

## New undergarment provides high protection against carcinogenic PAHs

*Now available is the protective undergarment developed by CPP Garments based on a patented fabric with activated carbon filter. In September, it was presented by Thomas Dederling of CPP Garments, Anders Cederberg of the Firefighters' Cancer Fund, Lars Ekberg from CIT Management AB, and the entrepreneur Hans Andersson.*

**Firefighters and increased risk of certain forms of cancer. A connection that no one wants to see, least of all Anders Cederberg, fire chief in Stockholm and a well-known figurehead for the Firefighters' Cancer Fund. Many years of work for a safer working environment have now resulted in protective undergarment that only allows one thousandth of the tested PAHs present in fire smoke to pass through.**

On September 23, it was presented to about 20 invited guests.

– Finally, we are here," Anders Cederberg concludes.

He doesn't say much, standing next to a mannequin dressed in CPP Garments' unique protective undergarment in a conference room in Stockholm. But Anders Cederberg, who, together with entrepreneur and educator Hans Andersson, has been involved in the entire journey – from idea to finished undergarment – has much more to tell.

– The fact that firefighters are at greater risk of certain forms of cancer has been genetically analyzed, we know that," says Anders Cederberg, referring to studies from, among other places, the USA, where prospective legislation means that it is the employer's responsibility to prove that a cancer diagnosis is not linked to the firefighter profession.

– Our protection against inhalation is okay with today's protective equipment; it's the skin that is the way in.

"Cancer-causing substances that are mutagenic are stored in fat depots and change our DNA," explains Anders Cederberg.

### For military use

The journey began back in 2013 when Anders Cederberg was contacted by Hans Andersson, who had noticed a connection between cancer and firefighters exposed to dangerous fire smoke.

– At that time, there was undergarment for military personnel in CBRNE forces that protected against chemical warfare agents and even sarin in liquid form," Anders Cederberg explains.

Couldn't that technology be used to protect firefighters too?

– A year later, we went to Germany to meet with the company's management that manufactures the fabric and explained our needs. It took them 30 minutes to deliberate and give the decision that we can solve this. Since then, we have been a thorn in the side of the industry to stand here today with the results of German and Swedish innovation, a world-unique undergarment," says Anders Cederberg.

In 2019, extensive testing began, starting with testing the material in the undergarment to see if it met the presumed dimensions. Over the next two years, the finished product was tested in the form of a two-piece protective undergarment with a hood and a standard undergarment of the type used by the rescue service today. The latest tests were completed as recently as August of this year.

Learn more about how they were conducted and the results in the article next to this one.

### A tool in the toolbox

The price tag for a protective undergarment is approximately 11,000 SEK each, compared to about 500 SEK for a conventional undergarment. Since the lifespan of the protective undergarment is limited, it can become expensive for the rescue services.

It is the total amount of PAH that the undergarment has been exposed to that determines its lifespan. The undergarment can therefore be used for a limited number of smoke dives before the protection becomes so low that it is considered consumed. So far, tests have been conducted on protective undergarment used in 20 smoke diving exercises, including intermediate washes.

– An important parameter in the tests is that each smoke dive lasted for 25 minutes in dense fire smoke. A normal apartment fire is extinguished in about ten minutes and ventilated. It is the cumulative exposures and how dense the fire smoke is that determines the lifespan. In other words, it can be washed 200 times without the active carbon losing its effectiveness.

– We should see this undergarment as yet another tool in the toolbox, not something we should put on for every alarm and then wash. For automatic alarms or a traffic accident, the standard undergarment is perfectly fine," concludes Anders Cederberg.

### Challenging tests show:

#### Only one thousandth of the measured PAH on the skin.

**In the tests with new undergarments of both standard type and the new protective undergarment, the results showed that the protection factor for the latter was 1000, which means that one thousandth of the measured PAHs in the smoke was present on the skin. In a standard type undergarment, the corresponding figure was 15.**

Lars Ekberg from CIT Energy Management and Chalmers shared information about the tests and the results from the three rounds of testing conducted on behalf of the Firefighters Cancer Fund.

"We chose to test 33 pre-selected PAHs, all of which are carcinogenic and pose a documented increased risk of cancer upon exposure," explained Lars Ekberg. The first test was a pure material test conducted with samples of each undergarment applied under samples of the turnout gear. The textile samples were mounted on hatches to a container where wood was burned.

### Full-scale smoke diving tests

The subsequent two rounds of testing were conducted with new undergarments of both types and after the new, adsorptive\* undergarment had been used in 20 smoke exercises and washed in between. In both tests, which were conducted at the Guttajön training field, a large number of full-scale smoke diving experiments were conducted in containers fired with wood material.

The smoke diving test subjects wore their respective undergarments under the turnout gear and dove in pairs for 25 minutes, rested for the same duration, and then dove for another 25 minutes. So-called PUF samplers made of polyurethane foam were placed on the thighs, upper arms, chest, and

neck to measure PAH levels. Additionally, another PUF sampler was placed outside the clothing to compare PAH levels in the smoke.

### Continued research

After the smoke dives, exhaust tests were conducted to determine the amounts of PAHs emitted from the clothing using PUF samplers.

"After 30 minutes in sealed plastic bags, we observed that the protective undergarment emitted one-tenth of the amount of PAHs emitted by the standard undergarment," said Lars Ekberg.

Now, the scrutiny of the latest test results remains, where the adsorptive undergarment has been washed 20 times and used in smoke diving 30 times.

"After ten uses, we reached a protection factor of 600, still far above the 15 that the standard undergarment has. We want to see how far below 600 we go after another ten smoke dives with intermittent washes to understand when the activated carbon filter is saturated with PAHs and thus the undergarment should be replaced. The question remains about what level of protection factor we should consider as adequate protection," said Lars Ekberg, adding that funding has been sought for further research. Among other things, they will investigate how the material performs in other types of operations and risks.

\*Adsorption is easily confused with absorption. Adsorption simply means that a molecule attaches to another material instead of being absorbed and evenly distributed, such as when water is absorbed by a sponge.