

IMT schools have focused on the issue of masks, looking at the certification of their effectiveness, recycling, and more.

Since the beginning of the crisis, IMT has been making the most of the scientific and technological expertise of its schools' laboratories to meet society's needs in various sectors of application.

Masks and visors are essential in the fight against the pandemic. They are widely used by health professionals and now by the general public. IMT's graduate schools began working on the issue very early on. They have mobilized their teams of faculty members and their laboratory equipment, both to meet urgent needs and to help develop new manufacturing sectors in France. IMT is recognized for its excellence in innovation, with a research model that combines academia and industry, developing solutions that can be quickly implemented.

Certification of the effectiveness of masks: a first in France!

The testing facilities set up jointly by the Centre for Biomedical and Healthcare Engineering (CIS) at **Mines Saint-Etienne** and its partners at Jean Monnet University is currently the only facility certified by the French National Agency for the Safety of Medicines and Health Products (ANSM) to validate the effectiveness of bacterial filtration of surgical and consumer masks. Manufacturers who are currently developing new mask manufacturing processes can thus have them validated by this testing center and then use the CE marking. This is therefore a key contribution to the development of national production and to supplying the health system in particular. The approval workload plan has been saturated with requests for several weeks now and will remain so until August.

Approval of recycled masks

Surgical masks and FFP2 protective masks are mainly single-use masks. At the height of the epidemic, 40 million a week were needed in hospitals alone. Faced with such large volumes, the question of reusing them over a period of a few hours including short breaks, or recycling them at the end of this wearing period arose in order to allow safe use for the wearer and their entourage while limiting the impact on the environment and reducing the risk of shortages. A national consortium was thus set up in March at the initiative of Grenoble University Hospital and Grenoble Alpes University, in conjunction with other research players abroad, to explore and validate the different methods of microbiological decontamination of masks with a view to recycling them. In this context, the Energy Systems and Environment Department (GEPEA laboratory) of **IMT Atlantique** soon joined the French research consortium to provide its expertise on aerosol filtration performance and mask breathability, later joined by the Health Engineering Center of **Ecole des Mines de Saint-Etienne**.

The consortium thus explored various decontamination methods depending on the type of mask (including washing with a detergent at 60 or 95°C, autoclaving at 121°C, irradiation with gamma or beta radiation, treatment with ethylene oxide, supercritical CO₂ or heating to temperatures above 70°C in dry or wet heat) and used the IMT schools' testing facilities to measure whether the filtration performance of these masks still met the standards. Others check to see if the treatment has eliminated the viruses and bacteria present on the masks. This work has shown that, depending on

the type of mask, certain decontamination treatments may or may not be appropriate, in particular based on whether or not they have reduced the filtration capacity.

This work, which has become less urgent after the end of the peak of the pandemic, must continue in order to carry out tests in real conditions, develop recycling channels or in-situ treatment devices based on specifications. In the case of reuse of these masks in a medical environment, the ANSM will have to validate the tests carried out (recommendation of the High Council of Public Health)

Approval of barrier masks

In connection with the Directorate General for Enterprise's mission to set up a national production line for barrier masks for professionals not directly exposed and for the general public, the testing facilities and test protocol set up in the Energy Systems and Environment Department (GEPEA laboratory) at **IMT Atlantique** is currently being inter-compared with the Directorate General of Armaments' testing facilities in order to contribute to the qualification tests of the performance of these new masks before they are placed on the market.

Solidarity-based manufacturing

IMT's graduate schools, which have research laboratories for additive manufacturing have collectively produced a very large number of visors or shields (more than 18,000 by **ITM Mines Alès** alone, where they were produced first by additive manufacturing and then more intensively by injection molding using a mold adapted by CFO Outillages. The Materials Center at IMT Mines Alès has just handed over to a local company).

IMT Mines Alès has also supplied the community of manufacturers with raw materials so that they can continue to produce the visors on their 3D printers.

About IMT www.imt.fr

Institut Mines-Télécom is a French public higher education institution under the aegis of the Ministry for the Economy, Industry and Digital Sector. It includes 8 engineering schools, 2 subsidiary schools and a network of strategic affiliated partners. Its activities in the fields of engineering and digital technology contribute to training engineers and managers, developing research partnerships, promoting innovation and supporting economic development. Always attentive to the economic world, IMT combines strong academic and scientific legitimacy, close corporate relations and strategic positioning in the key transformations of the 21st century: digital technology, industry, energy and ecology, and education. IMT is a founding member of the Alliance for the Industry of the Future and co-founder of the Franco-German Academy for the Industry of the Future with Technische Universität München (TUM). It is recognized by 2 Carnot Institute certifications for the quality of its partner-based research. Each year, IMT trains over 12,000 students, concludes nearly 70 million research contracts, and hosts some 100 start-ups in its incubators.

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