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Keratin – A Multifunctional Filler for Coatings

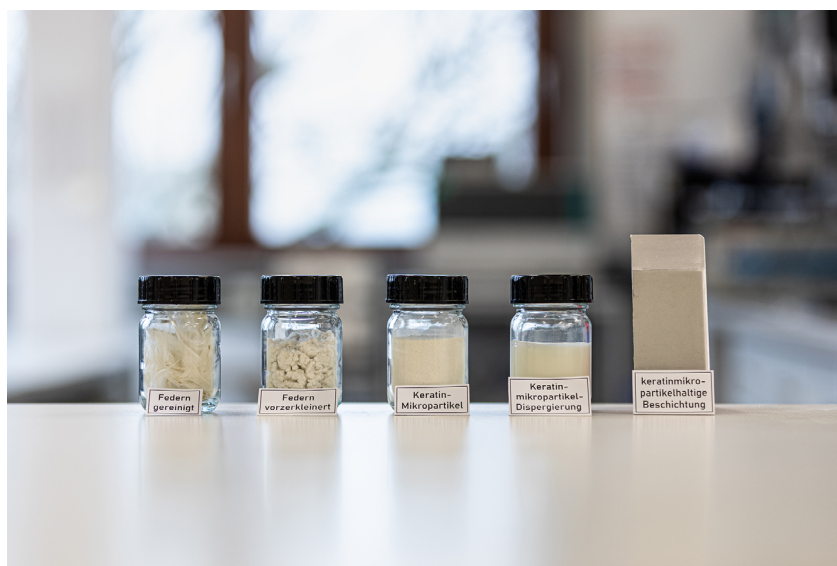
A cost-effective and multifunctional filler for paints and coatings could be obtained from chicken feathers in the future: keratin. Researchers at two Fraunhofer Institutes have achieved promising results with this protein.

Paints and coatings are often blended with mineral fillers to make them more durable, increase their volume, and reduce production costs – for example, using silicates and carbonates. These minerals are abundant in many sands. To use them as fillers, the sand must first be filtered, cleaned, and then chemically processed at high energy costs – nowadays a significant expense.

Therefore, researchers at Fraunhofer Institute for Applied Polymer Research IAP in Potsdam Science Park and Fraunhofer Institute for Manufacturing Engineering and Automation IPA in Stuttgart have set out to find more affordable alternatives. They came across a biogenic residual material that occurs worldwide in enormous quantities and has hardly been used until now: chicken feathers.

A sturdy structural protein with interesting properties

“Chicken feathers are unsuitable for duvets or down jackets, and only a very small amount is processed into meal for livestock feed,” says Dmitry Grigoriev of Fraunhofer IAP. “The vast majority either decomposes in landfills or is incinerated. However,



Keratin microparticles are produced from cleaned chicken feathers through several intermediate steps. These particles can then be used as functional fillers in coatings.

Source: Fraunhofer IPA/Foto: Rainer Bez

Press communication

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feathers contain keratin, a robust structural protein with interesting properties,” the chemist continues.

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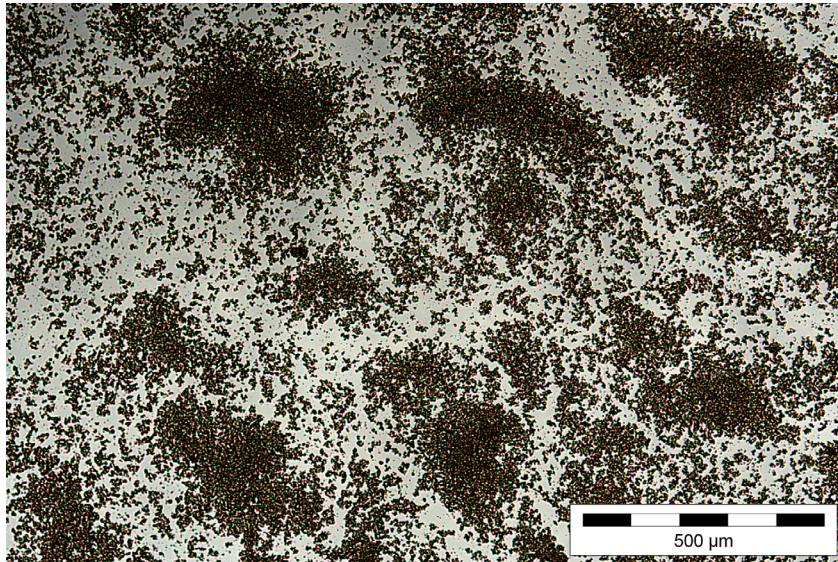
When keratin, ground into a fine powder, is mixed with water and sufficiently dispersed, it forms a milky liquid that microorganisms decompose only very slowly. This makes keratin not only a potential low-cost filler but also a promising base material for paints and coatings with enhanced resistance to microbial attack. In laboratory tests, keratin combined with small amounts of copper salts or particles also showed protective effects against ultraviolet radiation. Keratin particles could therefore one day serve similar functions to titanium dioxide, which is also antibacterial and UV-protective but is considered potentially carcinogenic.

Keratin can also interact with boron nitride. When both substances are dispersed as particles in a binder, ordered structures can form. This results in coatings that are mechanically strong and impact-resistant. “It takes water a long time to penetrate these layers, which significantly reduces its swelling and corrosive effect,” says Matthias Wanner from the research team for Applied Coating Technology at Fraunhofer IPA. “This opens up the possibility of keratin-based paints that prevent rust – such as powder coatings for fences, garden tools, or outdoor furniture,” adds Grigoriev. To move closer to this goal, the two researchers plan to collaborate with Enviral®, a surface finishing company from Niemegk, Brandenburg, specializing in powder coatings.



Matthias Wanner adds zirconium oxide beads into a dispersion vessel. In a shaker, the beads grind the pre-shredded chicken feathers into an ultra-fine powder.

Source: Fraunhofer IPA/Foto: Rainer Bez



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After four hours in the shaker, the pre-shredded feathers have turned into very fine particles, which are still combined into larger aggregates.

Source: Fraunhofer IPA/Foto: Matthias Wanner

Additional revenue for slaughterhouses

To use keratin in multifunctional coating additives, chicken feathers must be cleaned and processed into fine powder. In their lab experiments Grigoriev and Wanner tested several methods. Chemical processes can produce large quantities of keratin powder relatively easy, but they partially degrade the protein's functionality.

Mechanical or mechanochemical production methods yield better results but have one major drawback: In the lab, only small amounts – just a few grams – of powder could be produced. To scale up mechanical production for industrial use, Grigoriev and Wanner plan to cooperate with Zoz GmbH. The company from Wenden in the Sauerland region designs and builds specialized mechanical process systems and produces nanostructured high-performance materials.

The project partners aim to reduce waste and costs. Since transporting feathers is inefficient due to their large volume, a specially designed cleaning and grinding unit is being developed. This system would clean and mill feathers directly on-site into micro- or nanopowder that then can be recycled or further processed. The result would be a cost- and resource-efficient disposal process, lower CO₂ emissions from logistics, and reduced production costs for paints and coatings.

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The keratin powder is mixed with water and then dispersed. This process yields a milky liquid that is resistant to microbial attack and in which the keratin particles only settle after many days.

Source: Fraunhofer IPA/Foto:
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