

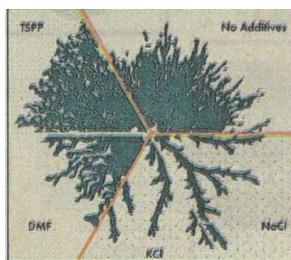
Cracks & zig-zags: B'luru scientists discover new play of water with clay

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Bengaluru: What happens when water pushes its way through clay? Scientists in Bengaluru report that the action can look surprisingly dramatic, with twisting finger, zig-zag pathways and even crack-like fractures spreading through the material.

Researchers from Ramakrishna Research Institute (RRI) have discovered two previously unreported patterns. The study, published in *New Journal of Physics*, focused on what scientists call “fluid flow instability” — a disturbance that forms where one fluid pushes another aside. In daily life, people encounter fluids of different thicknesses all the time. Honey flows more slowly than water, while toothpaste can briefly hold its shape.

Clay suspensions belong to this second category, known as non-Newtonian fluids. When water is forced through them in a confined space, branching



channels begin to form.

To study this behaviour, the researchers created clay mixtures using different additives, including common salt and chemicals that alter the clay's elasticity. The experiments were conducted inside a narrow gap between two circular glass plates, an arrangement known as a Hele-Shaw cell.

As water spread outward through the clay, it produced striking radial patterns. “An observation particularly exciting was that of new modes of finger propagation, namely, zig-zag and skewering. The appearance of these modes was unexpected and had

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never been reported in previous studies,” said Ranjini Bandyopadhyay, senior professor at the institute and co-author of the study.

The team found that the clay's elasticity determined the kind of patterns formed. When the clay mixture was less elastic, water created uneven pathways that bent into zig-zag shapes or pierced through surrounding structures in a “skewering” pattern. But when additives such as sodium chloride and potassium chloride were introduced, the clay became far more rigid and brittle.

Under those conditions, the advancing water no longer

created channels. Instead, the clay fractured. “It's like taking a sharp object and banging it on a piece of glass,” Bandyopadhyay explained. “The glass just cracks.”

Researchers say the findings could have practical applications in industries where controlling fluid movement is important. During oil extraction, for instance, fluids are injected into rocks to push trapped oil outward. But unstable finger-like pathways can reduce recovery efficiency because the injected fluid bypasses parts of the oil reservoir.

“Instabilities are not desired during oil recovery. You need to understand instabilities to control them,” Vaibhav Raj Singh Parmar, lead author of the study and PhD student at the institute, said.

The researchers also say the work may help scientists better understand how clays move in natural and industrial settings, including through pipelines and underground formations.