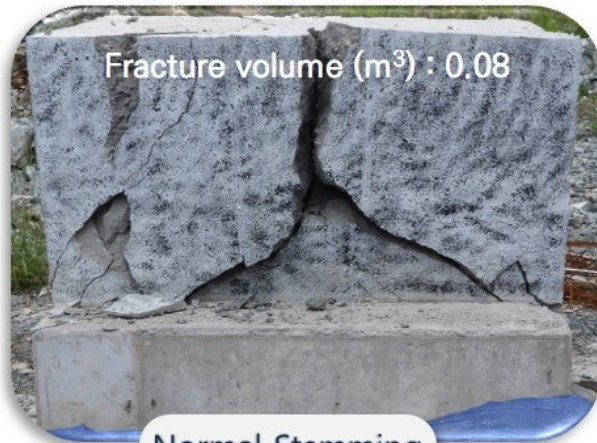


Shear-thickening-fluid–based stemming solution for the construction blasting industry

March 22 2023

Test Results (scaled bench model)



Normal Stemming



SMART-STEM

The blasting performance and stemming effect of SMART-STEM were evaluated through scaled bench model experiments. Credit: Korea Institute of Civil Engineering and Building Technology

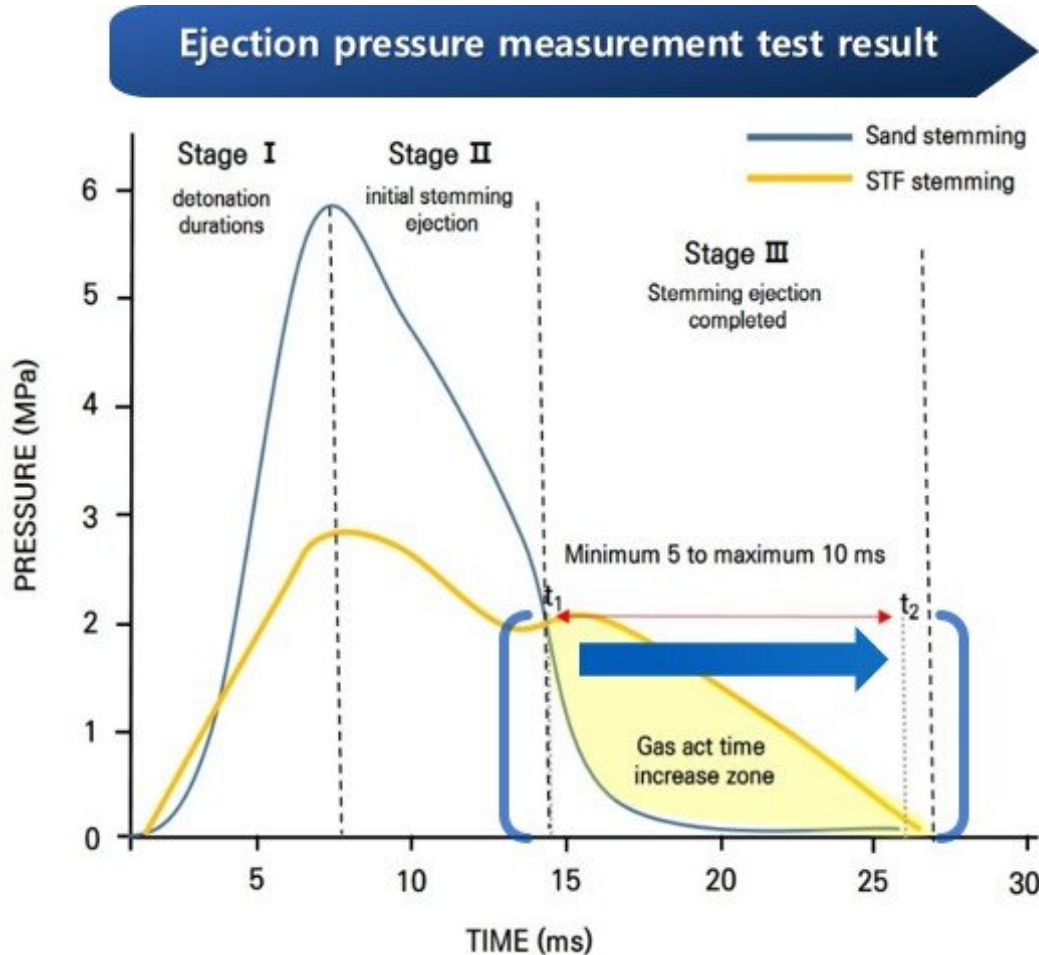
Korea Institute of Civil Engineering and Building Technology has developed the world's first shear-thickening-fluid–based (STF) stemming solution. This is the first time that an STF has been developed into a blasting construction material or product for stemming, promising

to revolutionize construction blasting with groundbreaking levels of efficiency and safety.

Blasting is a crucial process in both mining and construction. However, low blasting efficiency has been an issue that has long plagued the blasting industry. Low blasting efficiency is when the target (most commonly rock) is not well broken down compared to the mass of explosives used. Selecting the right stemming material plays an important part in optimizing blasting operations, allowing reduced costs and enhancing the productivity and profitability of excavation and mining.

Stemming is a process in industrial blasting in which a blasting hole is sealed with stemming materials to prevent the leaking of explosion gases from the blast hole. The use of inadequate stemming materials can lead to over 50% of the explosive energy being lost during a blasting operation. On top of the economic loss incurred by the waste of resources, the [excess energy](#) that leaks into the outward is converted to ground vibrations and noise, which may even cause environmental damage.

This STF-based stemming solution has been named SMART-STEM by the team of KICT researchers who developed it. The research team at the KICT Department of Geotechnical Engineering Research (Dr. Moonkyung Chung, Dr. Younghun Ko, Dr. Seunghwan Seo) performed numerous tests over a period of three years from 2020 onward. The findings, published in *Applied Sciences*, showed that SMART-STEM increased resistance to the eruption of explosive gases by 330% compared to the conventional sand-based stemming materials, while rock blasting performance was improved by more than 60%.



The lower the measured ejection pressure value, the lower the loss of explosive pressure in the blast hole. The longer the duration of the explosive pressure, the greater the energy that can be used to fracture the rock. Credit: Korea Institute of Civil Engineering and Building Technology

On-site demonstration of tunnel blasting in urban centers with [high population density](#) was also completed through a third-party validation test conducted in August 2022 in a very deep underground urban expressway construction site in Busan, South Korea. The excavation rate per blast increased greatly, with a reduction in total explosive consumption of up to 20%, leading to a reduction of ground blasting

vibration in residential area of up to 50%.

The newly developed SMART-STEM offers consistently robust and uniform sealing performance, reducing explosive consumption in blasting sites by simply substituting the existing stemming material with an affordable STF-based material. Moreover, with enhanced tunnel excavation rate per blast and reduced secondary work time, it can help reduce [construction costs](#) by up to 17%.



Photo of SMART-STEM product. From the left, bulk type for large-scale blasting sites to tunnel blasting products. Credit: Korea Institute of Civil

Engineering and Building Technology

The lead researcher of the project, Dr. Moonkyung Chung, commented, "I anticipate SMART-STEM to be utilized as a mainstay of tunnel construction and other blasting projects in the urban centers of Korea. The [construction](#) blasting industry will be able to achieve more efficiency and effectiveness in blasting projects, raising their productivity and profitability by adopting the SMART-STEM technology.

SMART-STEM was developed by a research team at the Korea Institute of Civil Engineering and Building Technology as a task under one of the institute's key projects, "Development of new stemming material and blasting method using shear thickening fluid by high shock wave reaction."

More information: Younghun Ko et al, Blast Hole Pressure Measurement and a Full-Scale Blasting Experiment in Hard Rock Quarry Mine Using Shock-Reactive Stemming Materials, *Applied Sciences* (2022). [DOI: 10.3390/app12178629](https://doi.org/10.3390/app12178629)

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