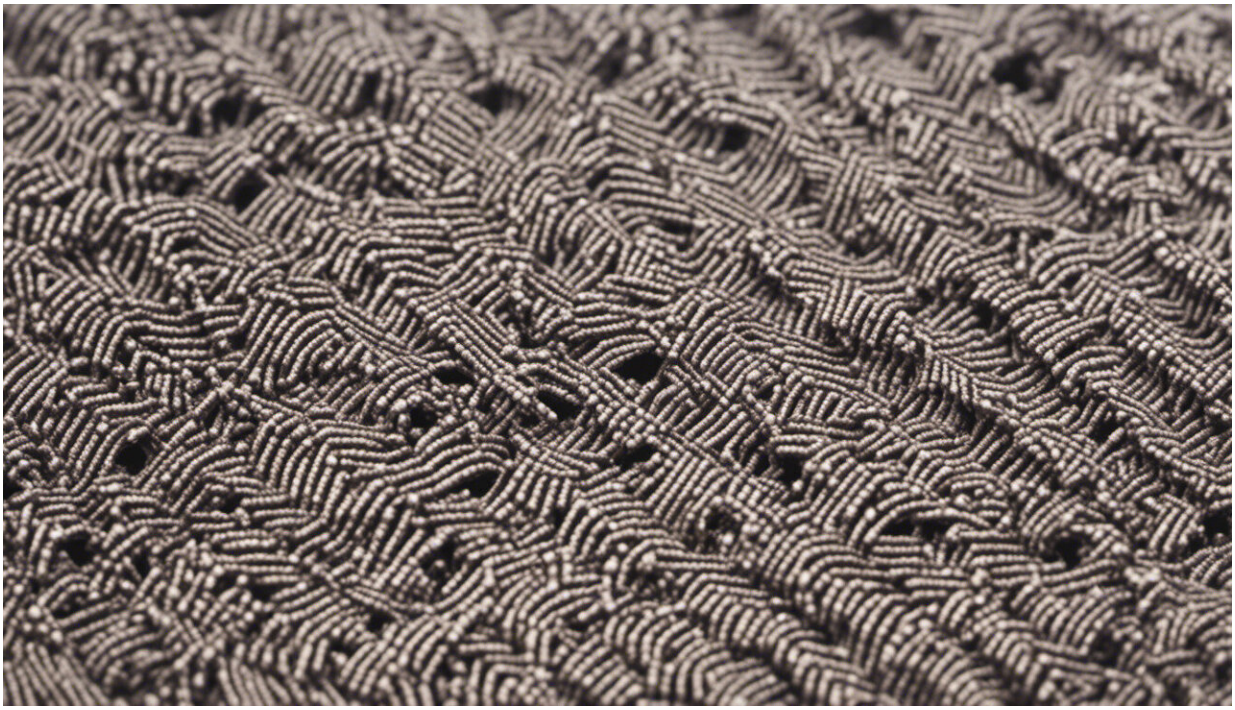
Environmental engineers study fabrics, materials for face covers

April 6 2020, by Andrew Careaga



Credit: AI-generated image

The day before the federal government issued new recommendations that Americans wear cloth face coverings to help slow the spread of the coronavirus, a researcher at Missouri University of Science and Technology decided to test a few common household materials—pillowcases, scarves, furnace filters—"out of curiosity." His

early results, which he shared on Twitter Thursday (April 2), have attracted the interest of do-it-yourselfers, fellow engineers and scientists, and the general public.

The tweet also attracted the attention of a journalist from the *New York Times*, who reported on the project Sunday as part of the newspaper's coronavirus coverage.

Dr. Yang Wang, assistant professor of environmental engineering at Missouri S&T, studies how fine particles like aerosols are transmitted. Recent research suggests that the coronavirus may survive on airborne aerosols for a few hours, although it also can be spread through larger respiratory droplets emitted through a cough or a sneeze.

> Out of curiosity, we tested non-medical materials for filtration. A scarf is NOT helpful for filtering aerosols, which may carry coronavirus. Instead, what about furnace filter/pillowcase? Thanks, @linseymarr for the filtration test doc! @MissouriSandT @JGB_Burken @aaqrl_wustl https://t.co/nm4j1WA3ct pic.twitter.com/5RkzYdYdnt
>
> — Yang Wang (@carlwangyang) April 3, 2020

After seeing posts on Twitter about whether scarves would sufficiently block aerosols, Wang decided to test a variety of household materials—including scarves, bandannas, pillowcases and household air filters—to see how well they might prevent the spread of aerosols.

Wang and his Ph.D. student, Weixing Hao, tested the various fabrics and materials using a scanning mobility particle sizer, which measures particle size and concentration. They then compared the "filtration efficiency" of multiple layers of each material against different aerosol particle sizes, ranging from a few nanometers to over 400 nanometers.

Wang then shared their preliminary results on Twitter.

Wang and Hao found that the layers of scarves and bandannas did a poor job of filtering out aerosols. Pillowcase fabric fared somewhat better, depending on thread count. A 600-count pillowcase filters better than a 400-count one, the researchers determined.

But the best aerosol-blocking material of those Wang tested comes from commercially available household air filters. The multi-layered air filters work almost as well as n95 medical mask to block aerosols, especially smaller particles, according to Wang's initial findings.

As more layers of filter materials are stacked, however, a change in air flow through the materials, or "pressure drop," becomes larger. This pressure drop increase can make it more difficult to breathe. Wang and his team are also looking for a combination of materials that produces the highest filtration efficiency, but the lowest pressure drop.

This off-the-cuff study was more than just a passing curiosity for Wang, however. He is one of several Missouri S&T faculty, students and staff members who have come together to help local physicians and medical staff by providing masks and face shields. The effort began after officials with Phelps Health, a regional medical system based in Rolla, sought help from the university a couple of weeks ago. A handful of students have been working across campus to 3-D print masks and face shield brackets for the cause. The students have delivered hundreds of face shields to Phelps Health, but are still working on the masks.

To adequately protect health care workers, these reusable masks require some type of filter to block airborne particles that may spread the coronavirus or other diseases. That's where Wang comes in.

Dr. Joel Burken, a fellow environmental engineer and chair of Missouri

S&T's civil, architectural and environmental engineering department, invited Wang to join the effort.

"We knew we had to come up with some sort of non-medical filters to use with these masks," Burken says, "so I asked Yang to be a part of this campuswide project, and he's been a strong team member."

Wang and Hao are continuing to test different materials for the masks. While a furnace filter may be much more efficient at filtering out aerosols than, say, a bandanna, it's possible that the components of such a filter could pose risks.

Different furnace filters are made of different materials, such as cotton, fiberglass or polyester. One further protective measure would be to wrap that filtration material with another type of material, such as a fabric.

"There are so many different types of fabric" to consider, says Wang, who recently won an international award for his research on aerosols. "Even for t-shirts, there are different types of materials. We plan to look at different types of pillowcases, bed sheets and other fabrics with different thread counts" as part of the testing, he adds.

Since posting his April 2 tweet, Wang has been surprised at the response.

"A lot of people are interested in this," he says, adding that fellow academics have shared previous research that may help inform Wang's current work.

"This is not a new field of study," he says. "People in volcanic regions have studied the filtration qualities of various fabrics for years. I have received information about some of these studies. I find it all very helpful."