg/l)	220	220
H2S (Diss) (mg/l)	2.1	0.4
S.S (mg/l)	29.2	18.8
COD(mg/l)	75	42



ANALYSIS REPORT FOR NETWORK DEPARTMENT

SAMPLE SUBMITTED ON 26/01/2010

PARAMETER	DB-86 BEFORE FILTER	DB-86 AFTER FILTER
p.H	**7.2**	**7.4**
Chlorides (mg/l)	**240**	**225**
E.Conductivity (Micromhos/cm)	**1238**	**1185**
TDS (mg/l)	**611**	**584**
H2S DISS.(mg/l)	**NIL**	**NIL**
BOD5(mg/l)	**1.0**	**0.7**
COD (mg/l)	**64.1**	**60.8**
T.Alkalinity(mg/l)	**140**	**124**
Ammonia(NH3N)(mg/l)*	**5.9**	**3.1**
S.S (mg/l)	**5.6**	**5.0**

Remarks

- The ammonia value is confusing us, if it is Aweer STP effluent, the value should be higher.
- Samples are collected and submitted by Network staff.