

**EUROPEAN TREATMENT PROCEDURE  
FOR SWIMMING POOL WATER**



*We do fantastic  
things with water!*

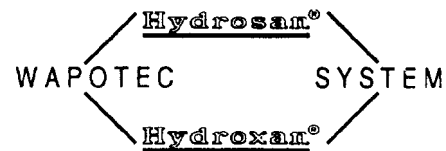
# Innovations in the field of pool water treatment and disinfection

To overcome all known risks to bathers and staff, swimming pool water, not only in public pools but also in private installations, should always be adequately treated and disinfected.

It is critical that the treatment processes, through filtration, flocculation, disinfection and pH correction, function correctly. They should not only be optimized to the pool's water hydraulics and bather loading to ensure satisfactory water quality but also avoid the production of harmful by-products caused by the use of chlorine (but also bromine) which may be potentially hazardous to health. These by-products are the typical odours found in swimming pools associated with poor water quality and unsatisfactory water treatment.

Water process engineers are nowadays able to overcome these problems and treat and disinfect swimming pool water with "state of the art" engineering techniques.

In consideration of the increasing awareness of the population for health and environmental issues WAPOTEC have been researching for years (together with renowned institutes and scientists) on the development of our new products, one of which is the "WAPOTEC-SYSTEM" and is described briefly on the following pages:

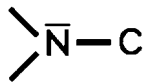


# Problems Caused By The By-Products Of Chlorination

When chlorine reacts with organic material in the swimming pool water undesirable by-products of chlorination are formed. This even more so if the water treatment and water disinfection does not work properly and/or if the pool's hydraulics are incorrectly designed.

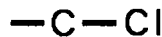
With the use of Chlorine there are two groups formed:

1. Chlorine nitrogen compounds (inorganic or organic bound nitrogen) represented simply as follows:



These compounds are known "promotors" of health hazards.

2. Chlorine carbon compounds (organic bound carbon compounds)



Both mentioned groups of compounds can have unpleasant consequences and can affect the swimmers, especially in indoor pools.

## Chlorine nitrogen compounds

These are formed by reaction of chlorine ( $\text{Cl}_2$ ) with organic nitrogen compounds in the pool water, such as urea, protein and amino-acids derived from the bather mainly as urine and sweat. Chlorine nitrogen compounds are measured totally as the parameter "combined chlorine". Combined chlorine consists mostly - depending on the chlorine concentration - of monochloramine. Monochloramine causes irritation of eye, skin and mucous membranes and is noticeable by its disagreeable smell ("chlorine smell").

Monochloramine is formed depending on the reaction between the chlorine concentration and pollutants. At higher concentrations monochloramine is oxidised to dichloramine and/or trichloramine.

## Chlorine carbon compounds

(=Organochlorine compounds, Trihalomethanes (THM) or Haloforms)

THMs are halogen-substituted, single-carbon compounds and occur principally as products of the reaction of chemicals used in the oxidative water treatment.

These products of chlorination cannot be detected and accurately measured without the use of sophisticated laboratory equipment and even then the sampling technique and laboratory methodology must be excellent. They are not perceptible like monochloramine and in the amounts found in swimming pools cause minimal smell or irritation. They do however represent a long term health hazard to humans.

Of the four members of the group (Chloroform [ $\text{CHCl}_3$ ], Bromodichloromethane [ $\text{CHBrCl}_2$ ], Dibromochloromethane [ $\text{CHBr}_2\text{Cl}$ ], Bromoform [ $\text{CHBr}_3$ ]) Chloroform is the compound most commonly encountered in swimming pools when using chlorine as the main disinfectant and is the compound upon which most of the carcinogenic and mutagenic research has been undertaken.

These volatile compounds are to be found in the water and air. They are released from the water surface into the surrounding air, inhaled by swimmers and personnel and can remain in the body for hours. They are also absorbed through the skin and injected.

In HVAC (heating, ventilation and air conditioning) it has been demonstrated that THMs cannot be easily "blown off" the water surface because they are heavier than air. They therefore remain on the water surface just in the area of mouth, nose and eyes.

The operators of swimming facilities should also recognize that their trainers and other staff have to stay in this air, possibly enriched with chloroform, for long-term periods. During that time the maximal concentrations for places of work could be exceeded. The Health and Safety Executives have set maximum levels as 10 ppm ( $50 \text{ mg/m}^3$ ) for the 8 hour TWA reference period and 50 ppm ( $225 \text{ mg/m}^3$ ) for the 10 minute reference period.

A limit value of 200 microgrammes of THMs per cubic meter in the air of indoor pools is proposed by the BGA Berlin (federal health department of Germany) and a limit value of 20 microgrammes of THMs per litre is likely to be agreed by FINA and the new DIN (German industrial norm).

# How To Reduce Those Problems And Carcinogens

The flocculation is one of the most important steps in the pool water treatment because it enables the effective removal of colloidal soluted inorganic and organic substances as well as bacteria and viruses. It is therefore extremely important to optimize the flocculation process.

Optimal flocculation reduces the turbidity substantially, especially during heavy bather loads and allows oxidation agents and disinfectants used for treatment and disinfection (chlorine, chlorinedioxide) to be effective.

For a foreseeable future it will not be possible to dispense with the use of the disinfection of swimming pool water by inorganic chlorine products (e.g. calciumhypochlorite, sodium hypochlorite, chlorine gas, etc.) as only these products will assure the required kill rate of disease causing organisms in the pool.

According to DIN 19643 (German Standards) the effectiveness of the disinfection has to be validated by a germ killing capacity of 1000 E. Coli organisms within 30 seconds.

Up to now this most important criteria could only be met by proven disinfectants based on chlorine given the precondition that the pool water is satisfactorily treated. The use of "chlorine free methods" failed among other reasons by virtue of their too long "killing time" of disease causing organisms.

Ozone is mentioned quite often in connection with pool water disinfection. However ozone must under no circumstances be allowed to get into the pool water in quantities which would enable it to be considered an effective disinfectant as it is hazardous to the bathers. As an oxidation agent in water treatment in sufficient quantity and for sufficient time it is no doubt excellent. Effective treatment combinations with ozone can also reduce organochlorine compounds and THMs in the pool water.

With small pools and pool remodelling/renovation it is necessary to use inorganic chlorine products correctly and sensibly to ensure that the use thereof is effective and safe, particularly with regard to optimisation of flocculation and filtration. Only this way will the formation of combined chlorine and organochlorine compounds be reduced; subject always to the control of the bather loading and effective water quality management.

Special attention should also be paid to the use of other organically based chemicals as these would unnecessarily contaminate the pool water and add to the formation of undesirable compounds.

The currently held view of diluting impurities by the addition of adequate levels of fresh water will not be possible in the future because of the high and raising costs of water and energy.

Whilst dilution reduces the concentration of impurities it does not completely eliminate all the hazards. Our thinking is to reduce this struggle by resolving the causes based on the extensive reduction of floccable organic substances before the addition of the disinfectant (reducing the potential for the formation of THMs) to avoid combined chlorine and haloforms.

That is only achievable by an

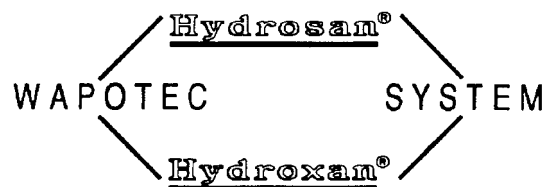
optimized flocculation

and a

strong additional oxidation.

It is necessary to optimize existing treatment and chlorination procedures by new treatment systems.

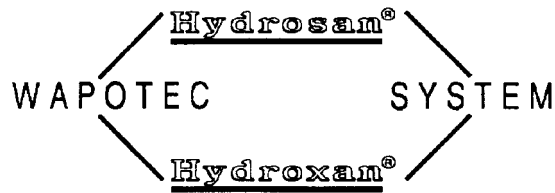
The enterprises of the WAPOTEC Group have spent years of research to find a non-polluting and effective solution:



With the use of **Hydrosan**<sup>®</sup> together with an adequate treatment technique optimisation of the flocculation filtration is obtained (dual-effect). That brings a reduction of the organic substances (= haloform formers!) in the pool water. This elimination of the organics reduces impurities (the THM forming potential) substantially - in many cases to a minimum.

Using **Hydroxan**<sup>®</sup> and chlorine, there is neither a chlorine reduction by forming chlorine nitrogen compounds (combined chlorine) nor a formation of haloforms in the pool water which appeared unpleasantly in the air (especially of an indoor swimming pool) in the past.

The **WAPOTEC-SYSTEM** achieves excellent pool water quality because of its better treatment effects.



## Product information

Please refer to **Hydrosan®** and **Hydroxan®** information and technical data sheets for more details.

## Application

The treatment system can be used in an optimal way with all types of filters and known current procedures.

The improvement of the treatment procedure has to be the most important aim of pool water treatment. The effects of bad treatment should not be tolerated and are no longer acceptable with today's state of engineering.

The new WAPOTEC-SYSTEM is an effective and cost-efficient way to improve pool water quality. In most cases it allows considerable savings in fresh water, waste water and energy besides improvement of the pool's water quality. Thus the WAPOTEC-SYSTEM supports the ecological and politicoecological thinking in modern pool management.

Whilst the current recommended levels of free chlorine in the UK are considerably higher than in other European Countries it is considered that by using the WAPOTEC-SYSTEM these could be substantially reduced to achieve adequate disinfection and a similar increase in the redox voltage. Each pool would always be thoroughly evaluated prior to the installation of the WAPOTEC-SYSTEM and closely monitored thereafter to determine optimal values.

## Effects of the WAPOTEC-SYSTEM on the water quality

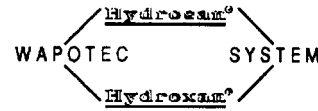
### Redox voltage

A raising of the redox voltage between 50 and 60 mV is usual with our treatment system compared with the following treatment combination

Flocculation - Filtration - Chlorination  
 (Minimum standards according to  
 DIN/ ÖNorm/ SIA-Norm)

at a level of 0.3 ppm of free chlorine.

Nearly all practical tests and applications with the



have shown a redox voltage between 780 and 810 mV in the treated water.

### By-products of chlorination:

**Trihalomethanes (THMs):** chlorine carbon compounds  
**Combined chlorine:** Chlorine urea, chlorine nitrogen compounds

The well-known risks of chlorination, especially with regard to the questionable and undesirable by-products of chlorination no longer exist by using the WAPOTEC-SYSTEM.

### Turbidity

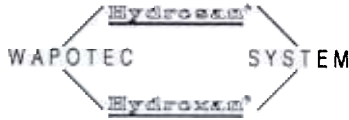
A reduction of the turbidity value of approximately 20 to 30 % (e.g. 0.2 TE/F origin value to between 0.04 to 0.05 TE/F after treatment) is obtainable by using **Hydrosan®**.

### Microbiology

Microorganisms (bacteria, viruses and protozoans), many of which are not only hygienically questionable but (given the correct environment and in sufficient numbers) may in certain circumstances be pathogenic, are brought into the pool water by bathers. That is why the disinfection has to take place in the pool water, to kill the germs within a short period of time, avoiding infection of any swimmer. The treated water and the pool water at the pool outlet has to be free of pathogenic germs (detectable by indicator germs, e.g. E. Coli, Coliforms, Pseudomonas aerug.). The efficacy of the disinfection is therefore critical! Germs, getting into the treatment plant, removed mainly by flocculation have to be killed by disinfection. These demands are fulfilled better and safer by using the WAPOTEC-SYSTEM.

Savings on fresh water and energy

Substantial savings on fresh water, energy, waste water and chemicals can be obtained with our treatment procedure. In public swimming facilities these savings are often much higher than the costs of the



## Installation of the WAPOTEC-Dosage-Unit

The use of the WAPOTEC-SYSTEM is not expensive in terms of overall water treatment; neither does it have major capital installation costs.

**Hydroxan®** and **Hydroxan®** should always be dosed continuously with the

### WAPOTEC-Dosage-Unit

The equipment is pre-adjusted.

## Dosage quantities

Before starting with the WAPOTEC-SYSTEM a filter material disinfection must be performed with sand and multi-layer-filters (see **Hydroxan®** Technical Data Sheet).

For continuous application the following quantities are recommended depending on the different kinds of filters:

Kinds of filter (filter material)		Dosage quantities m/m <sup>3</sup> of circulated water (ppm)			
		sand filter	multi layer filter	diatomite perlite filter	cartridge filter
<b>Hydroxan®</b>	outdoor pools	1,0	1,0	1,0	1,0
	indoor pools	0,6	0,6	1,0	1,0
<b>Hydroxan®</b>	outdoor and indoor pools	0,2	0,2	0,2	0,2

\*) Instead of diatomite earth perlite should be used as filter material because diatomite contains nitrogenous substances that react with strong oxidizing agents, e.g. chlorine and chlorinedioxid.

## Applications

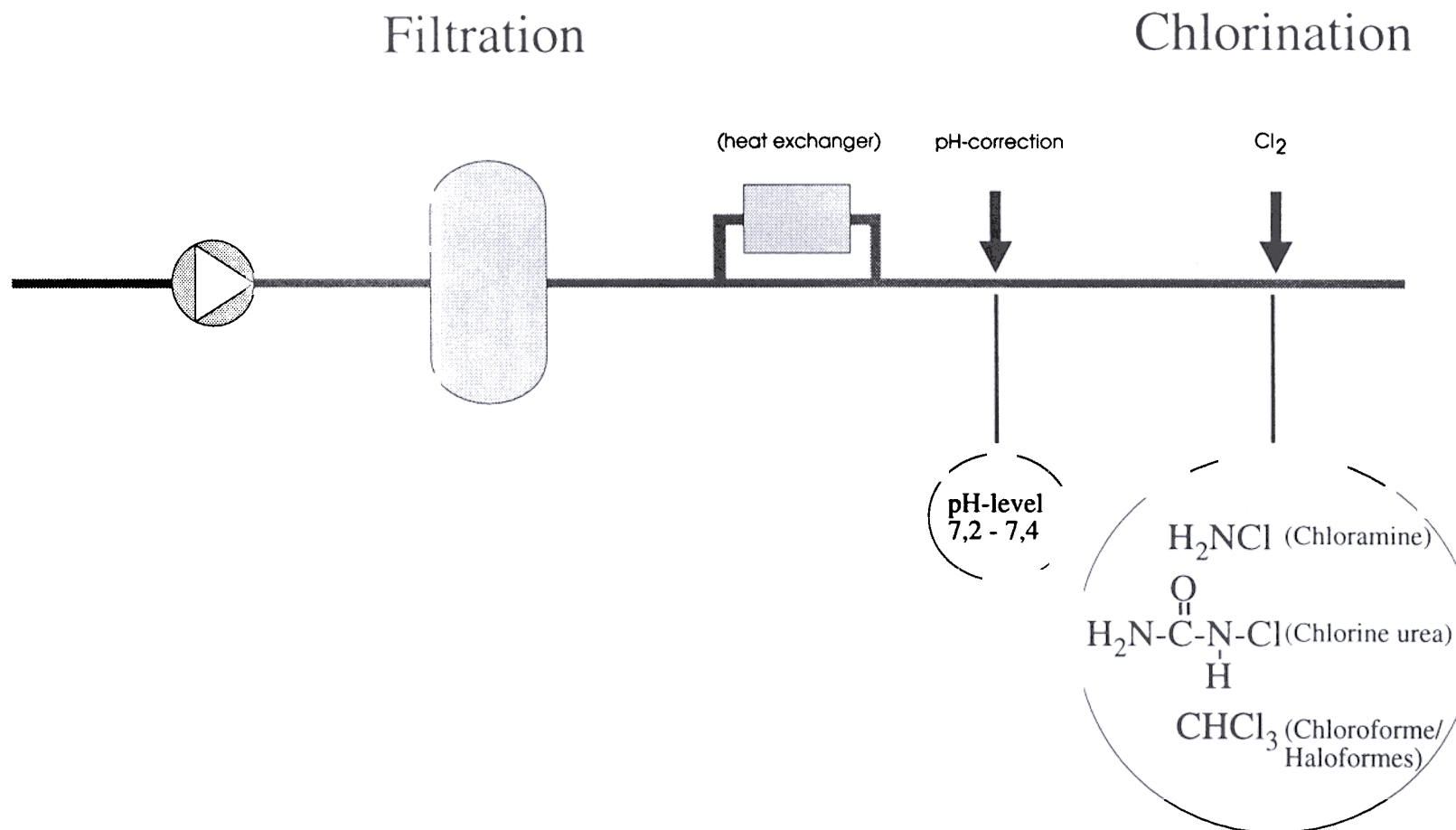
The WAPOTEC-SYSTEM was developed for pool water treatment. Further applications are possible or are already developed. Therefore our products and the system sometimes have to be modified depending on the specific demands:

- Drinking water
- Sewage water
- Industrial (circulation) water
- Cooling tower circulation water

Since we are cooperating with renowned institutes, we can help you to find a solution for your water problem or your customer's problem.

**Hydroxan®** and **Hydroxan®** are patented products.

# Treatment Procedure



Chlorination treatment

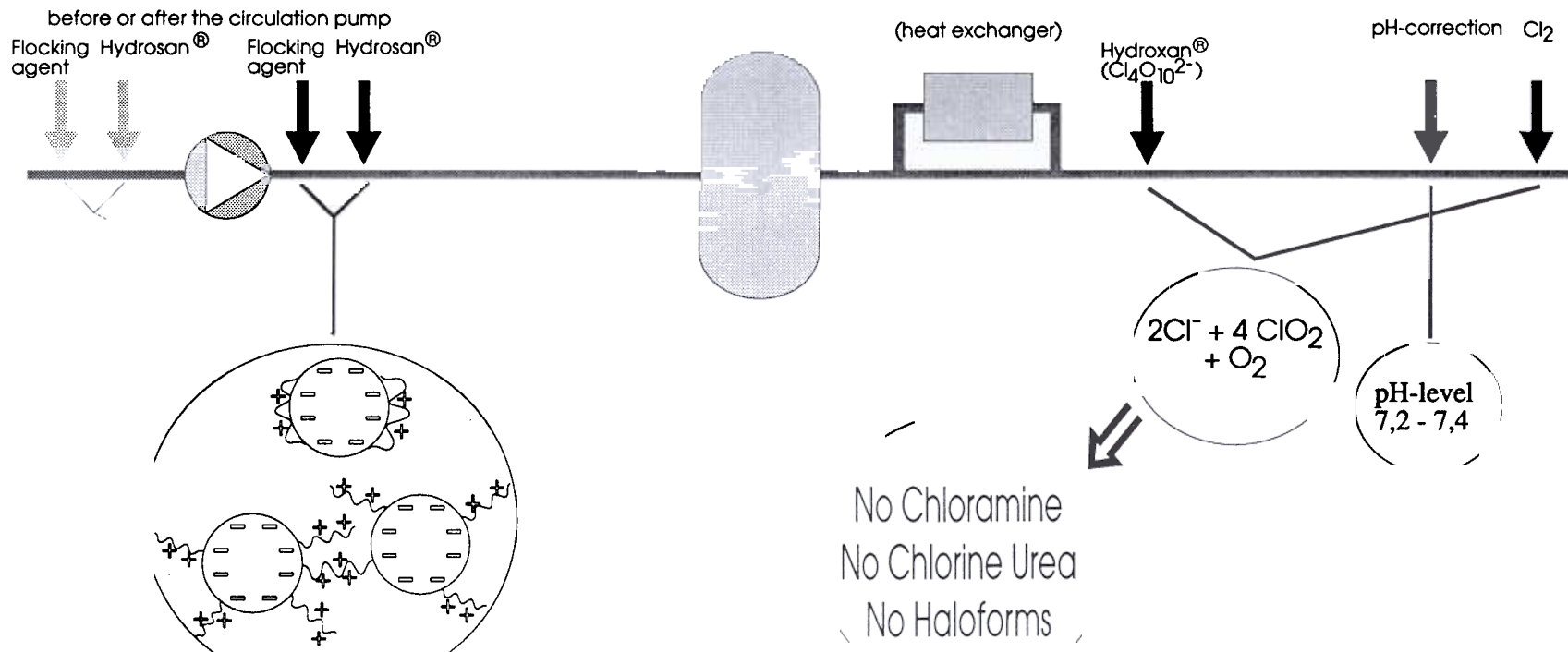
Even the finest filter media (sand) is not able to eliminate colloidal substances from the water without application of coagulants and flocculants.

The chlorination treatment forms hygienically questionable and undesirable compounds in the pool water.



# Treatment Procedure

Flocculation  $\rightarrow$  Hydrosan<sup>®</sup>  $\rightarrow$  Filtration      Hydroxan<sup>®</sup>  $\rightarrow$  Chlorination

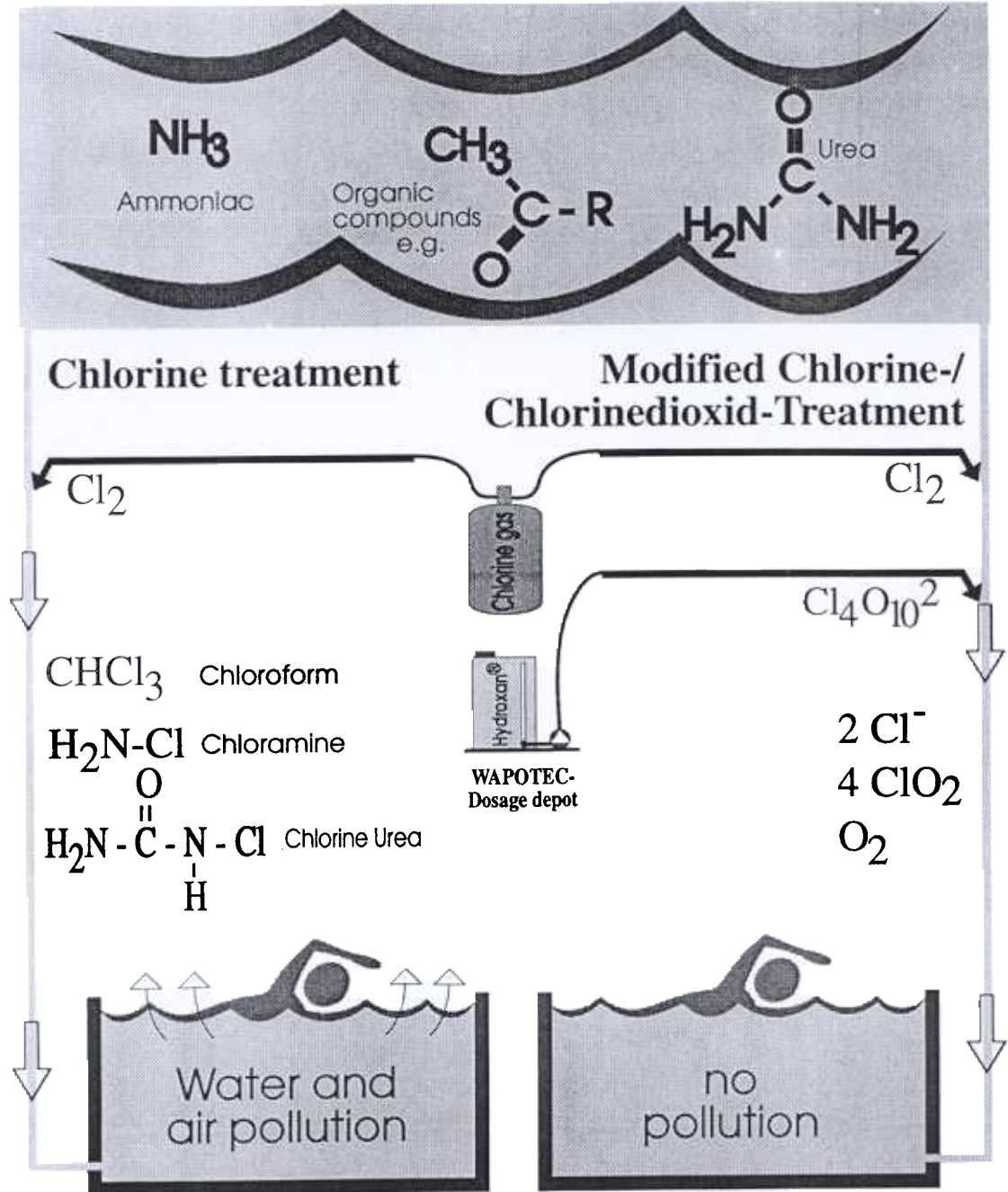


By using Hydrosan<sup>®</sup> in combination with flocking agents more undesirable substances are removed from the pool water (dual-effect).

By using the modified Chlorine-/Chlorine-dioxide-treatment no hygienically questionable and undesirable compounds are formed in the pool water.

# Hydrosan<sup>®</sup> und Hydroxan<sup>®</sup>

a contribution to the environment and health



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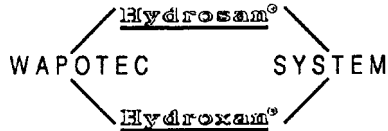
<b>THE PROBLEM</b>		<b>Reduction Of Problems</b>		<b>THE ANSWER</b> for better pool water and air quality
		Attempt	Disadvantage	
<b>IN THE POOL WATER</b>	Chlorine nitrogen compounds	Addition of fresh water	<ul style="list-style-type: none"> <li>• costs for fresh water and waste water</li> <li>• costs for heating</li> <li>• no elimination, just a reduction of the concentration of pollutants</li> </ul>	<p><b>WAPOTEC-SYSTEM</b></p> <p><u>Sufficient Pool Hydraulic</u></p> <p>+</p> <p><u>Reliable Filtration Technique</u></p> <p>+</p> <p><u>Certified, Effective Treatment agents:</u></p> <p>PAC-Flocking agent</p> <p>Hydrosan®</p> <p>WAPOTEC SYSTEM</p> <p>Hydrosan®</p> <p>Inorganic Chlorine products</p> <p>+</p> <p><u>Aimed Pool Deck Hygiene:</u></p> <p>Cleansers for pool edge and pool deck</p> <p>Agents for feet and floor disinfection</p> <p>Attention: Cleansers and disinfection agents must not form combined chlorine!</p>
	<ul style="list-style-type: none"> <li>• irritation of eye</li> <li>• irritation of mucous membrane</li> <li>• irritation of skin</li> <li>• brittle hair</li> </ul>	Chloramine separator	<ul style="list-style-type: none"> <li>• partial flow process ⇒ partial elimination</li> <li>• high investments</li> </ul>	
	Chlorine carbon compounds	Chlorine free methods	<ul style="list-style-type: none"> <li>• largely to long germ killing times</li> <li>• hardly tested</li> </ul>	
	<ul style="list-style-type: none"> <li>• Haloform enrichments in the body (organs)</li> <li>• (cancerogenic and mutagenic effects)</li> </ul>	Ozonation	<ul style="list-style-type: none"> <li>• only for oxidation, not for disinfection</li> <li>⇒ Chlorination necessary</li> <li>⇒ Chlorine by-products</li> <li>• high investments</li> <li>• high running costs</li> </ul>	
		Bromination	<ul style="list-style-type: none"> <li>• ⇒ bromide: similar by-products as chlorine (e.g. bromoform!)</li> </ul>	
<b>IN THE AIR</b>	<ul style="list-style-type: none"> <li>• smell of chloramine</li> <li>• head ache</li> </ul>	Addition of fresh air	<ul style="list-style-type: none"> <li>• costs for heating</li> </ul>	

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Summary

# Please note

According to our recent experience with the



additional treatment steps for the pool water treatment are not necessary.

Should special circumstances demand additional treatment, procedures can be integrated without any problems.

This information is based on practical experience and corresponds to the latest technology. We can only guarantee for constant high quality of the products delivered by us.

For hazardous data and handling information, please refer to the material-safety-data-sheets.

All tests, opinions and toxicological examinations are available and can be seen on request.

The products used with the **WAPOTEC-SYSTEM** conform with the DIN 19643 lit. 6 - Additives for treatment and disinfection of pool water (Zusätze für die Aufbereitung und Desinfektion von Schwimm- und Badebeckenwasser).

All tests necessary according to the German law for swimming pools (BGBl No. 12 - December 1985) have already been presented to the BGA (federal health administration of Germany) and the health departments of Austria, France, Switzerland and Sweden.



## WAPOTEC-GRUPPE

### WAPO-TECHNIK

Mittel und Verfahren zur  
Wasseraufbereitung-Gesellschaft m.b.H.

### WAPOTEC

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