

# PRESS RELEASE

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Fraunhofer ITWM vs. Corona: With Mathematics Against the Crisis

## **RECOMMENDED WEARING TIME OF PROTECTIVE MASKS - RESEARCHERS MAKE BETTER PREDICTIONS POSSIBLE WITH SIMULATIONS**

**How long can you wear a protection mask? When will you have to change a soaked mask? Researchers of the Fraunhofer ITWM tackle these question using mathematical models and computer simulations. It is important to take into account not only the type of mask and the filter material, but also the physical stress level and personal features of the wearer.**

The Covid-19 pandemic has led to an increasing awareness of the use of face masks and respirators in order to protect the wearer or the surrounding people against infections. Terms like FFP (filtering face piece), previously mainly known to experts, have become a part of the everyday language. The shortage of masks and the numerous initiatives for the production of DIY masks have given rise to a broad discussion about the suitability of materials to prevent the spreading of the disease. For people working in health and nursing care, the question about the maximal wear time of protection masks is of vital importance.

### **A Soaked Mask Has to Be Replaced – but How Long Does That Take?**

A reliable protection does not only depend on the filtration properties of the mask material. It is known that moisture penetration decreases the filtering efficiency and therefore, the safety is reduced. Humidity and body heat enhance the microbial contamination on the wearer's side of the mask. The most critical state is reached when the mask is imbrued entirely (moisture breakthrough), since the moisture can serve as an "infection bridge" spanning across the depth of the filter material. This holds for highly efficient filter masks (e.g. FFP-2), but even more so for masks to protect others: Coughing and sneezing can lead to the detachment of potentially infectious droplets from the outer surface which will then spread into the vicinity.

### **Simulation for Efficient Use and Demand-Oriented Distribution of Masks**

Most wear time recommendations are reference values, based on an average usage scenario. The speed and intensity of the moisture penetration of a protection masks depends heavily on the physical stress level of the wearing person. The time it takes until the moisture breaks through cannot be derived in a simple way ("rule of thumb") from the physical activity, which is usually fluctuating. In general, a visual check of the

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mask is neither feasible without aid nor reliable enough to detect a moisture breakthrough.

Utilizing adapted models and simulations, researchers of the Fraunhofer ITWM are working on improved predictions of the wear time by taking into account the physical activity profile of the wearer. This assists people with both a safe, optimal use by changing masks in time and to avoid wasting masks that could have lasted longer. The improved predictions enable – amongst others – hospitals and nursing care facilities to adapt their demand planning to their staff's activity profiles.

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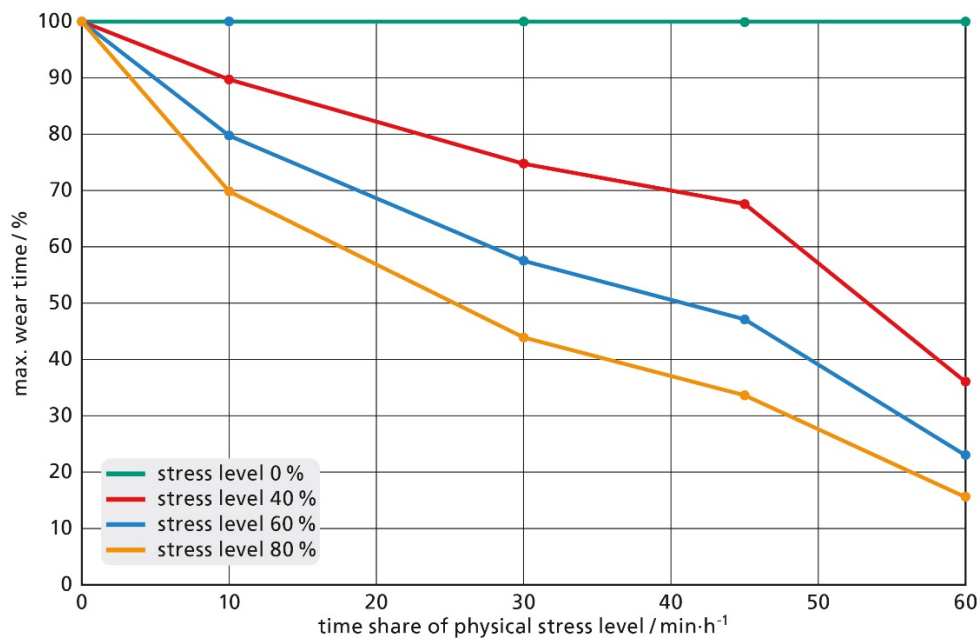
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**Results Also Relevant for Product Development After Corona Crisis**

"Beyond the current pandemic, these methods are also relevant for the product development. Especially in the case of multi-layered filter materials, optimal combinations can be found by simulation, reducing the need for extensive tests of prototypes", says Dr. Ralf Kirsch, head of the filtration and separation team at Fraunhofer ITWM.

**Picture**

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Relative reduction of recommended wear time depending on intensity level and time share of physical stress. Reference value is the wear time at rest or light labour. In the present example, a hospital or a nursing care facility could deduce that staff members doing the most exhausting work need to change their masks up to five times more frequently than people working in the administration or at the reception. @ Fraunhofer ITWM

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**The Fraunhofer Institute for Industrial Mathematics ITWM**

The Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern is one of the largest research institutes for applied mathematics worldwide. We see it as our task to further develop mathematics as a key technology and provide innovative impulses. Our focus is on the implementation of mathematical methods and technology in application projects and their further development in research projects. The close cooperation with partners from industry guarantees the high practical relevance of our work.

Its integral components are consulting, implementation and support in the application of high-performance computer technology and the provision of tailor-made software solutions. Our various competences address a broad spectrum of customers: automotive industry, mechanical engineering, textile industry, energy and finance. These customers also benefit from our excellent networking, for example in the Simulation and Software-based Innovation Service Centre.

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