

Chemical and microbiological decontamination of firefighting gear with Hygio a40 Medi

Hygio a40 Medi is a powerful ozonizing device for cleaning and disinfection of firefighting clothing, equipment and gear. Always follow manufacturers recommendations and instruction presented in the User Manual when operating Hygio devices.

Neutralization of Polycyclic Aromatic Hydrocarbons (PAH)

Research shows that PAH exposure is a key risk for cancer in firemen's work. It is important to understand that clean and proper conditions and procedures at the fire station are equally important for minimizing the PAH exposure as the conditions and procedures during the active mission at a fire, or another emergency site.

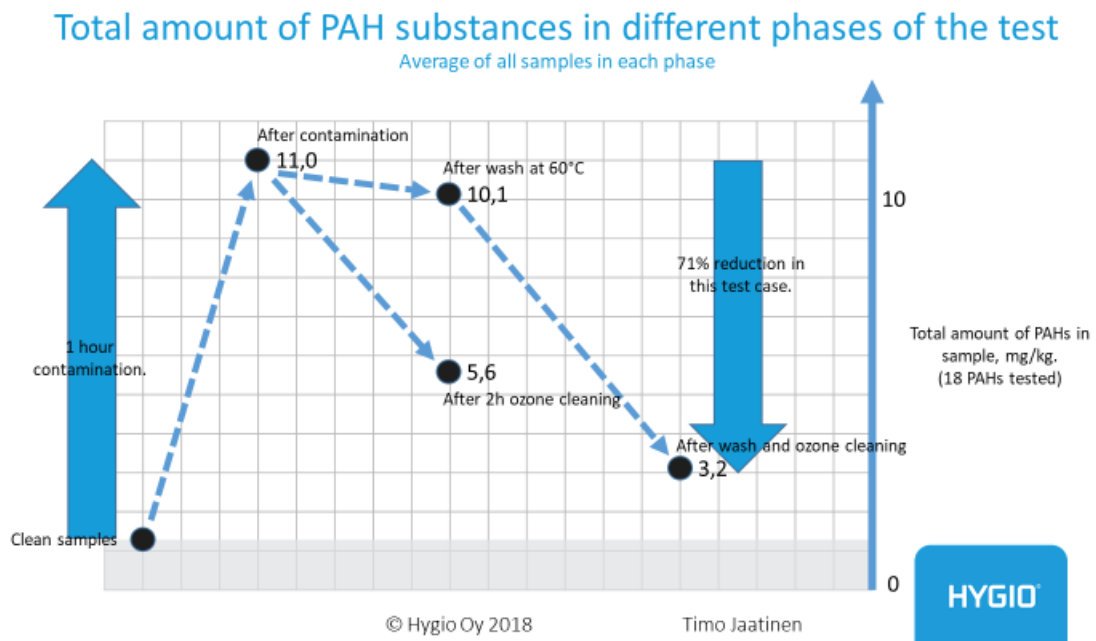
Ozone is among the most powerful oxidizing agents known. Ozone reacts with long carbon chained molecules, like hydrocarbons, by cutting them into smaller, less harmful compounds. The end results of ozonizing process are clean oxygen, carbon dioxide, water and neutralized molecules.

PAH decontamination efficiency of Hygio a40 Medi

PAH decontamination efficiency of Hygio a40 Medi has been tested according to AfPS-GS-2014-01 and REACH Regulation 1907/2006 standards for the following substances: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(e)pyrene, Benzo(ghi)perylene, Benzo-(j)-fluoranthene, Benzo-(k)-fluoranthene, Chrysene, Dibenzo(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene and Pyrene.

The test shows that a powerful decontamination of PAH substances is achieved using the 2 hour program of Hygio a40 Medi. The test also showed that normal wash at 60°C alone can't efficiently

clean PAH contamination and the best decontamination results are achieved by combining normal 60°C washing and 2h ozonisation. This is the best-known cleaning method for regular use in the fire stations for improving firemen's health.



Microbial disinfection

Ozone is one of the best disinfection agents. Ozone reacts with different compounds of microbe's cell wall (proteins and lipids, for example) causing damage to the cell wall and thereby destroys the microbe. Ozone also causes damage to microbe's DNA structure further enhancing the disinfection efficacy of ozone. The microbe is killed and becomes harmless.

Ozone disinfection effectivity depends on the material where the microbe is attached to. For example, microbes attached to a hard surface are most easily killed by ozone but microbes inside of a tight porous structure (like thick, tightly woven fabric) are well protected against gaseous disinfectants. It is generally considered that gaseous disinfectants are effective for up to 5 cm into a porous materials.

Ozone disinfection's effectivity depends on the structure of the microbe. For this reason, the disinfection result of different microbes can be estimated according to their physical structure. For example, bacteria in the gram-positive and gram-negative groups have different cell membrane structure and different bacteria belonging to the same group react similarly to ozone disinfection.

Disinfection capabilities of Hygio a40 Medi device have been tested by a third-party laboratory. The tests have been done with several microbes with different type of cell structure microbes. One-hour (1h) program was used in the test.

Microbiological disinfection – Hygio 1h program

Type	Test microbe	Test result correlates with these microbes, for example	Reduction of growth / log cfu/pcs	Disinfection result, killed %
Sporicidal bacteria	<i>Bacillus</i> spores	<i>Clostridium difficile</i> <i>Bacillus cereus</i> <i>Clostridium botulinum</i>	1,4	96%
Gram-positive	<i>Staphylococcus epidermidis</i>	MRSA Listeria, MRSP Streptococcus	>5,2	99,999%
Gram-negative	<i>Escherichia coli</i>	Salmonella Norovirus ESBL, EHEC All other viruses	3,9	99,99%
Yeasts	<i>Candida albicans</i>	Cryptococcus	1,6	97%
Molds	<i>Cladosporium sphaerospermum</i>	Aspergillus Fusarium	1,8	98%



These 1h disinfection results are measured with textile samples. Results are even better when disinfecting microbes from hard surfaces, such as telecommunication equipment or tools.

Hygio recommends that fire station use the 2h program in their decontamination cleaning because it will give better PAH decontamination compared to the 1h program. When using the 2h program, the microbiological disinfection results will be significantly better than in the test summary where 1h program was used.

Compared to the 1h test results, longer program will always give better microbiological disinfection. With 2h and 6h programs, the disinfection result will approach 100%, but will theoretically never reach it fully. In practical terms, Hygio will always give very powerful disinfection results.

Recommended cleaning process for fire stations

Hygio recommends that systematic cleaning practices and processes are used in fire stations for keeping clean of firemen's clothing and gear, rescue and fire-fighting equipment, vehicle and the station building spaces. The practices should be suited to local needs and conditions.

In addition to systematic cleaning, after each rescue or fire-fighting mission a practical assessment should be carried out to determine the level of decontamination needed.

- Minor missions (small traffic accident, e.g.) may require no decontamination activities in addition to normal routine cleaning.
- If the emergency mission involves any presence of fire, smoke, chemical (including hydrocarbons/ fuels) or microbiological contamination, the following practices should be followed:
 - a. Always use protective clothing and equipment at the mission site, even in supporting and managerial duties.
 - b. After the active mission is finalized, contaminated clothing should be changed already at the mission site to clean ones. To achieve best contamination protection results, all contaminated clothing, gear and equipment should be packed for cleaning already at the mission site.
 - c. Personal clothing and gear to be decontaminated following these steps:
 1. For all washable clothing and gear, wash at 60°C.
 2. Power drying to fully dry.
 3. Ozonizing in Hygio a40 Medi using the 2h program.
 - d. Rescue and fire-fighting equipment are cleaned respectively after each mission.

Other recommendations

Hygio recommends fire stations to follow best practices in their health and safety work, for example, the Finnish "Clean Fire Station Model" and the Swedish "Skellefteå Model".

In occupational health & safety and decontamination issues local authorities give instructions and advice.

In microbiological disinfection issues local health authorities and medical infection specialists give instructions and advice, also in use of ozone cleaning. If highly infectious microbes are suspected to be a possible health risk, you should always contact your local medical infection specialists for additional instructions.