Mongolian Emergency Service
Hospital Hygiene Project
MeshHp.mn

List of disinfectants

Definitions

Cleaning agent – chemical used in combination with water to clean a surface or product. As side effect also microbes are reduced: ideally removal of 90-99 %.
Disinfectant - chemicals used to inhibit or prevent the growth of microbes on inanimate objects: ideally killing of 99,999 %.
Bactericide — kills bacteria
Fungicide — kills fungi
Virucide — kills virus (enveloped/lipophilic are typically easier to kill than nonenveloped viruses)
Sporicide — kill spores (fungi and bacteria)
Biocide — kills living organisms
Bacteriostat — inhibits the growth of bacteria
Detergent — contains free ions (leaves film on surface)
Anionic Detergent — (soaps) have free negative ions that produce curd when combined with calcium and magnesium in hard water
Cationic Detergent — Quaternary ammonium contains positively charged ions which remain suspended in solution

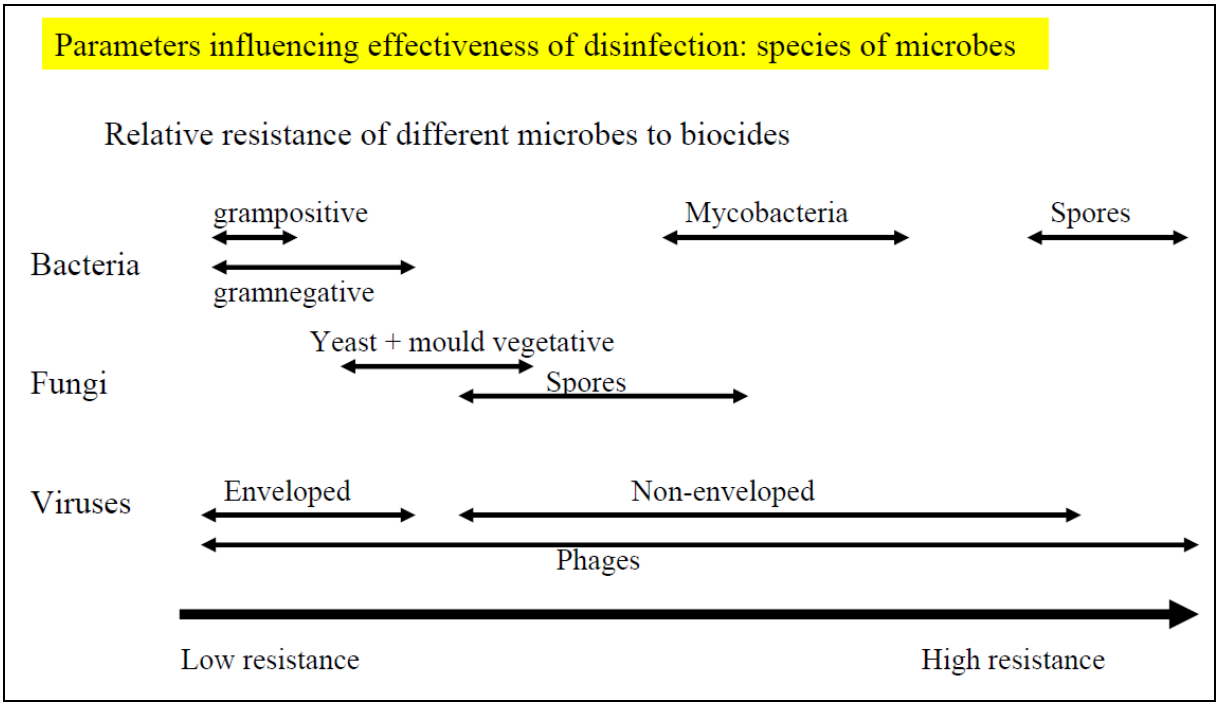
Disinfectant effectiveness depends on many factors:

- Type of contaminating microorganism. Each disinfectant has unique antimicrobial attributes.
- Degree of contamination. This affects the time required for disinfection and the amount of chemical required.
- Amount of protein-containing material present. Protein based materials absorb and inactivate some chemical disinfectants (“protein error”).
- Activity in organic matter and other compounds such as soaps. Soaps can react with chemical disinfectants and inactivate them (“soap error”).
- Type of chemical. It is important to understand the mode of action in order to select the appropriate disinfectant.
- Concentration and quantity of chemical. It is important to choose the proper concentration and quantity of chemical that are best used for the disinfection of each situation.
- Contact time and temperature. Sufficient time and appropriate temperature, which is proportional to the degree of contamination, must be allowed for action of the disinfectant.
- Residual activity and effects on fabric and metal.
- Application temperature, pH and interactions with other compounds must be considered.
- Toxicity to the environment and relative safety to humans that may be exposed.

- Cost.

Types of disinfectants considered

- Chlorine
- Iodophors
- Chlorhexidine
- Alcohols
- Peroxide
- Phenols
- Quaternary ammonia
- Aldehydes



Hypochlorites

Chlorine disinfectants as well as iodine disinfectants belong to the halogen group. Chlorine eliminates both enveloped and nonenveloped viruses. Chlorine also is effective against fungi, bacteria, and algae. Chlorine is not effective against spores. Household bleach (5.25 percent NaClO), a common source, is cheap and readily available. It is typically diluted using 1:128 to 1:32 with water.
Chlorine disinfectants corrode metals and deteriorate fabrics. Chlorine in high concentrations irritates the mucus membranes, eyes and skin. Organic material such as feces inactivate chlorine disinfectants, therefore, surfaces must be clean before using a chlorine disinfectant. In order to obtain maximum results with chlorine disinfectants they must remain in contact with surfaces for several minutes.
The pH of the water used for dilution should be between 6 and 8 to be effective.
Summary:

1) Provide wide germicidal activity and are relatively nontoxic
2) Limited activity when in the presence of organic matter

3) Poor residual activity and corrosive
4) Fair effectiveness as sporicidal agents
5) Effective at low concentrations for disinfecting objects
6) Low cost, but requires frequent applications
7) Can decolourise or bleach surfaces
8) Irritant to skin and mucous membranes
9) Unstable if left uncovered, exposed to light

Chloramine is effective by setting free chlorine (hypochlorite). In Europe, Chloramine T (Tosylchloramidnatrium) has 25 % chlorine available. For hand disinfection (1-2 %, but corrosive), alcohol is more efficient.

Iodine and Iodophor Disinfectants

Iodine and iodophors are simply chemical compounds. These compounds can be included in a time release formulation and with soaps (surgical scrubs). Simple iodine tinctures (iodine + R-OH) do not contain a cleaning compound. Iodine and iodophors are bactericidal, sporicidal, virucidal and fungicidal. Iodine, like chlorine, is inactivated in the presence of organic material and they must be applied multiple times in order to thoroughly disinfect. Iodine tinctures can be very irritating to tissues, can stain fabric and be corrosive.
“Tamed” iodines such as surgical scrubs and surgical disinfectants generally do not irritate tissues.
Summary:

1) Provide wide germicidal activity and are relatively nontoxic
2) Limited activity when in the presence of organic matter
3) Poor residual activity, corrosive, stains fabric and equipment
4) Fair effectiveness as sporicidal agents, but better than chlorine
5) Effective at low concentrations for disinfecting objects
6) Low cost but requires frequent applications

Chlorhexidine

Chlorhexidine, a biguanide, is widely used in the US.
Chlorhexidine is relatively nonirritating to tissues. Chlorhexidine, while considered bactericidal, virucidal and fungicidal, is less effective against these agents than many other disinfectants. Chlorhexidine maintains effectiveness in the presence of some organic material, but cleaning before application is recommended. To be effective chlorhexidine must remain in contact with the surface for at least five minutes. Hard or alkaline water will cause precipitation of the active ingredients necessary for disinfection.
Summary:

1) Wide germicidal activity, but ineffective against some important species
2) Some activity in the presence of organic matter
3) Some residual activity but must be in contact for at least five minutes
4) Fair effectiveness as sporicidal agents
5) Effective at low concentrations for disinfecting objects
6) Low cost but requires frequent applications
7) Nontoxic

Alcohols

Alcohols are commonly used topical disinfectants. They are effective against Gram+ and Gram– bacteria, and enveloped viruses. Alcohols are not effective against bacterial spores and nonenveloped viruses. Alcohols require time to work and they do not penetrate organic material. Alcohol irritates tissues and denatures protein which may promote bacterial growth in open wounds.
Summary:

1) Wide germicidal activity, noncorrosive, poses a fire hazard and irritating to tissues
2) Limited activity in the presence of organic matter and limited residual activity
3) Not effective against bacterial or fungal spores
4) Excellent when used at 70-95 percent concentration for disinfecting hands.
5) Low costs.
6) Widely available.
7) Flammable – do not use for disinfection of surfaces more than 1-2 m^2.

Oxidizing Agents

Working by reactive oxygen species, the following substances are basically used: Hydrogen peroxide, ozone and peracetic acid and related substances.

Peroxides such as hydrogen peroxide are often used to clean wounds. The activity of peroxides is greatest against anaerobic bacteria. Hydrogen peroxide is not virucidal and in some cases is damaging to tissues, resulting in a prolonged healing time. Hydrogen peroxide is useful for cleaning surgical sites after closure, but use sparingly to avoid penetrating suture lines which would inhibit healing.
Summary:

1) Moderate to wide germicidal activity, moderately corrosive and limited toxicity
2) Rendered ineffective in the presence of organic matter
3) Poor to limited residual activity
4) Not effective against bacterial or fungal spores
5) More valuable as a cleansing and deodorizing agent and are moderate in cost
6) Hydrogen peroxide is not an accepted disinfectant in Europe.

Ozone is only used for water disinfection.

Peracetic acid has a high oxidizing potential. It is broadly effective against microorganisms and is not deactivated by catalase and peroxidase, the enzymes that break down hydrogen peroxide. It also breaks down in food to safe and environmentally friendly residues (acetic acid and hydrogen peroxide), and therefore can be used in non-rinse applications. It can be used over a wide temperature range (0–40 ℃), over a wide pH range (3.0–7.5), in clean -in-place (CIP) processes, in hard water conditions, and is not affected by protein residues.
Peracetic acid kills microorganisms by oxidation and subsequent disruption of their cell membrane, via the hydroxyl radical (HO·).

Peracetic acid is a strong oxidizing agent and a primary irritant. Exposure to peracetic acid can cause irritation to the skin, eyes and respiratory system and higher or long-term exposure can cause permanent lung damage. In addition, there have been cases of occupational asthma caused by peracetic acid.
Peracetic acid can be explosive, must be down concentrated (and this can lead to mistakes) and is corrosive, the concentration is diminishing over the time. Also it is smelling like vinegar.
There are new substances available which are related to peracetic acid, but are firm substances without the high toxic potential.

Phenolic Disinfectants

Phenols are effective against bacteria (especially gram positive bacteria) and enveloped viruses. Phenols are not effective against nonenveloped viruses and spores.
Phenols maintain their activity in the presence of organic material and therefore are useful in disinfection of feces.
Phenolic disinfectants may cause skin irritation after prolonged exposure.
Summary:

1) Narrow germicidal range, relatively noncorrosive and, carcinogenicity cannot be excluded
2) Very effective in the presence of organic matter. Best disinfectant for feces.
3) Poor to limited residual activity
4) Not sporicidal, no activity against viruses
5) Low to moderate cost

Quaternary Ammonium Compounds (Quats)

Quaternary ammonium (QA) disinfectants contain NH4. The labels often list a form of ammonium chloride (AC) such as alkyl aryl, benzyl, didecyl, dimethyl, ethylbenzyl, octyl or a combination of different AC.
QA disinfectants are effective against Gram + and Gram - bacteria, and enveloped viruses. They are not effective against non-enveloped viruses, fungi and bacterial spores. QA compounds bind to organic material including soaps so the area to be disinfected must be cleaned and rinsed free of soap. Extremely hard water also deactivates QA disinfectants. QA compounds are generally low in toxicity, but prolonged contact can be irritating.
Summary:

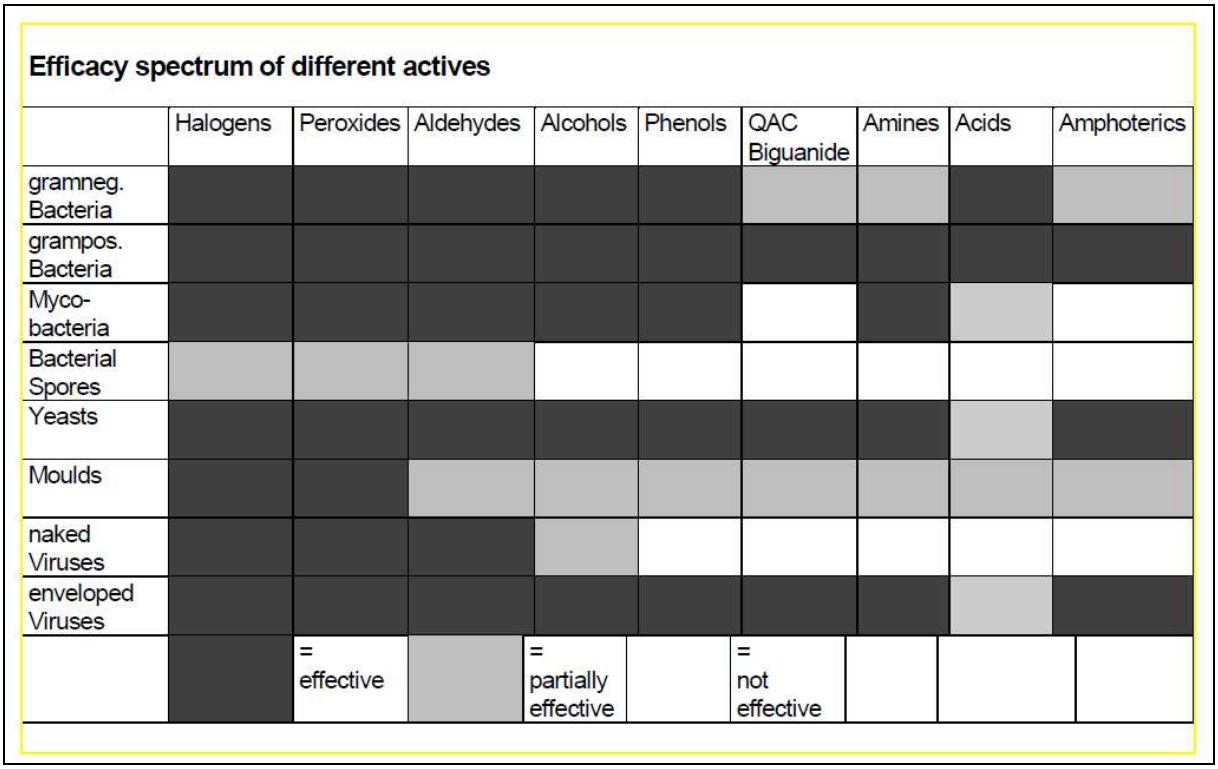
1) Relatively narrow germicidal range, noncorrosive and low toxicity
2) Reduced efficiency and residual activity in the presence of organic matter
3) Not sporicidal, effective against vegetative bacteria, fungi and viruses
4) Limited effectiveness in soaps, detergents and hard water salts
5) Good disinfectant for use on cleaned surfaces and low cost
6) Gram-negative bacteria can survive or grow in them

Aldehydes

Aldehydes have a wide germicidal spectrum. Glutaraldehydes are bactericidal, virucidal, fungicidal, sporicidal and parasiticidal. They have a moderated residual activity and are effective in the presence of moderate organic material. Formaldehyde is a very potent disinfectant, but can be highly toxic to people and animals because of its carcinogenic and allergenic potential.
Summary:

1) Wide germicidal activity is both sporicidal and fungicidal, effective against protozoa, is moderately toxic and poses a human health risk if improperly used
2) Slight to moderate efficiency in presence of organic matter
3) Slight residual activity
4) Most of these products are moderately expensive
5) Good material compatibility
6) Can cause skin allergies – use gloves!

Overviews



Compound	*Chlorine 0,01-5%*	*Iodine Iodophor 0,5-5%*	*Chlorhexidine 0,05-0,5%*	*Alcohol 70-95%*	*Oxidizing 0,2-3%*	*Phenol 0,2-3%*	*Quaternary Ammonium 0,1-2%*	*Aldehyde 1-2%*
Bactericidal	Good	Good	Very Good	Good	Good	Good	Good	Very Good
Virucidal	Very Good	Good	Very Good	Good	Good	Fair	Fair	Very Good
Envelope Viruses	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Non-Envelope Viruses	Yes	Yes	No	No	Yes	No	No	Yes
Bacterial Spores	Fair	Fair	Poor	Fair	Fair-Good	Poor	Poor	Good
Fungicidal	Good	Good	Fair to Good	Fair	Fair	Good	Fair	Good
Protozoal Parasites	Fair Strong Conc	Poor	Poor	Poor	Poor	Poor	Fair (Ammonia)	Good
Effective In Organic Matter	Poor	Fair	Fair	Fair	Poor	Good	Poor	Good
Inactivated by soap	No	No and Yes	No	No	No	No	Yes	No
Effective in Hard water	Yes	No	Yes	Yes	Yes	Yes	No	Yes
Contact Time (minutes)	5-30	10-30	5-10	10-30	10-30	10-30	10-30	10-600
Residual activity	Poor	Poor	Good	Fair	Poor	Poor	Fair	Fair

Sorts of disinfectants

The following disinfectants are **usually used**:

Disinfectants for hand

Alcohol solutions or gels. Water solutions are recommended by WHO and can be used very often without skin irritation. Gels may make sense outside of healthcare systeme – within healthcare systeme frequent use may make hand very sticky.

The usual application time for hygienic disinfection is 30 seconds, for preoperative disinfection at least 3 minutes.

Examples:

- Skinman soft (Ecolab)
- Spitacid (Ecolab)
- Sanitas gel hand sanitizer (Monos)

Disinfectants for skin (eg preoperative)

Alcohol solutions.

The usual application time is 15 seconds before blood taking and at least 1 minute (better longer) before puncture of sterile body areas (joints at least 3 minutes).

- Skinsept F (Ecolab)
- Skinsept G (Ecolab) (colored)

Disinfectants for surfaces.

They are used in concentrations and application time which must be given by producer. Usually, the area is not allowed to be used as long as it is wet, but not the full application time.

They have to be changed at least daily, better more often.

Aldehydes and oxygen producing agents are the strongest disinfectants for surfaces.

- Incidin plus (Ecolab) (containing glucoprotamin)
- Incidin aktiv (Ecolab) (containing oxygen producing agents)
- Incidin rapid (Ecolab) (containing aldheydes)

Disinfectants for instruments (manually)

They are used in concentrations and application time which must be given by producer. The application time has to be adhered to and after that the instrument has to be rinsed with water, best of all de-salted water.
They have to be changed at least daily, better more often.
Aldehydes and oxygen producing agents are the strongest disinfectants for instruments.

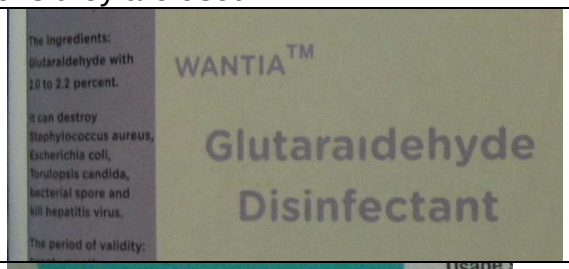
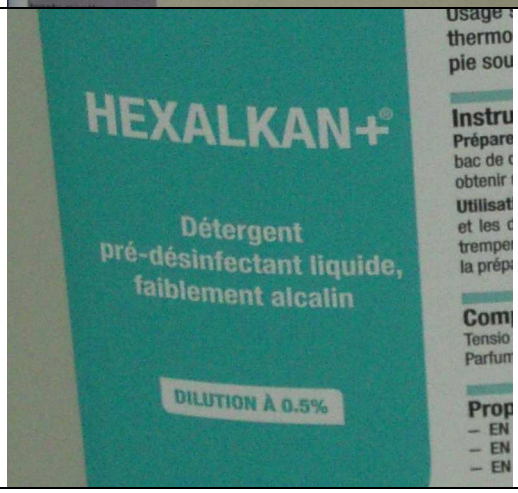
- Sekusept aktiv (Ecolab) (containing oxygen producing agents)
- Sekusept Extra N (Ecolab) (containing aldehydes)
- Sekusept Forte S (Ecolab) (containing formaldehyde)

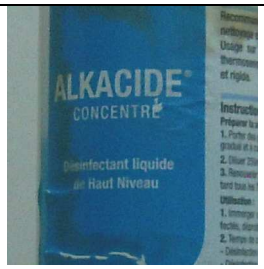
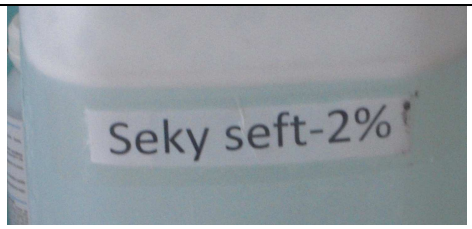
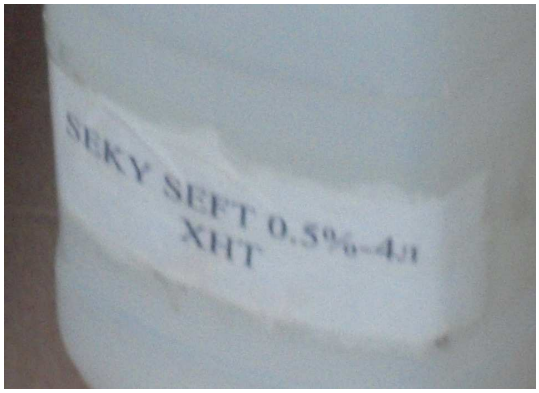
Disinfectants for instruments (washer disinfectors)

Recommendation of the washer disinfector company should be followed.

A critical look on the situation in Mongolia

The following list contains disinfectants which are used or were mentioned during visits of MeshHp project or are mentioned in the Order of MoH from May 2010.
The data cited are what we know and in most cases preliminary.
There are a lot of doubts about the disinfectioni quality of many of the products, especially in the way and under the conditions they are used.

Wantia Disinfectant - glutaraldehyde 2 %.	
Hexalkan+ detergent pre-disinfectand liquid. aldehyde free. alkaline pH 9.5 in diluted solution of 0.5 %. ingredients: propanol <10 %, QAT <10%.	

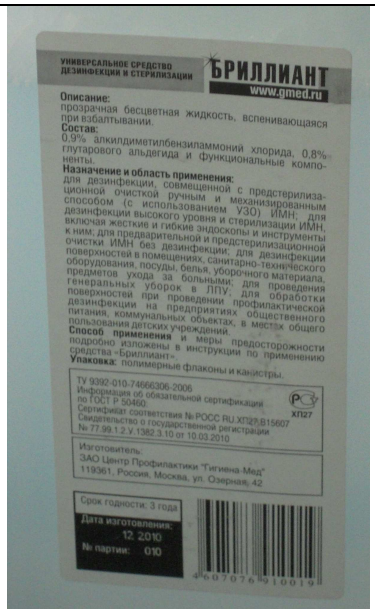
Alkazyme detergent pre-disinfectand proteolytique, alcalin (pH 10,5 in 0.5 % solution). no aldehydes. ingredients : Didecyldimethylamonium chloride < 5 %, Isopropanol, proteolytic enzyme.	
Alkacide Disinfectant. ingredients : Didecyldimethylamonium chloride < 5 %, Glutaraldehyde 0.17 %, Isopropanol.	
Sekusept active Basically disinfectant from Ecolab on basis of oxygen radicals (produced from Natriumpercabonate), also good cleaner. Order from May 2010 It is said that it contains glutaraldehyde, formaldehyde, gliozsal. Very contradictory to original Ecolab product! Product on the right might be a fake product from Russia.	 

Brilliant

Russian product.
Disinfectant.
ingredients :
alkyldimethylbenzylammonium chloride 0.9 %, Glutaricaldehyde 0.8 %.
Standing time 14 days if in closed container and in a dark place (seems much too long).
It seems that a solution is made (400 ml Brilliant for 10 l of water) so that the aldehyde concentration is going against zero.
For comparison:

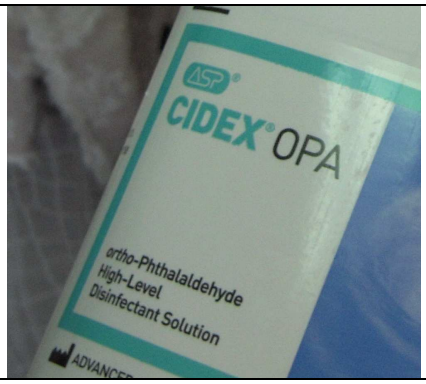
- Sekucid (Ecolab) contains 12 % Glutaral – if used as 4 % solution (30 minutes, virucidal), this means 0.5 % glutaral
- Gigasept FF (Schülke) contains 12 % succinic acid dialdehyde – if used as 4 % solution (30 minutes), this means 0.5 % aldehyde.
- If you prepare Brilliant solution (400 ml in 10,000 ml water) this means 0.03 % aldehyde.

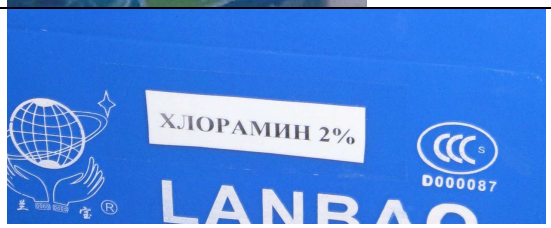
Order from May 2010
disinfection with 0.8 – 1 %.



Cidex Opa

US product.
Disinfectant.
Ortho-Phthalaldehyde.
Order from May 2010
It is said that it contains glutaraldehyde.
Disinfection with 2 %.



Mikro Quat Ecolab product. For floors and surfaces. Ingredients: 9 % Alkyl chloride dimethylbenzyl, also ethanolamine (1-5 %), alcohol (1-5 %). Used especially in kitchen and food industry, 1-2 % concentration.	
Spiritus No disinfectant.	
Chloramine Highly unstable in concentrated form. Setting free chlor (hypochlorite). High protein mistake – better use only on clean surfaces. Used especially for water disinfection. For hands only 1-2 % - but corrosive! Alcohol more efficient for hand disinfection. In 1 liter of water: 1 tablet = 0.5 %, 2 tablets = 1 %, 4 tablets = 2 %, 6 tablets = 3 %. Oldfashioned. Order from May 2010 recommended as prewash in department in 0.5-1 % solution for 30 minutes. available as powder and solution disinfection with 0.2 – 10 %.	
Hydrogen peroxide Order from May 2010 recommended as prewash in department in 3 % solution for 20 minutes. recommended as second stage cleaning in sterilisation unit in 1 % solution for 2 hours (made from 30-33 % concentration). disinfection with 1 – 6 %.	
Javelion	

Obviously Russian product. Based on cyanuric acid salts, seems to produce hypochlorous acid. Order from May 2010 recommended as prewash in department in 0.15 % solution for 20 minutes. disinfection with 0.015 – 0.3 %.	
Absolucid-oxy Order from May 2010 recommended as second stage cleaning in sterilisation unit in 0.5 % solution for 30 minutes disinfection with 0.5 %	
Virkon S Oxygen producing. Not good for surface disinfection, especially if not clean. Order from May 2010 Persulfate calium, disinfection with 1 – 3 %.	
Septodor forte (Glutamon) Russian product. QAT (>15 %) and glutaraldehyde (12 or16 % ?). For surfaces, water pipelines, food processing. Use as 0.5 % or 1 %.	

4 July 2012