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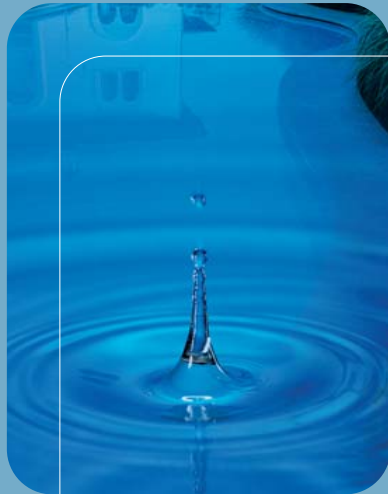


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Water treatment handbook



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INTRODUCTION

The aim of this Technical Handbook is to supply few useful suggestions about the correct treatment of swimming pool water. These indications recommend how to prevent any inconvenience that may frequently occur, which are not among the goals and satisfactions that a swimming pool should offer to its owner.

The purpose of this Handbook is not to replace any of the already existing exhaustive documents on the chemical products used in this field, or, generally speaking on chemistry and on the natural balance of water.





It is always advisable to refer to the indication on use and dosage suggested by the manufacturer of the chemicals employed.

Also as concerns handling, mixing, dilution and all related risks and hazards for the human health and for the environment, we strongly suggest always to refer to the safety datasheets of the products.

PH, ALCALINITY, HARDNESS, CHLORINE RATE

The ideal value of pH should range between 7.2 and 7.4. If pH is lower than 7.0 the water is acid and could corrode the metal element it gets in touch with.

In this case it is necessary to increase the value with a basic substance (e.g. sodium carbonate).

If the pH value is over 7.6 the water is basic and it therefore favours the development of bacterial flora, calcareous scale and has a cloudy aspect.

Use an acid substance to solve the problem (e.g. sodium bisulphide). In case of public swimming pools, within structures with recreation activities or activities destined to water games, the current legislation allows the use of the following pH correctors: hydrochloric acid, sulphuric acid, sodium hydroxide, sodium bisulphate and sodium bicarbonate.

pH always tends to increase as time goes by: it increases quickly using chloride alkaline products (hypochlorites).

The value of the free chlorine should be included between 0.6 ppm and 1.00 ppm and must have the same level all



over the pool. In inlet water this rate could range from 0.6 to 1.8 ppm.

A correct balance of water requires a good capacity to resist against pH rate variations.

This resistance degree is defined complete alkalimetric titration (CAT). The highest is the CAT, that is the alkalinity rate of water, the more difficult will be to modify the pH value.

CHLORIDE TREATMENT (MAINTENANCE)

On the market there are standard kits for the detection of CAT. The hardness of the swimming pool water indicates the more or less high concentration of calcium and magnesium ions and it is generally defined by titration.

A high hardness causes the development of scale deposits that damage the swimming pool equipment and create unaesthetic effects. On the contrary an excessively low hardness can trigger a corrosion process of all metal parts.

To reduce water hardness are generally used water softeners or specific anti-scaling products. The increase of the hardness is obtained using calcium salts such as for example the calcium chloride. For further and more detailed information please refer to standards UNI 10637.



For the standard chloride treatment of water use trichlorisocyanuric acid in 200 g tablets (for lapping dissolving units) and 500 g tablets for swimming pools with skimmers. Each 500 g tablet has a chloriding power for about 30 mc of water, provided that the plant operates at least 4 hours within the day, and its effect will last for a few days. In normal operating conditions, a concentration of free chlorine ranging between $0,7 \div 1,50$ ppm.

If such a concentration is



DISINFECTION

not achieved, it is necessary to increase the quantity of tablets.

The product must be introduced in the skimmer and/or in the compensation basin for swimming pools with spillway border when the plant is operating.

In case of public swimming pools, within structures with recreation activities or activities destined to water games, the current legislation allows the use of the following disinfecting products: ozone, liquid chloride, sodium hypochlorite, calcium hypochlorite, anidro-sodic dichlorisocianurate, bi-hydrate sodium-dichloroisocianurate and trichloroisocyanuric acid. For further details please refer to standard UNI 10637.

IMPORTANT: Since the aim of the treatment with tablets is to maintain the chlorine level, these should be used after having reached the water balance, and particularly with a free chlorine value into the pool of at least 1,00 ppm.

HOW TO REDUCE CHLORINE DISPERSION

Chlorine consumes for two reasons:

1. oxidising transforms water organic substances in chlorides;
 2. direct sunlight destroy it.
- This last cause, which leads to high variation of the free chlorine rate, can be reduced using a specific product such as isocyanuric acid.

Add 30 g/mc of this product to the water, to protect chlorine against U.V. rays; isocyanuric acid also maintains the excessive quantity of chlorine, and frees it in the water as soon as it is necessary. The product must be introduced in the skimmer and/or in the compensation basin for swimming pools with spillway border when the plant is operating.



TREATMENT OF SUPERCHLORINATE

This must be performed at the beginning of every season and must be repeated every fortnight for private swimming pools, while for public swimming pools this treatment must be carried out every 5/6 days with Sodium dychloroisocianurate.

Once this operation is done, perform at least one filtration before checking the level of free chlorine in the pool. Surely the chlorine level will be high, therefore it will not be necessary to add further chlorine until this level is in the standard range.



WHY IT IS NECESSARY TO SUPERCHLORINATE

The operation for periodical superchlorinate are efficient particularly in the warmest periods, to inhibit the development of algae, bacteria and organic contaminating agents.

It is advisable to use the following quantities:

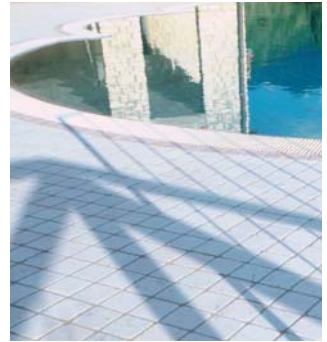
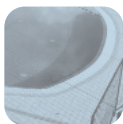
- superchlorinate at the beginning of the season $15 \div 20 \text{ g/m}^3$
- periodical superchlorinate $8 \div 10 \text{ g/m}^3$

After having performed a counter-washing, pour the product slowly (to enable an easy solution) into the skimmer and/or in the compensation basin for swimming pools with lapping border.

The chlorine introduced in the basin is used to oxide contaminating substances contained in the water. These are substances normally introduced by bathers (sweat, urine, saliva, etc.), by atmosphere precipitations, by the wind, by insects and to eliminate the resistance against chlorine of algae, bacteria, etc.

Each kind of swimming pool water, according to the contamination degree, has a particular "need of chlorine", necessary to oxide these contaminating agents.

Whenever the oxidation is insufficient, it origins intermediate products, the chloramines, that are the responsible for the particular smell of chlorine



and for the irritation of eyes.

When all contaminating products in the water have been oxidized (i.e. the "Break point" has been overcome) the still available chlorine quantity remains as free chlorine, to control other possible contaminating agents that could develop.

It is advisable to maintain a free chlorine rate ranging from 0,6 to 1,00 ppm, to guarantee maximum hygiene in the swimming pool water. The superchlorinate process maintains the chlorine in the water over the break-point, thus ensuring the complete oxidation of fastidious products (chloramines).

ALGAE PREVENTION TREATMENT

This procedure must be carried out at the beginning of every season introducing a specific algacide product every fortnight.

The elements which favour the creation and development of algae are:

- high temperature
- high pH
- insufficient chlorine level
- nitrates

It is therefore necessary to check frequently the values of pH and of free chlorine in order to quickly take the necessary corrections to take the parameter within the standard level.

Algae develop under different forms.

Normally they are anchored to the wall or on the bottom of the swimming pool, in

such spots where the water circulation is lower, but they could also be suspended.

There could be different kind and different colours of algae.

The most frequent kinds are green and black: the latter are the most difficult to eliminate.

In case of public swimming pools, within structures with recreation activities or activities destined to water games, the current legislation allows the use of the following algae prevention substances:

N-alchil-dimetil-benzilammonia chloride, polyhydroxiethilene (dimetiliminium) ethilene (dimetiliminium) methilene dichloride) polyoxiethilene (dimetiliminium) ethilene (dimetiliminium) ethilene dichloride).

Use:

The algacide must be slowly poured into the skimmer when the plant is operating or into compensation basin in case of swimming pools with lapping border.



FLOCCULATION SYSTEM

The flocculation system, as support method for filtration, occurs eliminating from the swimming pool water microscopic suspensions that could cause clouding.

The flocculation product is a substance that hydrates and increases its volume. The hydrated molecules binds among each other generating reticulated flocks, that depositing on the sand layer of the filter increase the filtering power of the sand, thus increasing the capacity of the filter to hold even the tiniest impurities.

Nowadays research and experimentation enabled to find products with an almost constant effect within a wide pH range (6.8 - 8.0) thus obtaining the highest result between pH values ranging from 7.2 to 7.4. In case of public swimming pools, within structures with recreation activities or activities destined to water games, the current legislation allows the use of the following flocculation agents: aluminium sulphate (solid and solution), ferric chloride, ferric chloresulphate, aluminium polyhydroxichloride, aluminium

polyhydroxichlorosulphate, sodium aluminate (solid and solution).

Use:
the flocculation substance must be diluted in a container in a ratio 1:10 (1 part of product in 10 parts of water). The product must be introduced in the skimmer and/or in the compensation basin for swimming pools with spillway border when the plant is operating.

HOW TO ELIMINATE CLOUDING

After having mixed the flocculation product (2-3 minutes) in a plastic container, pour it in the nearest skimmer of the pump or in the compensation basin near the intake with operating plant.

Use:
Dose: 400-500 g of products diluted at 10% for every 100 m³ of water.

- Perform an energetic counter-washing every 4-5 hours of filtering and immediately perform a new flocculation until the desired clearness is achieved.



HOW TO PREVENT CLOUDING or EMPOWER THE FILTERING LAYER

- Pour in the skimmer nearest to the pump or in the compensation basin near the intake, 200-250 g of product diluted at 10% every 100 m³ of water.
- Repeat flocculation every time the counter-washing of the filter is performed.

The product must be introduced in the skimmer and/or in the compensation basin for swimming pools with spillway border when the plant is operating.

Note: The filtration must continue until the water is at ideal conditions.

CLEANING AND DESCALING OF THE SWIMMING POOL WALLS AND BOTTOM

Apart from its amusement function, the swimming pool has an aesthetic function as concerns the house environment. Therefore obtaining a crystal-clear water is just one of the aims that the swimming pool owner should achieve, the other aim is to get a basin (both walls and bottom) in optimal conditions therefore without lime scale and black deposits on the waterline, both unaesthetic elements. The first is due to the hardness of the water deposited by calcium carbonate and the last to organic deposits that float on the water: both accumulates on the water line.



LIME SCALE ON THE WHOLE SURFACE OF THE SWIMMING POOL DUE TO LIMESTONE PRECIPITATIONS AND TO AN EXCESSIVE pH VALUE

Empty the swimming pool and pour the lime prevention product in a plastic bucket, and enter the basin wearing rubber boots with white sole and rubber gloves: treat the surface dipping a brush into the bucket and rub the bottom and the walls. A sponge or some clothes can also be used. The operation must be performed as soon as the basin is empty in order to avoid that the limestone dries up excessively. Leave the product react for about 5/10 minutes before carrying out an accurate rinsing, taking then care to discharge the water using a back up pump (submerged pump).

It is difficult to define the quantities that depend on several variables: quantity of deposited limestone, dimension of the swimming pool and, particularly, possible organic deposits mixed with lime; what's important is to maintain the surface wet with a lime-prevention product for a sufficient period.

LIME SCALE ONLY ON THE WATER LINE THAT HOLDS ORGANIC IMPURITIES, CREATING A BLACK STRIP

These appear as a whitish veil. Considering that the intervention area is approximately at water level, it is sufficient to low the water level for some centimetres and, always using rubber gloves, rub with a rough clothe wet with lime prevention product. Let it act for about 5/10 minutes and then rinse thoroughly with the water of the swimming pool. Repeat the operation if the result is not satisfying. The small quantity of product that precipitates into the water, will not alter the quality of the water itself.

ORGANIC DEPOSITS ON THE WATERLINE

These are caused by oily materials that include smog and dust; being light, these float on the surface and deposit on the waterline.

To eliminate them it is necessary to use an alkaline detergent.

Spread the alkaline detergent on the rough side of a sponge and rub the area to be cleaned.

Wait 5/10 minutes before rinsing with the water of the swimming pool. The small quantity of product that precipitates in the basin will not alter the quality of the water.

It could happen that organic substances deposit on the surface before lime scale and/or vice-versa, therefore it is necessary to perform a double intervention, that is removing the lime scale before removing the organic deposits or vice-versa.



HOW TO ELIMINATE THE EXCESSIVE FREE CHLORINE

In some cases there could be the possibility to use high quantities of chlorine to sanitise the water in the swimming pool.

When the quantity of residual free chlorine in the swimming pool should be excessive to enable the bathing, it is advisable to use the Calcium Seizing to rapidly reset the correct concentration of free chlorine.

The 2 g/m³ dose enables to reduce the rate of free chlorine of about 1,00 ppm. The product must be poured into the skimmer and/or in the compensation basin for swimming pools with lapping border, when the plant is operating.

HOW TO LIMIT LIME SCALES

When particularly hard or ferruginous water it is possible to inhibit the precipitation of calcium and magnesium salts and of the iron hydrate using since the first treatment the product called Calcium Seizing, that inhibit calcium and magnesium precipitations. The doses varies from kg 0,5 to 1,5 kg for every water m³ for a maximum hardness of 50 French degrees.

For higher hardness levels, the quantities can also be doubled. The product does not influence the pH value. The product must be poured into the skimmer and/or in the compensation basin for lapping border swimming pools, with the plant operating for at least 14 hours.

SANITATION

It is necessary to prevent the development and the spreading of funguses and warts that could transmit from an individual to another, walking barefoot on the floor around the swimming pool, in the bathrooms and in the dressing rooms.

The Sanitising product must be used after dilution at 1% in container.

Wash the floor with the solution using a broom.

The product is particularly fit for sanitation of dressing- and bathrooms.



Use a common house-sprayer, to be exclusively employed for this task, wetting all surfaces and letting them dry without rubbing.

It can be added in the water of foot-washing basins (maximum dose 3%) set on the compulsory paths in public swimming pools.



PROBLEMS TYPICALLY CONNECTED WITH ALGAE AND THEIR RESOLUTION



ALGAE IN SUSPENSION

The water of the swimming pool appears green and cloudy: that means that there are suspending algae. Check the pH value (correct it if necessary) since algae consume the carbon dioxide contained in the water making it rapidly alkaline.

Check also the value of free chlorine and superchlorinate if necessary.

To set the water to its ideal clearness in short, a flocculation can also be performed.

Remove the deposits on the bottom with a vacuum broom and perform, during this operation, frequent counter-washings.

Filtration must continue until the water returns to its ideal conditions.



GREEN ALGAE ON THE WALLS

The water appears veiled but not cloudy, nevertheless the bottom and the walls are slippery and are locally spotted by green areas.

For water treatment see the section "Suspending algae".

After 12-24 hours brush the spots and vacuum the removed algae using the vacuum broom.

Filtration must continue until the water returns to its ideal conditions.



BLACK ALGAE

Where do they locate?

- painted swimming pools, on vinyl liner or glass-resin covering: they are intense black spots gradating to grey on the edges;

- in swimming pools with tiles or vitreous mosaic: in the gaps between tiles or tesseras.

This kind of alga resists also to strong rubbing, it is therefore necessary to intervene with "chock" water chemical treatments. Check the pH level and, if necessary, set it to the ideal values and superchlorinate at 30 g/m³.

Maintain this condition for two or three days with the

plant constantly operating according to the seriousness of this phenomenon, AVOIDING BATHING, until the conditions of free chlorine and of pH are within normal levels.

In the plants with metal tubing there could occur tiny corrosions due to the aggressiveness of water, therefore from the inlets could exit "brown fumes" due to the oxidised iron produced by corrosion. It could be necessary to repeat the treatment in case the situation is particularly serious. Filtration must be continuous until the water is in its ideal conditions.

THE WATER USED TO FILL THE SWIMMING POOL TREATED WITH CHLORINE, CLOUDS ASSUMING A DARK COLOUR, EITHER GREENISH, BROWN OR BLACK.

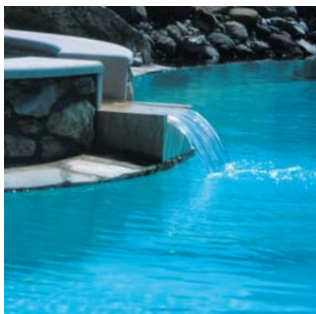
The filling water contains iron, manganese or copper that oxidised by chlorine precipitate on the bottom. The clouding phenomena and therefore the colouring of the water fades away within 24 - 28 hours.

In this case it is advisable to superchlorinate to enhance oxidation and the precipitation of oxides, increase the filtration time, counter-wash every 3-4 hours, and furthermore it is advisable, after the first counter-washing to perform a flocculation, and repeat it after every counter-washing. The flocculating product operates within a wide pH spectrum (6.5-8.0), nevertheless it is advisable a pH level ranging between 7.2 and 7.4.

It is necessary to remove with the vacuum broom, the deposits that precipitated on the bottom of the swimming pool.

Filtration must be continuous until the water is in its ideal conditions.





SCALE DEPOSIT ON THE WALL AND ON THE BOTTOM OF THE SWIMMING POOL

These are due to the excessive hardness of the water (see table) that causes calcium carbonate scales.

To solve this situation, it is enough to employ a quantity of Calcium Seizing equal to $0.5 \text{ kg} \div 1.5$ for 100 m^3 of water to reach a hardness of 50° French.

WHITISH, MATT WATER

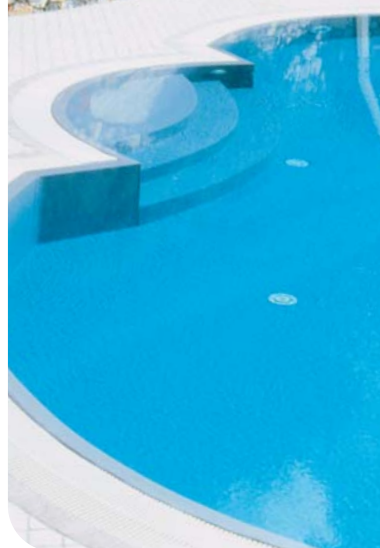
If this phenomenon is not due to a faulty operation of the filter, it could be due to a suspension of calcium carbonate, caused by an high pH level and to an excessive water hardness.

Reduce the pH to a value included between 7.2 and 7.4.

Check and/or let check the water hardness, compare the values with those indicated in the following table, which has to be referred to in case the filling water is hard or too hard.

French degrees

from 0 to 7	very sweet water
from 7 to 15	sweet water
from 15 to 30	average hardness water
from 30 to 50	hard water
over 50	very hard water



ODOUR OF CHLORINE

The odour of chlorine that could be smelled is not due to an excessive quantity of chlorine but to a low quantity of the chlorine itself in the water.

The particular odour of chlorine is due to non completely degraded chloramines since the situation is under the break-point, over which this phenomenon disappears. In this case it is necessary to check pH (and correct it if necessary), superchlorinate in order to overcome the break point and maintain the chlorine level around $0,7 \div 1,50 \text{ ppm}$.

SKIN IRRITATION, ITCHING, EYES IRRITATION

This phenomenon is due to an excessive increase of pH value that normally increases on its own.

In this case it is enough to set the pH value within 7.2-7.4.

BIBLIOGRAPHY

- UNI 10637
- Agreement dated 16 January 2003 between the Ministry of Health, the Regions and the Autonomous provinces of Trento and Bolzano as concerns the Hygiene-Health aspect for the building, the maintenance and supervision of swimming pools.

