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Pulse Velocity Tester – Vikasonic

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STANDARDS

ASTM C 597-16
BS 1881: Part 203
CEN/TR 15177
CEN/TS 12390-9
EN 12504-4:2021
NF P 98-231-5

APPLICATIONS

Pulse Velocity Tester – Vikasonic

Vikasonic is an ultrasonic testing device designed for measuring the setting time and detecting internal damage in concrete and other materials. It features adjustable frequency options (54 kHz or 80 kHz) and provides highly accurate measurements with a pulse width of ≤ 1µs and sensitivity better than 250µV. The device offers features like pulse velocity calculation, Young's Modulus, real-time clock, temperature measurement using a Type K thermocouple, and a USB interface for data storage. It operates on mains or internal battery power and is suitable for both lab and on-site structural damage assessments, including freeze-thaw resistance testing.

In the early 1960s, researchers proposed using ultrasonic transition time to measure the setting of mortar and fresh concrete as an alternative to traditional methods like the penetrometer and Vicat apparatus, which have certain limitations. In collaboration with a German dry-mix company, Qualitest-Schleibinger developed a specialized ultrasonic unit featuring an integrated data logger and a custom-designed setup for mortar specimens.

Measurement Principle

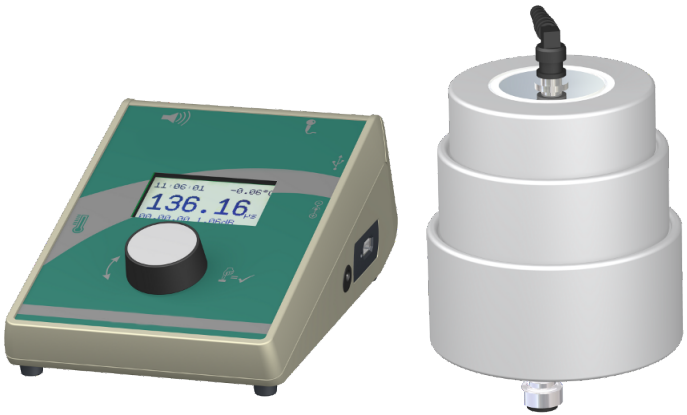
Fresh mortar is placed between two ultrasonic transducers, which emit pulses at intervals of 0.25 seconds or less at a frequency of 54 kHz. As the mortar sets, the ultrasonic transition time changes. Once the binder begins to form a cohesive structure, the speed of the ultrasonic waves increases. When a fully developed crystalline structure is established, the rate of change in sound speed slows. However, as the cement stone continues to aggregate, the speed increases again.

Measurement Setup

Each measurement cell contains a pair of ultrasonic transducers. The Vikasonic continuously records ultrasonic transition time and signal damping, storing data digitally on a standard USB drive. Each dataset can contain over 300,000 data points, including date, time, sound speed (m/s), Young’s modulus (GPa), and signal strength (dB). Temperature readings inside the

specimen are captured using a Type K thermocouple and recorded in Celsius.

The device is operated with a single wheel, easily managed even while wearing protective gloves. It runs on mains power or batteries, making it suitable for on-site measurements, including structural damage assessments. Using the C0026 measurement bath, the system can detect internal damage in concrete cubes during freeze-thaw cycle tests like the CIF test.



The Qualitest-Schleibinger Vikasonic operates independently, requiring no PC during tests. Data can be directly imported into Excel, and the proprietary software developed by Qualitest-Schleibinger can be customized to meet specific requirements.

Application Example

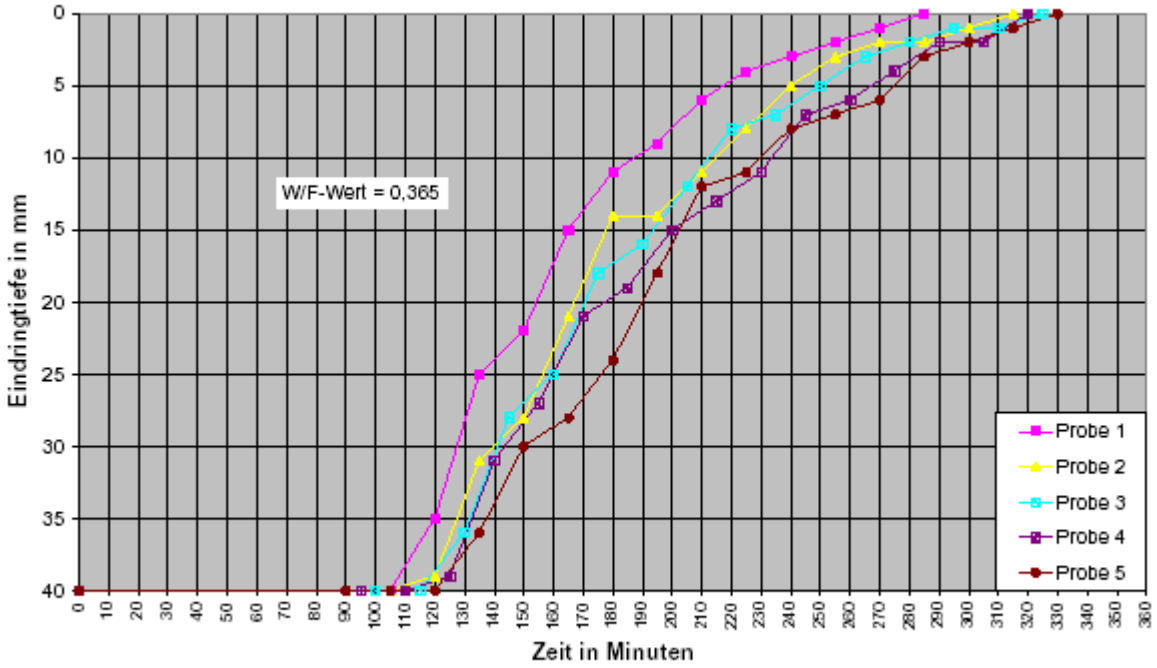


Bild 1: Reproduzierbarkeitsuntersuchungen zum Abbinden von Kalk-Gips-Putz 150 (Kissing) mit dem Abbindekonus

Penetration depth in mm over time in minutes - 5 times measured with same material and the same water/binder ratio

Tests with the Vicat Apparatus

With the Vicat apparatus the deviation in percent depends on the penetration depth. With this tests the deviation range was from 27% to 40%.

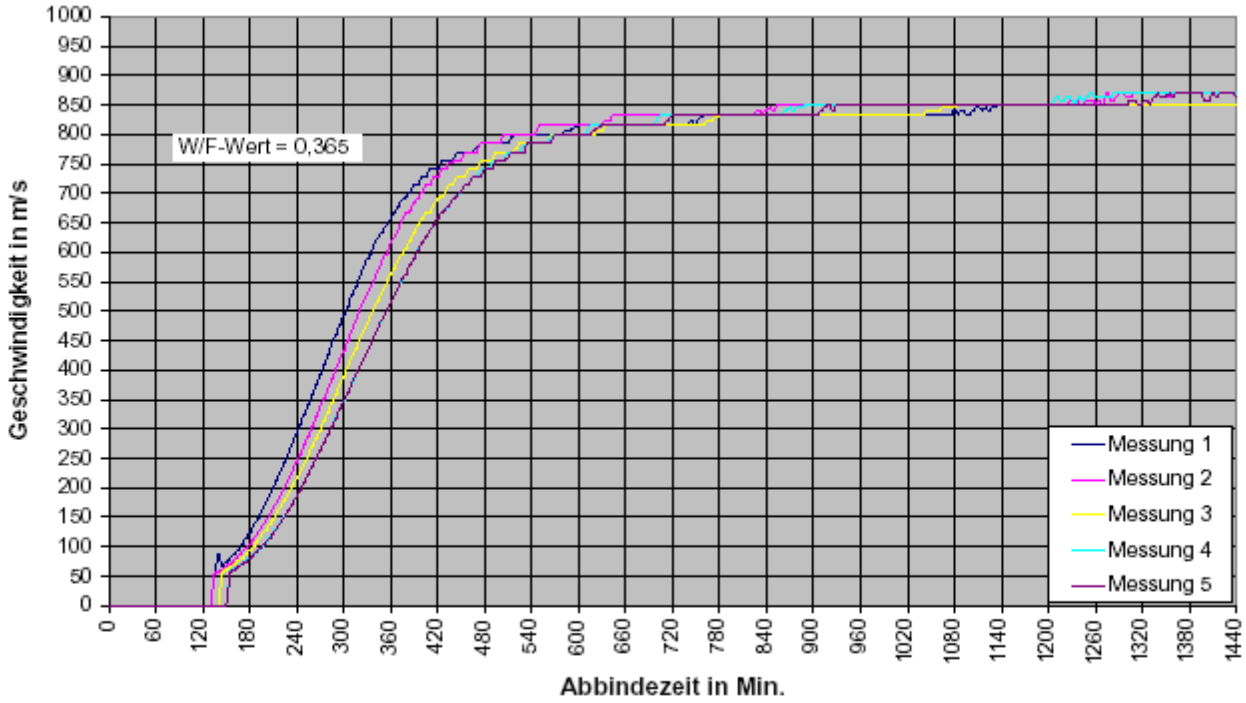


Bild 2a: Reproduzierbarkeitsuntersuchungen zum Erhärten von Kalk-Gips-Putz 150 (Kissing) mit der Ultraschall-Messzelle (Kunststoff)

Ultrasonic sound speed in m/s over time in minutes - 5 times measured with same material and the same water/binder ratio

Test with the Vikasonic Ultrasonic Method

With the ultrasonic test the deviation was 18%. So the ultrasonic method is more accurate then the Vicat method.

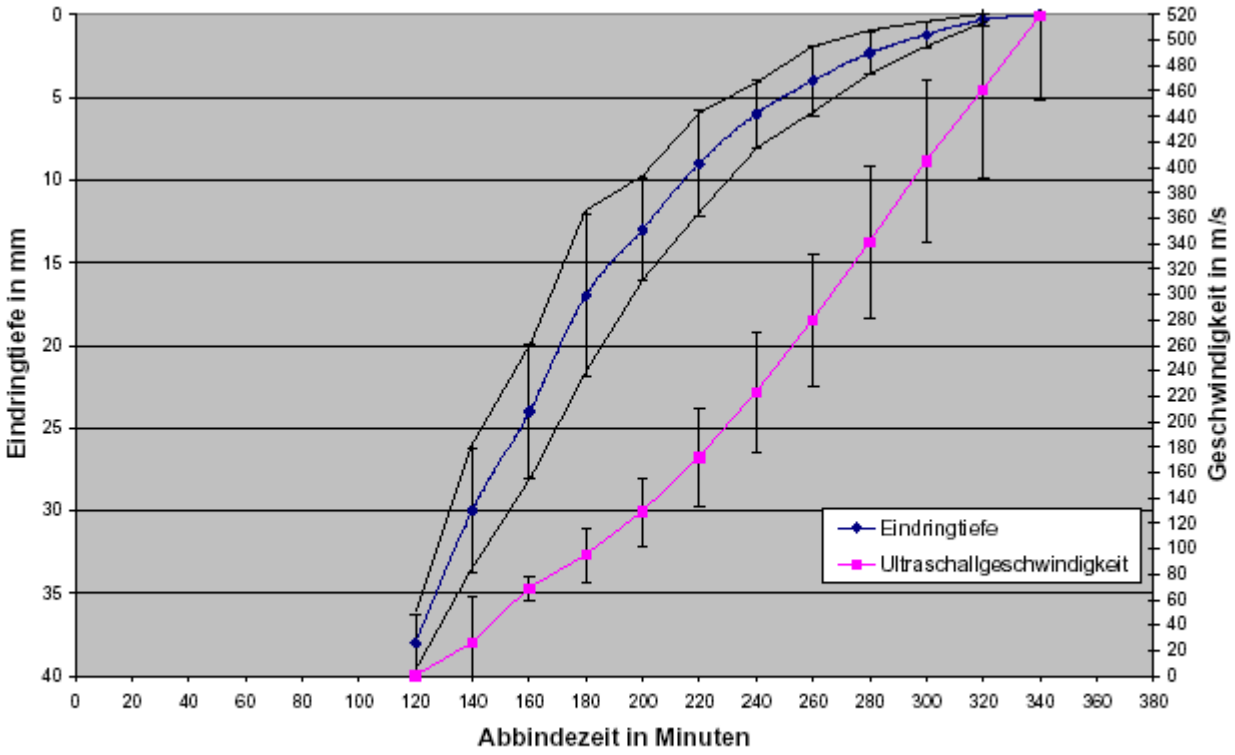


Bild 3a: Zum Zusammenhang zwischen Abbinden (Eindringtiefe) und Erhärten (Ultraschallgeschwindigkeit) am Beispiel des 150er - Kissing

Penetration depth (blue) in mm and and ultrasonic sound speed (magenta) in m/s over time in minutes - 5 times measured with same material and the same water/binder ratio

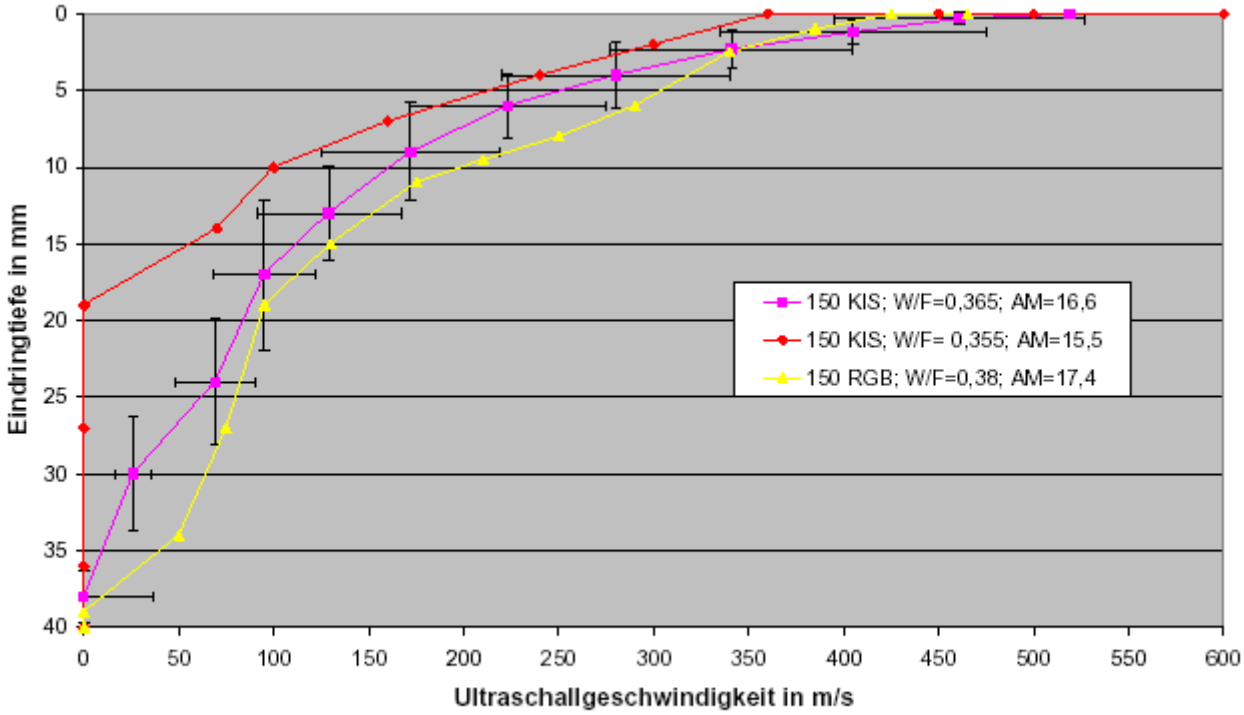


Bild 5: Zusammenhang zwischen dem Abbinden (Abbindekonus) und Erhärten (Ultraschallmesszelle) nach gleichen Zeiten

Penetration depth in mm over the ultrasonic sound speed for 2 materials (KIS) with different water/binder ratio and another material (RGB)

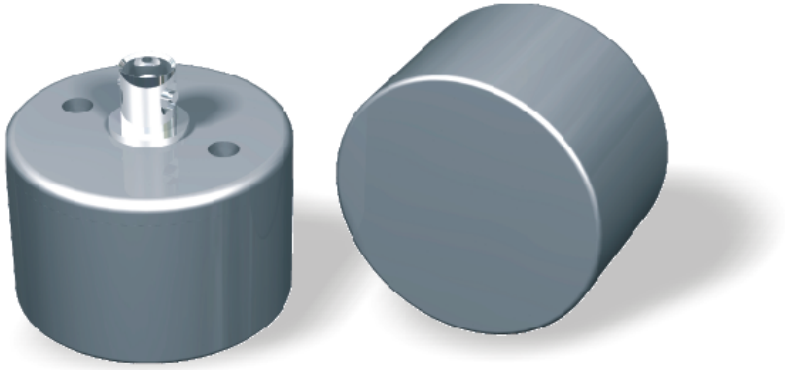
Comparison of Both Methods

The correlation between the Vicat test and the Vikasonic ultrasonic method varies depending on the material and mix design. Therefore, calibration between the two methods is necessary for each specific mix. Once this calibration curve is established, the ultrasonic test can effectively replace the Vicat test.

While the initial cost of the ultrasonic setup is moderately higher, it requires fewer personnel and provides more objective and reliable results.

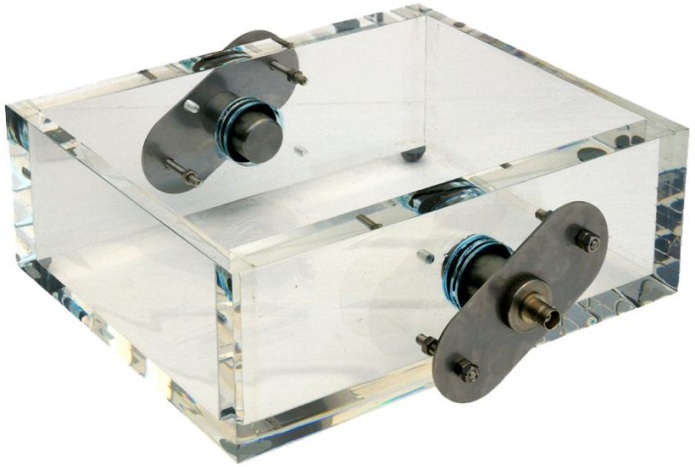
Testing Youngs Modulus or Inner Damage of Concrete Elements with the Vikasonic

The Vikasonic is not only suitable for measuring setting times but also for detecting internal damage in specimens or structural elements. For this application, we recommend using the 54 kHz transducers (order code U0009). Applying an organic, grease-free coupling gel ensures direct and effective contact with the specimen for accurate measurements.



Specimens can be tested either by direct contact with the transducers or in a water bath, where water acts as the coupling agent. This method ensures results are unaffected by the alignment of the transducers.

The bath setup features two 80 kHz transducers mounted on opposite sides (order code C0026). This approach complies with CEN/TS 12390-9, "Testing Hardened Concrete — Part 9: Freeze-Thaw Resistance with De-Icing Salts — Scaling," and CEN/TR 15177, "Testing the Freeze-Thaw Resistance of Concrete — Internal Structural Damage."



Standards

- **ASTM C 597-16:** Standard Test Method for Pulse Velocity through Concrete.
- **EN 12504-4:2021:** Testing concrete — Determination of ultrasonic pulse velocity.
- **BS 1881: Part 203:** Testing concrete — Recommendations for measuring ultrasonic pulse velocity in concrete.
- **NF P 98-231-5 (April 1997):** Tests related to pavements — Compaction tests on non-bituminous materials. Part 5: Workability time limit determination of granular materials bound with cementitious binders using sonic examination.
- **CEN/TS 12390-9:** Testing hardened concrete — Part 9: Freeze-thaw resistance with de-icing salts (Scaling).
- **CEN/TR 15177:** Testing the freeze-thaw resistance of concrete — Internal structural damage.

TECHNICAL SPECIFICATIONS

Pulse Velocity Tester – Vikasonic Technical Specifications

Transit Time Measurement Range	2µs to 24000µs (auto ranging)
Frequency	54 kHz or 80 kHz, others available
Accuracy	+/- 0.1µs
Over Range Indication	Indicated on the display
Input Sensitivity	Better 250µV
Bandwidth -3db	10KHz .. 1 MHz
Transmitter Excitation Voltage	200V, 750V, 1000V, 1500V
Pulse width	<= 1µs
Pulse Rate	0.1 .. 10 s
Received Signal Strength	0.1 .. 20 dB
Calculated Data	Pulse velocity / m/s <-> input value: transducer distance
	Youngs Modulus / GPa <-> input value: transducer distance, bulk density, Poisson ratio
Power Supply	Mains or internal battery
Voltage	110V to 240V, 50/60Hz
Battery	Three common AA cells
Display	Liquid Crystal 56mm x 38mm
USB Interface	Host interface for ;connecting a USB flash drive (2 drives included) recording: date, time, transit time (µs), pulse velocity (m/s), Youngs modulus (GPa), signal power (dB), Temperature (°C)
Real-Time Clock	Integrated
Temperature Measurement	Type K thermocouple

Test Cell	Holder for transmitter and receiver; Vicat Ring as described in ASTM C472-99: Vicat Ring: Ø70/80 x 40 mm or in EN 196-3: Vicat Ring: Ø70/80 x 40 mm, volume 177 ml

Order Info

Qualitest-Schleibinger Vikasonic with test cell, transducers and thermocouple	U0001

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