

# Researchers find fat turns into soap in sewers, contributes to overflows

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Researchers from North Carolina State University have discovered how fat, oil and grease (FOG) can create hardened deposits in sewer lines: it turns into soap! The hardened deposits, which can look like stalactites, contribute to sewer overflows.

"We found that FOG deposits in sewage collection systems are created by [chemical reactions](#) that turn the [fatty acids](#) from FOG into, basically, a huge lump of soap," says Dr. Joel Ducoste, a professor of civil, construction and environmental engineering at NC State and co-author of a paper describing the research. Collection systems are the pipes and pumping stations that carry wastewater from homes and businesses to sewage-treatment facilities.

These hardened FOG deposits reduce the flow of wastewater in the pipes, contributing to [sewer overflows](#) – which can cause environmental and public-health problems and lead to costly fines and repairs.

The research team used a technique called Fourier Transform Infrared (FTIR) spectroscopy to determine what the FOG deposits were made of at the molecular level. FTIR spectroscopy shoots a sample material with infrared light at various wavelengths. Different molecular bonds vibrate in response to different wavelengths. By measuring which infrared wavelengths created vibrations in their FOG samples, researchers were able to determine each sample's molecular composition.

Using this technique, researchers confirmed that the hardened deposits

were made of calcium-based fatty acid salts – or [soap](#).

"FOG itself cannot create these deposits," Ducoste says. "The FOG must first be broken down into its constituent parts: glycerol and free fatty acids. These free fatty acids – specifically, saturated fatty acids – can react with calcium in the sewage collection system to form the hardened deposits.

"Until this point we did not know how these deposits were forming — it was just a hypothesis," Ducoste says. "Now we know what's going on with these really hard deposits."

The researchers are now focused on determining where the calcium in the collection system is coming from, and how quickly these deposits actually form. Once they've resolved those questions, Ducoste says, they will be able to create numerical models to predict where a sewage system may have "hot spots" that are particularly susceptible to these blockages.

Ultimately, Ducoste says, "if we know how – and how quickly – these deposits form, it may provide scientific data to support policy decisions related to preventing sewer overflows."

**More information:** “Evidence for Fat, Oil, and Grease (FOG) Deposit Formation Mechanisms in Sewer Lines”

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### **Abstract**

The presence of hardened and insoluble fats, oil, and grease (FOG) deposits in sewer lines is a major cause of line blockages leading to sanitary sewer overflows (SSOs). Despite the central role that FOG

deposits play in SSOs, little is known about the mechanisms of FOG deposit formation in sanitary sewers. In this study, FOG deposits were formed under laboratory conditions from the reaction between free fatty acids and calcium chloride. The calcium and fatty acid profile analysis showed that the laboratory-produced FOG deposit displayed similar characteristics to FOG deposits collected from sanitary sewer lines. Results of FTIR analysis showed that the FOG deposits are metallic salts of fatty acid as revealed by comparisons with FOG deposits collected from sewer lines and pure calcium soaps. Based on the data, we propose that the formation of FOG deposits occurs from the aggregation of excess calcium compressing the double layer of free fatty acid micelles and a saponification reaction between aggregated calcium and free fatty acids.

Provided by North Carolina State University

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