

## **DISINFECTION OF DRINKING WATER WITH HYDROGEN PEROXIDE / SILVER (bafry D – 50/500)**

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### **INTRODUCTION**

Drinking water is the most important diary for human beings and also important is water for animals and plants. We have only one stock – the earth and its atmosphere (1).

1350 million cubic kilometer in sum on the earth, only 8.5 million cubic kilometer as ground water, our main supplier, 1322 million cubic kilometer from oceans and water vapor in our atmosphere.

The numbers in per cent are:

97.2% form oceans  
2.15% form glacial ice  
0.624% form ground water  
0.017% form surface water (rivers, lakes and so on).

We can only make usable for drinking purposes ground water and with treatment of water also surface water .The conclusion of this facts is, that our life depends on only 0.5 per cent water of the stock of the earth. The problem of the mankind is to have water at the right time on the right place without hygienic problems.

### **HYGIENIC PROBLEMS OF DRINKING WATER**

The microbiological problems of drinking water are following diseases caused of bacteria, viruses, and amoeba:

Typhoid epidemics, dysentery, cholera, legionnaire's disease, enteritis, hepatitis, tuberculosis, amoebic dysentery, etc.

These diseases are caused from faeces and urine. The microorganisms which are responsible for these diseases have a life span in water between 2 and 200 days.

## **Reproduction rate**

The reproduction rate is 15 – 20 minutes in an optimal environment and at optimal temperature.

20 min	2
200 min	1.024
400 min	1,048.576
600 min	1,073.741.824
800 min	1,059.511.627.766

## **INHIBITION OF GROWTH OF MICROORGANISMS**

The inhibition of growth can be done as following:

### Damage of the membrane and cell wall

With phenols, aldehyde, tensides destroy the semipermeability.

### Damage of enzyme

Silver, copper and mercury destroy the tertiary and quaternary structure of proteins.

Sulphurous acid attacks dehydrogenases.

Cyanides poison the cytochromoxidase.

Higher temperature denatures proteins.

### Damage of the synthesis of proteins and nucleic acids

Antibiotics hinder protein and nucleic acid synthesis of prokaryotes.

UV and gamma rays damage the nucleic acid synthesis.

## **DISINFECTION OF DRINKING WATER**

Several methods are well known for the disinfection of drinking water. The used substances are chlorine gas, hypochlorite solution, hydrogen peroxide, ozone, UV-rays.

Ozone is used for the disinfection of swimming pools and not so often for drinking water. The main disadvantage is the high toxicity. UV-plants are expensive and the service is intensive for the correct work of these plants. Chlorine and hypochlorites are cheap but the taste of water is changed

and they have gaps of efficiency. The reaction products of chlorine and hypochlorite with organic pollution are cancerogenic and mutagenic. Hydrogen peroxide / silver has no of these disadvantages.

## **MECHANISMS OF DISINFECTANTS:**

Adsorption – reactive groups in molecules are needed,  
Disturbance of growth,  
Morphologic changes,  
Hindering of enzymes,  
Destruction of the permeability of the cytoplasmic membrane –  
cytoplasm is leaving,  
Coagulation of cytoplasm.

A transport of disinfectant into the cell takes place at low concentrations with enzymes. The cytoplasmic membrane is destroyed at high concentrations.

## **RESISTANCE OF DISINFECTANTS**

Resistance appears if low doses of disinfectant have an effect on microorganisms over a long period. Several cell divisions of bacteria happen during this period and an adaptation of the bacteria to the disinfectant is the consequence. The mechanism of resistance is only known partly:

- Transformation of substances into ineffective derivatives,
- Reduction of the permeability of the cell (probably because of increase of lipids in or on the cell wall).

## **GENERAL DISINFECTION OF DRINKING WATER**

Drinking water is the only food, which cannot be substituted. Therefore drinking water must be well conditioned that its consumption or use does not endanger health.

An important target of water treatment of underground and surface water is the removal of water pollution which are harmful or toxic or which give rise to technical problems in water works, water basins, storage reservoirs or consumers.

With usage of D – 50/500 drawbacks of conventional disinfection products can be avoided. Unobjectionable disinfection of water is reached without harmful side effects as carcinogenicity, mutagenity or changes of smell or taste.

## **DISINFECTION OF DRINKING WATER PLANTS**

Because of the long time effect of D – 50/500 it is excellent suited for the application as a disinfectant for drinking water. Especially for long drinking water pipes or systems with dead zones and long duration of stay the advantages of D – 50/500 takes effect. D – 50/500 causes no changes in smell or taste in the treated drinking water.

The required dose and minimum duration of stay in drinking water reservoirs depends on the quality of the raw water, quantity and species of microorganisms, temperature and length and good or bad repair of water pipes.

A maximum of 35 mg/l (ppm) of D – 50/500 is required for treatment of drinking water. The minimum overdose of D – 50/500 in drinking water is about 1 – 5 mg/l (ppm).

The installation of a fully automatic measurement instrument and a control unit is forcing necessary for proportioning and monitoring of the content of D – 50/500 in waterworks.

The disinfection of drinking water in waterworks is done basically in two steps:

- a) With a proportion pump, which is connected with the raw water pump 5 - 35 ppm D – 50/500 is conveyed to the raw water in accordance of the quality of the raw water.
- b) The treated drinking water is brought to the drinking water reservoir after sedimentation and filtration.
- c) The drinking water of the reservoir is analyzed after a sampling is made.
- d) Is content of D – 50/500 below the range of 1 - 5 ppm, which is necessary for the safeguard of the network, an additional dose of D – 50/500 is made with the proportioning pump.
- e) Is the measured overdose of D – 50/500 in the reservoir enough for the safeguard of the network, no further dose of D – 50/500 is done.

## **DISINFECTION OF DRINKING WATER BASINS**

(Water for need, civil protection, and army)

Closed water basins without water circulation can be kept clean with D – 50/500 for a nearly unrestricted time.

Also, after long time, water doesn't lose its fresh taste and is not influenced through an unpleasant taste of disinfectants. A first dose of 25 – 35 mg/l (ppm) of D – 50/500 is necessary in accordance of the quality of the raw water and the condition of surface of the basins. The minimum over dose of D – 50/500 should be 3 – 5 mg/l (ppm). This concentration is enough in a hermetic closed drinking water basin to keep the drinking water sterile for several months.

The control of the overdose of D – 50/500 could be made with fully automatic units or manually measurement systems.

## **SURFACE DISINFECTION OF DRINKING WATER RESERVOIRS AND DRINKING WATER PIPES**

Legal directions require a disinfection of drinking water reservoirs or drinking water pipes at start-up or restart-up after a longer period of standstill.

### **Disinfection of reservoirs**

After a mechanical cleaning of the surfaces from dust and dirt sediments the walls are brushed with a high-pressure unit and a 0.05 – 0.1 % solution of D – 50/500. After this working step the reservoir can be filled directly with drinking water without problems.

### **Disinfection of pipes**

For the removal of impurities in pipes the pipe net is rinsed with water. Two processes of disinfection are applied for pipes:

#### **1 – Stand process**

The disinfection with D – 50/500 takes place during standing of a solution in the pipes. The disinfection time should be at least 12 hours. In accordance to the material of pipes and conditions of surfaces several concentrations of D – 50/500 are used to keep sterility.

- a) Polished surfaces (plastic, metal) 50 mg/l (ppm).
- b) Untreated surfaces (stoneware, concrete, and cast iron) 80 mg/l (ppm).
- c) Untreated surfaces (old pipes) 100 mg/l (ppm).

## **Consumption**

### **Filling**

During pipe filling with water D – 50/500 is mixed proportionally with a disinfection proportioning pump to the filling water.

The concentration of D – 50/500 is measured with a measuring stripe. During the pipe disinfection process hydrants should be opened for a short time to disinfect these also.

At the end of the pipe filling process, filled pipes must be closed hermetically to avoid further contaminations with micro-organisms. During stand disinfecting it must be provided for that disinfected raw water cannot enter into other pipe nets.

### **2 – Flow process**

For pipes with big diameters, we recommend disinfection with D – 50/500 in a flow process of at least seven days. The dose is corresponding to the stand process. The flowing amount of water could be reused for following rinsing. The amount of water must be substituted during the seven days two till three times.

### **Disinfection during hydraulic tests**

Disinfection with D – 50/500 is very good suited for disinfection of pipes during hydraulic tests. Filling of pipes is done in the same manner as the stand process. With D – 50/500 mixed water produce during the hydraulic test higher pressures and is pressed into pores and fissures of pipe material. Therefore a better disinfection is obtained.

### **Proceeding during repairs**

If pipe breaks crops up, pipes must be let under reduced pressure to avoid entering of micro-organisms and impurities. Units, which must be changed, should be disinfected with a D – 50/500 solution of 80 – 100 mg/l (ppm). After repair or reinstallation respectively of pipes, a rinsing with D – 50/500 should be made. During the disinfection process of pipes hydrants should be opened to disinfect these also.

## **Removal of rinsing water**

D – 50/500 solution can feed into sewers or rivers without charging of wastewater or environment. A neutralization of D – 50/500 is not necessary in contrast to other disinfectants.

## **DISINFECTION OF WELLS AND FILTER UNITS**

The natural filtering of wells is often not efficient to keep water with good quality. In opposite again and again wells cannot be used for drinking purposes directly because of negative environmental influences. This Fact is true of for private wells, wells for public water supply and also for wells for producer of mineral water, breweries and bathing water. Through the demonstrated long-time effect of D – 50/500, through the falling away of changes of taste and smell and other undesirable side effects and through the demonstrated non toxic, non carcinogenic and non mutagenic effect D – 50/500 is absolutely suitable for disinfection of wells.

For addition of D – 50/500 are principally two possibilities:

1. Direct addition of D – 50/500 to well water. The dose depends on the quality of raw water and is between 15 and 35 mg/l (ppm).
2. The second possibility is a injection of diluted solution of (about 1%) into the surrounding sand, stone or gravel bulk material. Infiltrated water dissolves D – 50/500 from bulk material and a completely disinfection is possible.

An overdose of D – 50/500 is controlled with measuring stripes, manual measuring units or automatic units.

## **MICROBIOZIDE EFFICIENCY**

D – 50/500 has a broad spectrum of efficiency and no gap of effects

D – 50/500 is efficient against

- \* Bacteriophages
- \* Viruses
- \* Spores
- \* Yeasts
- \* Moulds
- \* Grampositive bacteria
- \* Gramnegative bacteria

D 50/500 is usable at a temperature range between 0 °C and + 90 °C. The efficiency is increasing with rising temperature.

D – 50/500 is also efficient in charged water with organic substances.

## **DOSE**

For the determination of the application concentration of D – 50/500 following criteria must be taken into consideration:

- \* Start concentration of bacteria
- \* Application temperature
- \* Condition of surface and material (at surface disinfection)
- \* Care of purification

The regulations for the maximum content of silver ions in drinking water are considerable higher than concentrations of silver ions in drinking water treated with D – 50/500. A correct application of D – 50/500 fulfils legal regulation. The average dose of D – 50/500 for the disinfection of drinking water is 10 mg/l. The content of silver ions in this dose is 0.005 mg/l.

Some examples of legal allowed maximal contents of silver ions in drinking water are following:

- |                              |           |
|------------------------------|-----------|
| * USA, Canada, Russia, Japan | 0.05 mg/l |
| * EU                         | 0.08 mg/l |
| * Switzerland                | 0.10 mg/l |

That is with D – 50/500 prepared drinking water contains according to the specific directions 10 – 20 times fewer silver ions as allowed.

The World Health Organization WHO recommends a maximal harmless silver absorption of silver ions by drinking water treatment of 180 mg/day (31/drinking water/person/day).

A man absorbs 15 mg silver with 31 drinking water per day and an average dose of D – 50/500 of 10 mg/l. This is 12 times less than the WHO recommendation.

## **SIDE EFFECTS**

D – 50/500 has no smell or taste in diluted solutions, causes no changes of taste or smell, doesn't react with other ingredients, is not carcinogenic and/or mutagenic, is colorless clear liquid similar water with an pH of



1.5-2.0, doesn't charge waste water and its degradation products are water and oxygen.

### **COMPARISON OF DISINFECTION WITH D – 50/500 AND DISINFECTION WITH CHLORINE**

	<b>D – 50/500</b>	<b>Chorine</b>
Long time effect	Very long	In dependence of temperature short till medium
Light sensibility	Practically not	Medium
Temperature sensibility	Practically not	Quick degradation at rising temperatures
Neutral pH	Neutral	Change of pH of the treated water
Contact time	Medium	Short
Retarded efficiency through organic materials	Yes	Yes
Influence of ammonia or urea	Till 5 mg/l not	Reaction to chloramines
Efficiency against algae	Yes	Limited
Efficiency against fungi	Yes	Limited
Forming of smell	No	Yes
Change of taste	No	Yes
Danger of over dose	Practically	Yes
Carcinogenic/mutagenic	No	Reaction products yes

### **SUMMARY OF ADVANTAGES AND PROPERTIES OF D - 50/500**

- \* Universal usage
- \* No gaps of effect
- \* Long time effect
- \* No change of taste of treated foods
- \* No smell
- \* Efficiency and long time effect remains also at high water temperatures
- \* No forming of resistant microorganisms
- \* No charging of waste water and environment
- \* No toxic effects of the application
- \* No carcinogenic or mutagenic effects

- \* No irritation of skin, eyes or respiratory organs with the application solutions
- \* Equipment for measurement and feedback control

## **APPLICATION FIELDS OF D – 50/500**

### **1 - FOOD AND BEVERAGE INDUSTRY**

- \* Beverage industry:  
Breweries, mineral water production, fruit juice and lemonade production, must production, wine production and so forth.
- \* Milk industry:  
Packaging, dairies, cheese-dairies, and so forth.
- \* Food industry:  
Tinning factories, butchers, bakers, mills, farinaceous paste production, finished product producer, fish manufacturing, chocolate factories, salad oil and margarine producer, aromas and essence producer and so forth.

### **2 - AGRICULTURE**

- \* Animal farms  
Disinfection of stables and butchers.

### **3 - AIR-CONDITIONERS AND COOLING TOWERS**

- \* Disinfection of humidifier, cooling towers, air-conditioners, removal of algae.

### **4 - HOSPITALS AND PUBLIC BUILDINGS**

- \* Hospitals, nurse homes and old-age asylums:
  - Disinfection of surfaces, linen and so forth.
  - Disinfection of sanitation.
- \* Hotels, restaurants, kitchens, warehouses, schools, showers, lavatories and so forth.

### **5 - MEDICINE AND COSMETICS**

- \* Surgery:  
Disinfection of surfaces, equipment, humidifiers, sanitation and so forth.
- \* Chemical and pharmaceutical industry:  
Disinfection of surfaces, production equipment for pharmaceuticals, perfumes, extracts, colors and so forth.

## **6 - TOURISM AND HOUSEHOLD**

- \* Drinking water, sanitation, camping, hobby, containers for drinking water and waste water (caravans, ships).
- \* Disinfection of bathrooms, showers, lavatories, glass, carpets and so forth.

## **7 - SWIMMING POOLS**

Private and public pools, hotel pools, thermal baths, whirlpools, fitness centers, saunas, solar banks and so forth.

## **REFERENCES**

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