



# CSIR-Central Mechanical Engineering Research Institute

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### High Efficiency Hydrophobic Three-Layered Facemask:

To combat pandemic COVID-19, protection and the control measures are the key factors. In this regard, wearing of facemask is highly desirable personal protective equipment not only for frontline warriors but also for common people. We must think about the technoeconomic solution apart from the quality of the product. Keeping these in mind, CSIR-CMERI has developed a low-cost but high efficiency three-layered facemask, which is believed to be efficient enough to provide much needed protection.

The facemask is composed of two hydrophobic non-woven polypropylene (PP) layers in the outer and inner side and a 'High Efficiency Particulate Air' filter in the middle. While the hydrophobic PP layer will restrict the contaminated droplets to enter or transmit, inside filter is capable to restrict particulates of as small as  $0.3\ \mu\text{m}$  effectively. The FESEM images in Figure 2 show the distribution of polypropylene fibers in the inner and outer layer of the developed face mask and inner layer contains very dense distribution of nonwoven fibers. It is anticipated that such distributions of fibers and choice of filter components will give rise to high efficiency facemasks.



Figure 1: High efficiency three-layered facemask by CSIR-CMERI

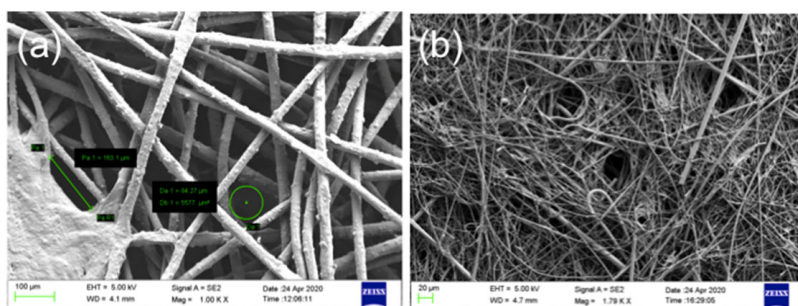


Figure 2: Field-Emission Scanning Electron Microscope of (a) PP layer as the outer and inner layer and (b) Middle layer filter

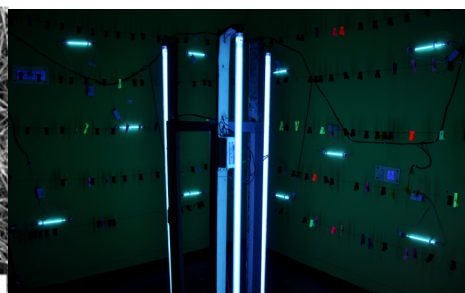


Figure 3: UV Sterilization

In order to check all the important parameters, the performance of the developed facemask has been evaluated by the South India Textile Research Association (SITRA). The performance of the developed mask based on the report received from SITRA are tabulated below:

Table 1: Performance of developed facemask based on the test reports from SITRA.

Sl. No.	Tests / Standards	Results
1.	<b>Bacterial Filtration Efficiency (ASTM F 2101)</b> Test Organisms Used : <i>Staphylococcus aureus</i> ATCC 6538 Mean particle size of challenging aerosol: $3.0 \pm 0.3\ \mu\text{m}$ Flow rate of aerosol: 28.5 L/min	99.9%
2.	<b>Particulate Filtration Efficiency at 0.3 Microns (ASTM F2299/F2299M-03 (2010))</b>	95.46%
3.	<b>Differential Pressure (IS 16289:2014 Annexure C)</b>	43.0 Pa/cm <sup>2</sup>
4.	<b>Splash Resistance (ASTM F1862/F1862M-13)</b> at 160mmHg	Pass
5.	<b>Flammability (16 CFR Part-1610)</b>	Class 1

Based on the test reports, the developed facemask can be recognized as a high efficiency facemask, with the bacterial filtration efficiency as high as 99.9% and particulate filtration efficiency as high as 95.46% along with good breathability and splash resistance against synthetic blood. CSIR-CMERI has developed the facility for sterilization of 6000+ masks per day under UV-C light of 254 nm wavelength.

### Technology transfer fee (Non exclusive, 5 years validity):

- Rs. 1 Lakh plus GST (For MSEs) and Rs. 5.0 Lakh including GST (For others).
- Royalty @ 2% on sale value plus applicable GST

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