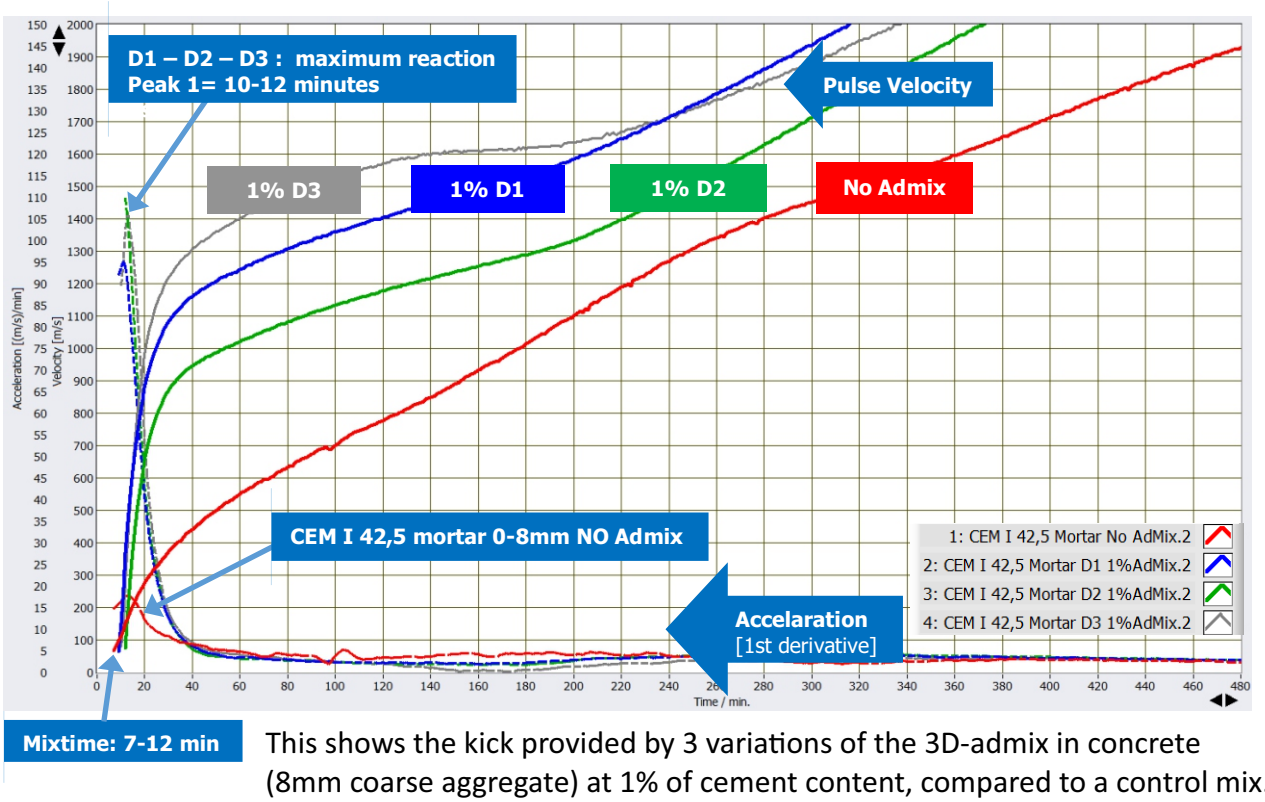
Results of Ultrasonic Pulse Velocity Measurements at UltraTest, Achim

1. Ultrasonic Velocity and Acceleration (0-480 min)

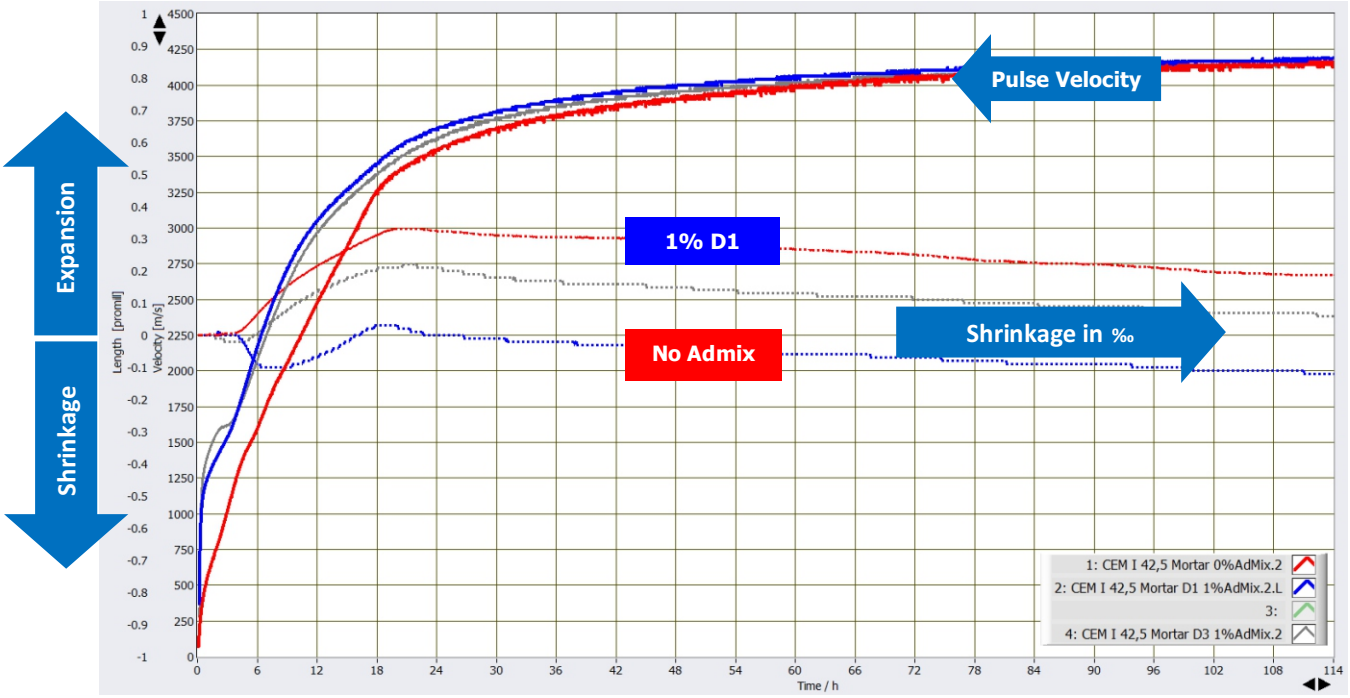
(Acceleration = first derivative = increase of velocity per minute)



This shows the kick provided by 3 variations of the 3D-admix in concrete (8mm coarse aggregate) at 1% of cement content, compared to a control mix.

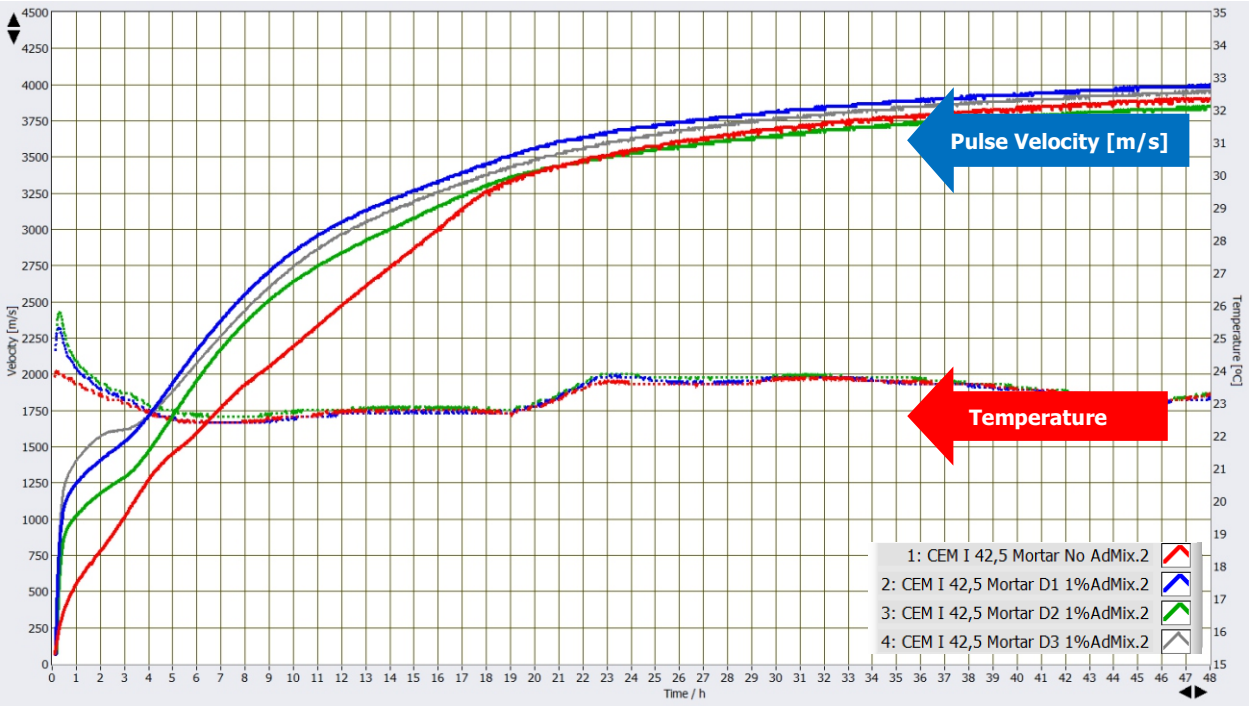
2. Ultrasonic Velocity and Expansion / Shrinkage (0-7 days)

Additional shrinkage measurement required:
https://www.youtube.com/watch?v=Bb5DHtZmCSc



This shows 2 variations of the concrete with 3D-admix **that did not shrink** , where control shrank. We will repeat this test for a longer period.

3. Ultrasonic Pulse Velocity and Temperature (0-48 hours)



This shows how the mixes that were kicked by the 3D-admix continued on to match the unmodified concrete.

4. Result Table

T | Config. | Results | Copy to

Description	Channel 1	Channel 2	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7
File [.lvm]	CEM I 42,5 Mortar	CEM I 42,5 Mortar	CEM I 42,5 Mortar	CEM I 42,5 Mortar			
max. Velocity [m/s]	4124	4167	4020	4124			
max. Acceler.1 [(m/s)/min]	17.4	93.2	107.8	102.8			
max. Acceler.1 [min]	13:00	11:00	12:00	13:00			
max. Temp. [°C]	24.2	25.3	25.8				
Mark(800m/s) [min]	126	18:06	25:13	16:53			
Mark(2500m/s) [min]	730	461	534	499			
Mark(4400m/s) [min]							
Mark(0m/s) [min]							
Density [kg/m³]	2200	2200	2200	2200			
E dyn [GPa]	32.8	33.5	31.1	32.8			
Strength [N/mm²]							
Mixtime [min]	7:00	9:00	12:00	10:00			
Duration [min]	5657.0	5799.0	5802.0	5800.0			
Sample	No Admix	1% D1	1% D2	1% D3			

Highest measured velocity in m/s.

Maximum of first derivative (acceleration)

Time in minutes at max. acceleration

Time when velocity reached mark 800 m/s - 2500 m/s – 1000 m/s

Dyn. E-modulus calculated on input of density

The green band shows how the modified mixes hit a target set point at 17 to 25 minutes verses 126 minutes of control up to 740% faster, at 1% of cement.

Legend:

1. Max. Velocity : Highest measured velocity in m/s.
2. Max. Acceler. 1: Maximum of first derivative of ultrasonic sound velocity in m/s*min
   highest acceleration = increase of velocity per minute
3. Max. Acceler. 1: Time in minutes at max. acceleration
4. Max. Temp. : Highest measured temperature value

5. Mark xxx m/s : Time when measured velocity reached mark xxx.

For a certain material, the ultrasonic sound velocity shows a very strong correlation to the material strength. Even small differences in the strength development of different manufacturing batches can be measured very precisely and reproducible.

The first derivative of the velocity (= acceleration) displays the variation of the velocity with respect to time. The maximum of the acceleration indicates the 'maximum of the reaction intensity'. At most cementitious systems, initial set occurs before and final set after this maximum.

Graphic marks are freely definable velocity levels (here 200, 900, … m/s). At a certain consistency or strength, a material shows the same ultrasonic sound velocity. Characteristics such as working time or initial set can be determined precisely and reproducibly by means of graphic marks.