Cleaning and Disinfection of Breathing Masks in Washing Machines

Simple, effective, practical and safe

VIMPEX

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2022-07-20. Washing process Cleanox disinfection

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Cleaning and disinfection of breathing masks

Breathing masks used by fire-fighting personnel are contaminated by many health hazardous substances, including carcinogenic substances, as well as different types of microorganisms. For simple, effective and safe cleaning and disinfection of breathing masks, Lejon Kemi has developed a holistic solution, consisting of detergent, washing bags, disinfectant and washing programme, which makes it possible to wash and disinfect breathing masks in washing machines. The development work and testing have been performed in consultation and collaboration with manufacturers of berathing apparatus and breathing masks, manufatureres of washing machines, chemists, external laboratories and other specialists in various fields as well as fire-fighting personnel. The development work has resulted in a detergent and disinfectant as well as a washing process which provide highly effective cleaning of residues of health hazardous substances and reduction of microorganisms according to independent laboratory analyses.

Lejon Kemi's washing and disinfection process for breathing masks

The washing and disinfection process developed by Lejon Kemi for use in washing machines comprises several steps. In the first step, the breathing masks are washed using Lejon Kemi's liquid detergent, FPG Wash, at 50° C for 40 minutes. The masks are then rinsed with plenty of water. After rinsing, the masks are disinfected with Cleanox at 40° C for 15 minutes. The process is concluded with three rinsing cycles with lots of clean water. During the washing process, the breathing masks are placed inside Lejon Kemi's microfibre bags, which protect the masks from mechanical damage and enhance the cleaning effect. The washing process is controlled by a special washing programme developed especially for cleaning and disinfection of breathing masks.

- **Detergent: FPG Wash. Dosage: 0.4 – 0.6 % depending on water hardness**
- **Washing temperature: 50° C**
- **Washing time: 40 minutes (Excluding rinsing)**
- **Disinfectant: Cleanox surface disinfectant. Dosage: 0.2 – 0,5 %**
- **Disinfection temperature: approx. 40° – 45° C**
- **Disinfection time: 15 minutes**
- **Total number of rinsing cycles: 4**
- **Total washing time approx. 1 hour 30 minutes**

Up to 12 – 14 masks can be washed together (14 – 18 kg washing machine)

Manual cleaning and disinfection of breathing masks and other items

Prepare a working dilution by mixing 0.5 % FPG Wash and 0.5% Cleanox in warm water and stir. For example, mix 25 ml FPG Wash + 25 ml Cleanox in 5 litres warm water (approx. 35° C– max 40° C). Soak the breathing mask/item in the dilution for about 15 minutes (max 30 min). Work over the surface with a soft brush or sponge and rinse carefully in clean water. **Drying:** Thorough drying of breathing masks at 55° C– 60° C for at least 30 minutes limits the growth of many types of microorganisms.

Note! Wear protective gloves of plastic or rubber. Do not wash breathing masks with built-in electronics in washing machines.

Lejon Kemi's washing bags developed for washing breathing masks

Photo 1. Washing bag in microfibre material

Photo 2. Washing bag and breathing mask

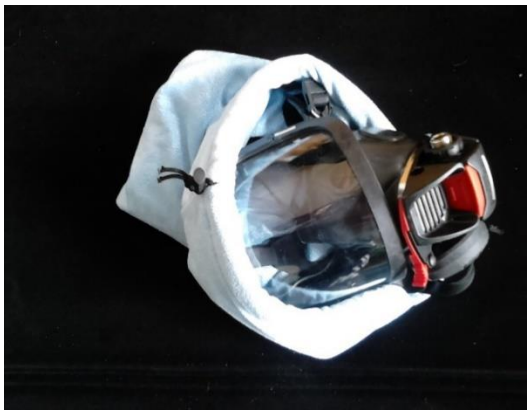

Photo 3. Washing bag and breathing mask

Photo 4. Breathing mask inside washing bag

Breathing masks before and after machine washing

Photo 5. Sooty breathing masks before washing

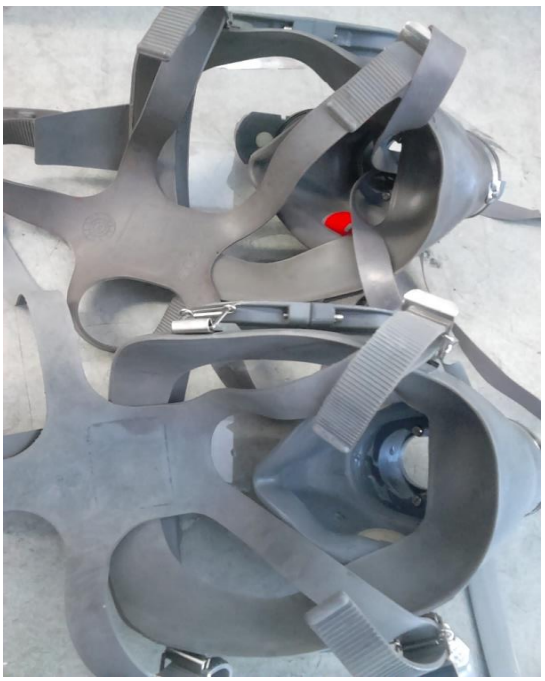

Photo 6. Breathing masks after washing

Analysis av polycyclic aromatic hydrocarbons (PAHs) after machine washing

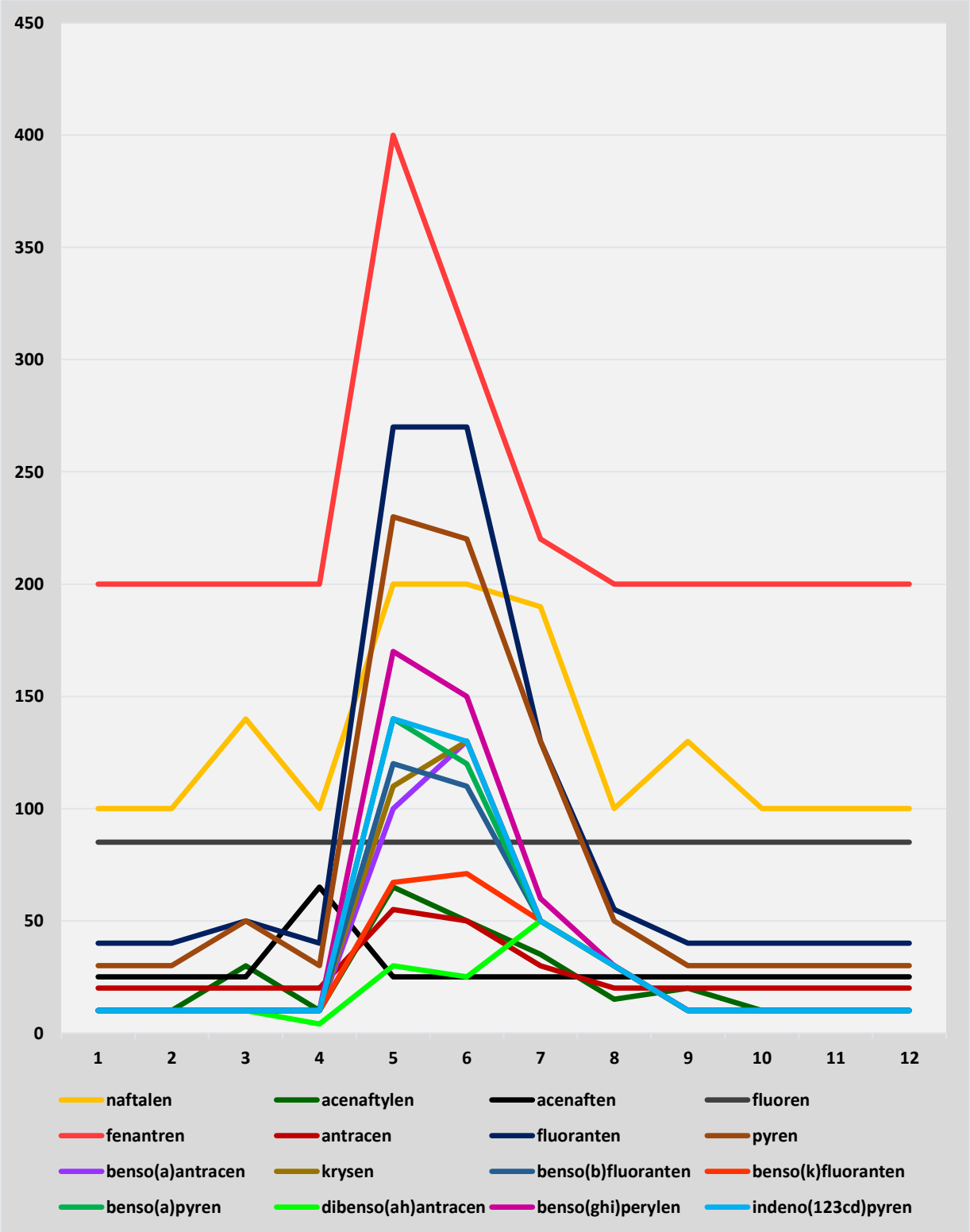

Diagram 1. Residues in **ng** (nanogram)/dm^2 of 16 analysed polycyclic aromatic hydrocarbons (PAH) on new unused breathing masks, on sooty breathing masks and on washed breathing masks.
1 – 4 concern analysis values from samples taken from clean **unused breathing masks**.
5 – 8 concern analysis values from samples taken from **sooty breathing masks.**
9 – 12 concern analysis values from samples taken from **washed breathing masks**.
Analysis method: Gas chromatography combined with mass-spectrometry (GC-MS).

Analysis av polycyclic aromatic hydrocarbons (PAHs) after machine washing

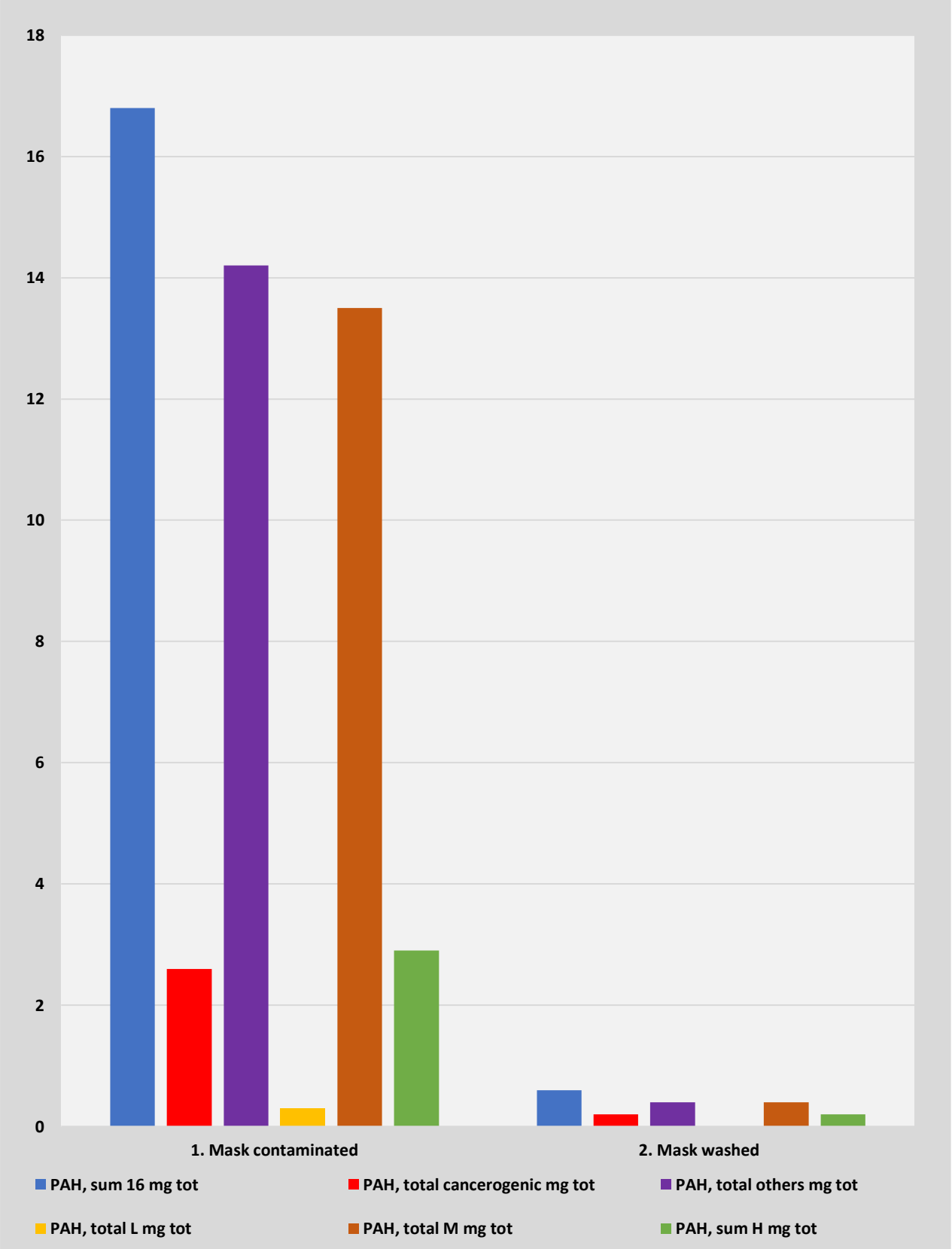

Diagram 2. Total Levels of PAH, in mg/dm^2, on unused and contaminated breathing masks before and after cleaning in a washing machine with Lejon Kemi detergent, FPG Wash and Lejon Kemi washing program designed for cleaning breathing masks at 50^o C. Analysis method: Gas chromatography combined with mass-spectrometry.

Reduction of microorganisms after machine washing with Cleanox

Microorganism	Reduction
Enterococcus Faecium	> 10^7
Escherichia Coli	> 10^7
Pseudomonas Aeruginosa	> 10^7
Staphylococcus Aureus	> 10^7
Aspergillus Niger	> 10^7
Candida Albicans	> 10^7
Mycobacterium Terrae	> 10^7

Table 1. Analysis of reduction of microorganisms after machine washing with Lejon Kemi's washing programme for breathing masks with disinfection step with 0.5 % Cleanox at 40° C for 15 min.
The washing process with the built-in disinfection step results in a very large reduction in various types of microorganisms.

Bactericidal effect of Cleanox at different temperatures

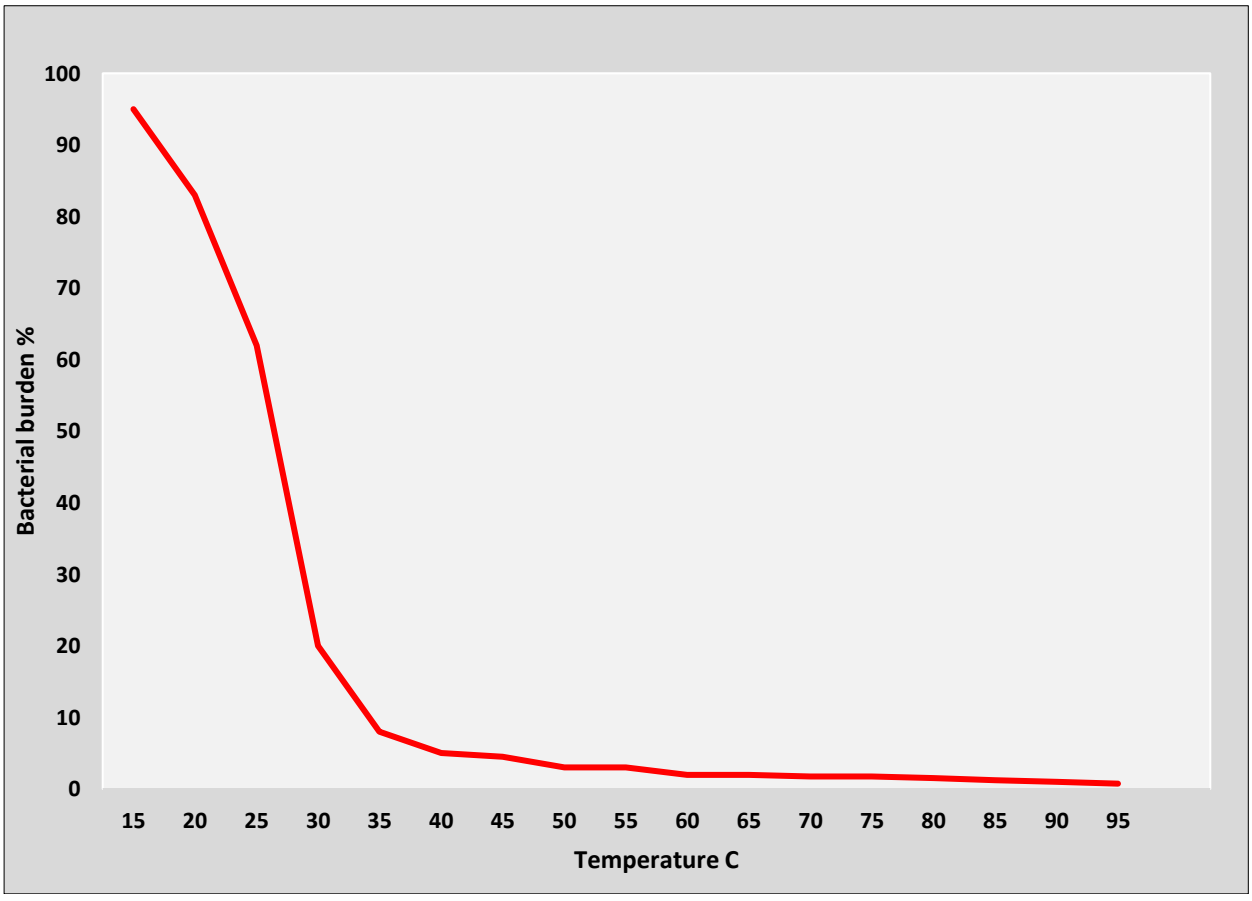

Diagram 3. The bactericidal effect on microorganisms increases quickly at increased temperature up to approx. 35° to 40° C after which it starts levelling off. Lower temperature in disinfection bath can be compensated for with longer contact time and/or a higher dosage. In most cases, it is sufficient with 1% Cleanox dosage and 30 minutes of contact time at 20° C for manual disinfection (see test results below, Tables 2-4).

Biocidal activity of Cleanox surface disinfectant

Tests performed in accordance with European Standards EN 1040, EN 1276, EN – fungicidal activity, EN 14476, EN WI 15, EN 13697, EN 1656 and EN 1657 with active substance in Cleanox converted into mg/l and % Cleanox.

PRODUCT TYPE 1

EN 1040 – Bactericidal activity (base activity)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	590 (0.059 %)	5 min	20 C
Staphylococcus Aeruginosa ATCC 15442	590 (0.059 %)	5 min	20 C
EN 1276 – Bactericidal activity (Suspension test: 0.3 % bovine albumin)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	5 900 (0.59 %)	5 min	20 C
Staphylococcus Aeruginosa ATCC 15442	5 900 (0.59 %)	5 min	20 C
Enterococcus Hirae ATCC 10541	5 900 (0.59 %)	5 min	20 C
Escherichia Coli ATCC 10536	5 900 (0.59 %)	5 min	20 C
EN – Fungicidal activity (Suspension test: 0.3 % bovine albumin)			
Fungus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Candida Albicans ATCC 10231	5 900 (0.59 %)	5 min	20 C
Aspergillus Niger ATCC 16404	206 000 (20.6 %)	15 min	20 C
EN 14476 - Virucidal activity (0.3% bovine albumin + 0.3 % ram erythrocytes)			
Virus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Poliovirus type 1	12 500 (1.25 %)	30 min	20 C
Poliovirus type 1	3 000 (0.3 %)	60 min	20 C
Adenovirus type 5	12 500 (1.25 %)	30 min	20 C
Adenovirus type 5	3 000 (0.3 %)	60 min	20 C
EN WI – Mycobactericidal activity (Suspension test: 0.3 % bovine albumin)			
Mycobacterium Terrae	4 706 (0.47 %)	15 min	40 C

Table 2. Test results for disinfectant for personal hygiene.

PRODUCT TYPES 2 AND 4

EN 13697 – Bactericidal activity (Surface test: 0.03 % bovine albumin)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	2 353 (0.24 %)	5 min	20 C
Staphylococcus Aeruginosa ATCC 11442	2 353 (0.24 %)	5 min	20 C
Enterococcus Hirae ATCC 10541	2 353 (0.24 %)	5 min	20 C
Escherichia Coli ATCC 10536	2 353 (0.24 %)	5 min	20 C
EN 13697 – Fungicidal activity (Surface test: 0.3 % bovine albumin)			
Fungus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Candida Albicans ATCC 10231	30 000 (3 %)	30 min	10 C
Candida Albicans ATCC 10231	5 883 (0.59 %)	15 min	20 C
Penicillium Verrucosum var. Cyclopium CIP 1186-79	120 000 (12 %)	15 min	20 C

Table 3. Test results in accordance with EN 13697 for disinfectant not intended for direct use on humans and animals (product type 2) and for disinfectant for surfaces that come in contact with foods and animal feed (product type 4).

PRODUCT TYPE 3

EN 1656 – Bactericidal activity (Suspension test: 0.3 % bovine albumin)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	30 000 (3 %)	30 min	10 C
Staphylococcus Aeruginosa ATCC 15442	30 000 (3 %)	30 min	10 C
Enterococcus Hirae ATCC 10541	30 000 (3 %)	30 min	10 C
Proteus Vulgaris ATCC 13315	30 000 (3 %)	30 min	10 C
EN 1656 – Bactericidal activity (Surface test: 0.03 % bovine albumin)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	58 824 (5.9 %)	30 min	10 C
Staphylococcus Aeruginosa ATCC 15442	58 824 (5.9 %)	30 min	10 C
Enterococcus Hirae ATCC 10541	58 824 (5.9 %)	30 min	10 C
Proteus Vulgaris ATCC 13315	58 824 (5.9 %)	30 min	10 C
EN 1656 – Bactericidal activity (Surface test: 1 % Reconstituted milk)			
Bacterium	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Staphylococcus Aureus ATCC 6538	58 824 (5.9 %)	30 min	30 C
Staphylococcus Aeruginosa ATCC 15442	58 824 (5.9 %)	30 min	30 C
Enterococcus Hirae ATCC 10541	58 824 (5.9 %)	30 min	30 C
Proteus Vulgaris ATCC 13315	58 824 (5.9 %)	30 min	30 C
EN 1657 – Fungicidal activity (Suspension test: 0.3 % bovine albumin)			
Fungus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Candida Albicans ATCC 10231	30 000 (3 %)	30 min	10 C
EN 1657 – Fungicidal activity (Suspension test: 1 % Reconstituted milk)			
Fungus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Candida Albicans ATCC 10231	30 000 (3 %)	30 min	30 C
EN 1657 – Fungicidal activity (Suspension test: 0.03 % bovine albumin)			
Fungus	**Cleanox mg/l (%)**	**Contact time**	**Temperature**
Candida Albicans ATCC 10231	30 000 (3 %)	30 min	10 C

Table 4. Test results in accordance with EN 1656, EN 1657 for disinfectant for veterinary hygiene (Product type 3).

The tests performed as shown in Tables 2 – 4 were done in accordance with European standards (EN) and consist of quantitative suspension and surface tests for assessment of bactericidal, fungicidal and virucidal activity of the active substance in Cleanox in different areas of application.

The result for the different areas of application in accordance with 1 – 4 is stated as the dosage of Cleanox in mg/l and the temperature and contact time which give the necessary reduction of microorganisms in accordance with the current requirements.

It is important first to wash the surfaces that are to be disinfected to achieve the best possible disinfection effect. After disinfection, the surfaces should be rinsed carefully with clean water. Careful drying of breathing masks at 55°- 60° C prevents regrowth of, for example, bacteria and mould.

Cleanox surface disinfectant

Cleanox is an effective disinfectant which acts against a wide spectrum of both gram-negative and gram-positive bacteria, fungi (mould) as well as several types of virus. Cleanox is especially designed for disinfection of breathing masks in a washing machine in which the masks are placed in washing bags produced by Lejon Kemi and washed using a special washing programme for breathing masks with a disinfection step. Cleanox can also be used together with FPG Wash for manual disinfection of most materials which tolerate water such as plastic, rubber, stainless steel, aluminium, glass, ceramics, clinkers, lacquered and painted surfaces as well as most types of textiles. The disinfectant has been tested in accordance with European Standards EN 1040, EN 1276, EN 14476, EN 13697, EN 1656, EN 1657, EN WI 15 and EN Fungicidal activity.

Environmental information

The ingredients used in the product are rapidly biodegradable in accordance with the OECD's criteria. The packaging is made of polyethylene/polypropene and can be recycled through sorting at source as hard plastic packaging.

Classification of Cleanox disinfectant in accordance with Regulation EC no. 1272/2008:

WARNING

Causes severe eye irritation
Use eye/face protection. IN CASE OF CONTACT WITH EYES: Rinse carefully with water for several minutes. Take out any contact lenses if this can be done easily. Continue to rinse. In case of persistent irritation, seek medical attention. IN CASE OF SKIN CONTACT: Wash with plenty of water. Remove stained clothes.
Contains: e-phthalimido-peroxy-hexanoic-acid 15-30 %, Disodium salt of 1.1-hydroxyethylidene diphosphonic acid < 5%.

Transport classification: Not classified as hazardous goods.

FPG Wash liquid detergent

FPG Wash is an effective and gentle liquid detergent, developed especially for washing of breathing masks and emergency suits (fire protection suits) used by fire-fighting personnel.
In connection with machine washing of breathing masks, the masks must be washed in specially designed washing bags from Lejon Kemi and in a washing programme developed specially by Lejon Kemi for washing of breathing masks. The detergent dissolves and removes soot, oil, grease and other dirt. It is suitable for washing of, for example, cotton, polyester, acryl, PBI, nomex, aramid, stainless steel, aluminium, glass, plastics, rubber, painted and lacquered surfaces. It contains additives that facilitate subsequent cleaning and additives that bind soot particles.

Environmental information

Surfactants and complex builders used in the product are rapidly biodegradable in accordance with the OECD's criteria and are primarily based on vegetable renewable raw materials. The packaging is made of polyethylene/polypropene and is recyclable through sorting at source as hard plastic packaging.

Classification of FPG Wash in accordance with Regulation EC no. 1272/2008:

DANGER

Irritates skin. Causes severe eye damage
Use protective gloves and eye protection. Avoid breathing in vapour or sprays. IN CASE OF SKIN CONTACT: Wash with plenty of water. Remove stained clothes. IN CASE OF CONTACT WITH EYES: Rinse carefully with water for several minutes. Take out any contact lenses if this can be done easily. Continue to rinse. Contact GIFTINFORMATIONSCENTRALEN (Swedish Poisons Information Centre) or a doctor. **Contains:** Fatty alcohol ethoxylates C12-C14, EO 3-10) < 15 %), 2-ethyl-hexyl-sulfate-sodium salt < 10 %.

Transport classification: Not classified as hazardous goods.

FPG Washing Bags for machine washing of breathing masks

Lejon Kemi's unique washing bag has been specially developed for machine washing of breathing masks. The bag provides good protection against mechanical damage during washing, and, during the washing cycle, the microfibre material of the bag contributes with effective and gentle mechanical processing of dirty surfaces on the breathing masks. The washing bag must be used together with Lejon Kemi FPG Wash and Lejon Kemi's washing programme for washing of breathing masks.

Environmental information Lejon Kemi washing bags

The washing bag is made of microfibre material environmentally approved in accordance with the Nordic Environmental Labelling Agency's criteria (the Nordic Swan Ecolabel), Class 2.

Products, Packaging and Art. No.

FPG Wash liquid detergent. 10-litre container: Item. no. 30 0100 01
FPG Wash liquid detergent. 25-litre container: Item no. 30 0250 01
Cleanox surface disinfectant: 10-litre container. Item no. 85 0100 01
FPG Washing Bags for breathing masks: 6 bags per customer pack. Item no.: 31 0006 01

Washing programme for washing and disinfection of breathing masks

Installation of dosage pumps and of Lejon Kemi's washing programme for washing and disinfection of breathing masks can be ordered from, for example Electrolux Professional.

Lejon Kemi AB

Lejon Kemi AB is a Swedish company specialising in applied surface- and cleaning chemistry as well as product development. The company has more than 35 years of experience in development and production of chemical-technical products for degreasing, cleaning, washing, disinfection and personal hygiene for industrial and occupational use as well as for private consumer use. Lejon Kemi works within a network of partners which produce, market and sell products developed by Lejon Kemi in a number of countries. In Sweden, Lejon Kemi's products are produced in Piteå in a factory with good capacity, high flexibility and a quality assurance system that ensures a high even quality as well as full traceability throughout the production chain. Lejon Kemi's warehouse is located in Hallstavik in the Municipality of Norrtälje, approximately 100 km north of Stockholm.

Since 2011, Lejon Kemi has worked with the development of detergents and cleaning methods for decontamination of health hazardous and carcinogenic substances from equipment used by fire fighters. The development work has been performed in consultation and collaboration with breathing apparatus manufacturers, external analysis laboratories, chemists, toxicologists, manufacturers of specially designed PPP dish washers and washing machines as well as several fire departments in Sweden. The development work has resulted in a wide product range for cleaning and decontamination of, for example, breathing apparatus, breathing masks, emergency suits, fire hoses, tools, machinery and vehicles. Lejon Kemi products are sold in several countries for example in Sweden, Norway, Denmark, Iceland, Germany, Netherlands and Slovenia.

Lejon Kemi AB - Development and production of environmentally friendly chem.-technical products
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