

Dehydrated cellulose nanofiber: New method to keep thickening agents tiny in transport and big in application

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Evaporative dry CNF powders



recover the inherent dispersion properties, and reduce the transportation and storage costs.

Freeze dry CNF powders



recover the inherent dispersion properties, but bulky powders easily stick to surroundings.

Evaporated CNF powders recover the inherent dispersion properties and are dense, which reduces the transportation and storage costs (upper). Freeze-dried CNF powders recover the inherent dispersion properties, but have a large volume and readily stick to surrounding objects (lower). Credit: 2023 Nogi et al., Evaporative Dry Powders Derived From Cellulose Nanofiber Organogels to Fully Recover Inherent High Viscosity and High Transparency of Water Dispersion. *Macromolecular Rapid Communications*

Many commercial products such as food, cosmetics, and inks contain cellulose nanofiber (CNF) as a thickening agent. However, CNFs have some limitations that prevent their more widespread use. Now, researchers from Osaka University have demonstrated a method of dehydrating CNFs to a dense powder without affecting their three key properties.

The article, "Evaporative Dry Powders Derived from Cellulose Nanofiber Organogels to Fully Recover Inherent High Viscosity and High Transparency of Water Dispersion," was published in *Macromolecular Rapid Communications*.

CNFs are a popular thickening agent because small amounts in water have [high transparency](#), high [viscosity](#), and the viscosity can be controlled. However, the amount of CNF needed in water is very small, so the most efficient way of transporting CNFs is as a [dry powder](#).

Sounds good, but how do we get CNFs into powder form? The water containing the CNFs can be boiled away, but the remaining fibers stick together and redispersing these clumps leads to liquids that are cloudy, unless a lot of energy is used to break up the clumps. If water is removed by freeze drying, the resulting CNF powder is quite fluffy and takes up a lot of space. It is also affected by [static electricity](#), making it difficult to handle.

These are significant drawbacks in industries where efficiency affects profitability. Therefore, the research team from Osaka University devised an improved water-removal method, the first step of which is to form an "organogel," a type of gel consisting partly of organic molecules.

"Our process involves taking a CNF paste in water and dehydrating it by stirring in ethanol," explains corresponding author Masaya Nogi. "The ethanol is then removed at 30°C, which is a low and cost-effective temperature. After some processing, it can then be redispersed in [water](#) simply by stirring."

The redispersed product was shown to retain the three key properties of CNF thickening agents. Its tunable viscosity was demonstrated by spraying it from a pump spray bottle. It was successfully sprayed from the nozzle, which requires a low viscosity, and the ejected droplets did not run from where they landed on an upright surface, which requires high viscosity behavior. Furthermore, the spray doesn't generate dripping, which can be a problem with other sprays.



Evaporated CNF powders have a small volume and no handling issues related to static electricity (upper left). Their water dispersions are colorless and transparent (upper right) and dispersion droplets formed by spraying do not drip (lower). Credit: 2023 Nogi et al., Evaporative Dry Powders Derived From Cellulose Nanofiber Organogels to Fully Recover Inherent High Viscosity and High Transparency of Water Dispersion. *Macromolecular Rapid Communications*

"The large scale of many industrial processes means that all process improvements can have a big impact on the bottom line," says senior author Masaya Nogi. "Our method of [powder](#) creation retains all key properties of CNFs while also enabling effective handling and cheaper

transport and storage."

The ease of use of the organogel-derived CNF powders is expected to make them an attractive prospect for application in many areas, including in the food, cosmetics, and sanitation industries.

More information: Hitomi Yagyu et al, Evaporative Dry Powders Derived from Cellulose Nanofiber Organogels to Fully Recover Inherent High Viscosity and High Transparency of Water Dispersion, *Macromolecular Rapid Communications* (2023). [DOI: 10.1002/marc.202300186](https://doi.org/10.1002/marc.202300186)

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