

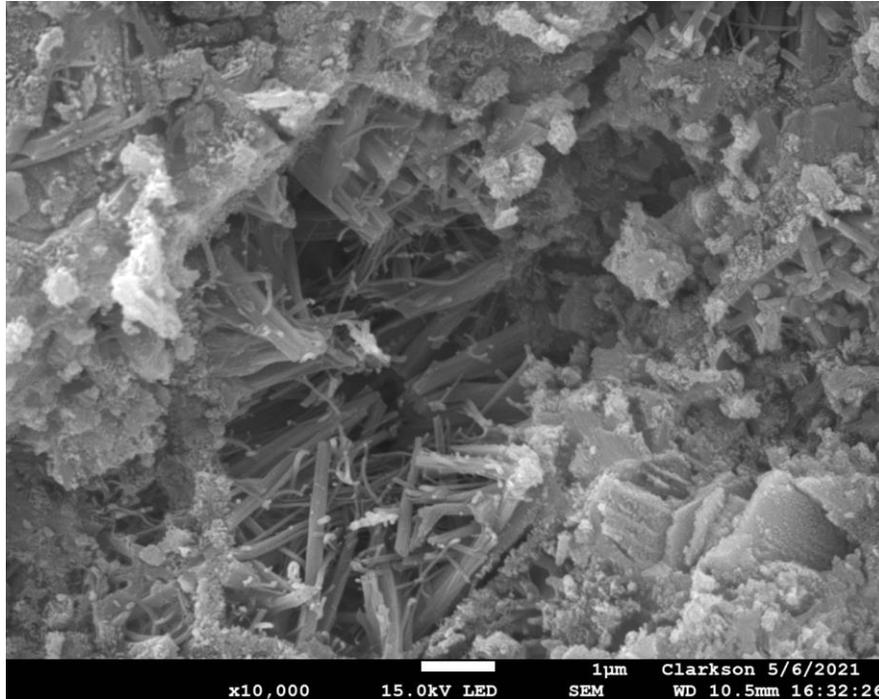
Solidification Behavior of BCSCA Cement

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THE WORLD'S GATHERING PLACE FOR ADVANCING CONCRETE



Belitic Calcium Sulfoaluminate (BCSA) Cement



Scanning electron micrograph of BCSA showing ettringite formation after 4 hours of hydration

	BCSA	Portland cement
	(% by mass)	
Belite (C_2S)	30-60	15-30
Calcium sulfoaluminate ($C_4A_3\bar{S}$)	20-30	-
Calcium sulfate ($C\bar{S}$)	5-25	2-8
Ferrite (C_4AF)	<10	5-15
Alite (C_3S)	-	50-70
Aluminate (C_3A)	-	5-10

Benefits of BCSEA

- Use as a repair material
- Environmental benefits
- Low-carbon cement for use in construction
- Potential to accelerate construction with controllable setting time

Objectives

Understand the influence of mixture parameters on setting time of BCSA cement:

- Water/cement ratio
- Citric acid retarder dosage

Correlate different measurements of setting and solidification in BCSA cement:

- Vicat penetration
- Ultrasonic monitoring
- Isothermal calorimetry

Methodology

Vicat Test (ASTM C191)

- Establish initial and final setting times



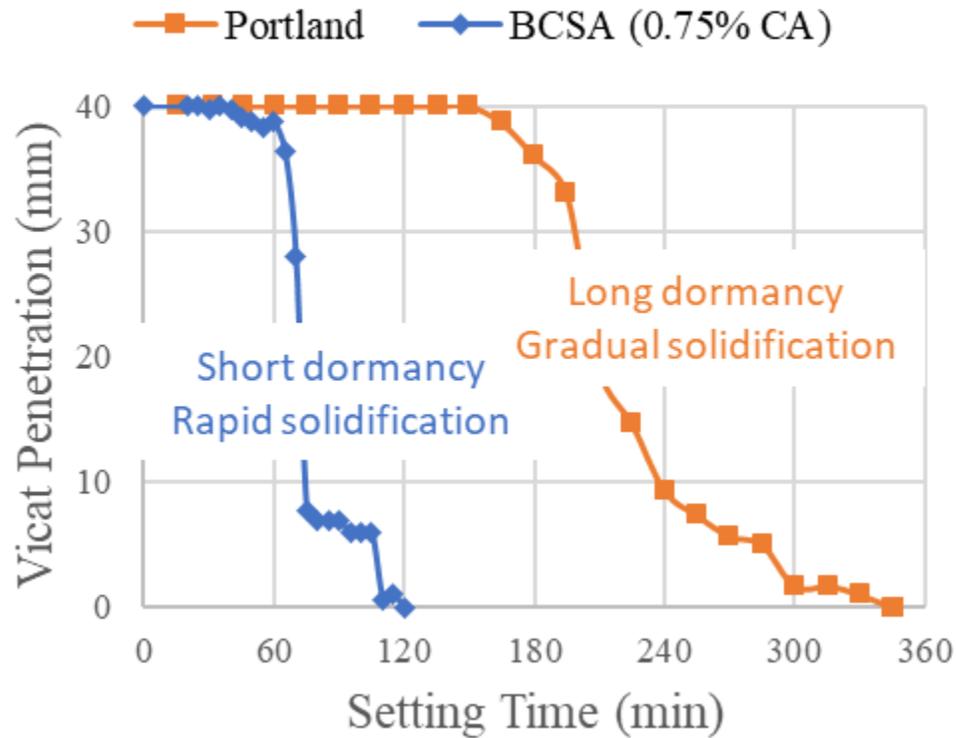
Ultrasonic Monitoring

- Data collected on velocity and acceleration of setting cement paste

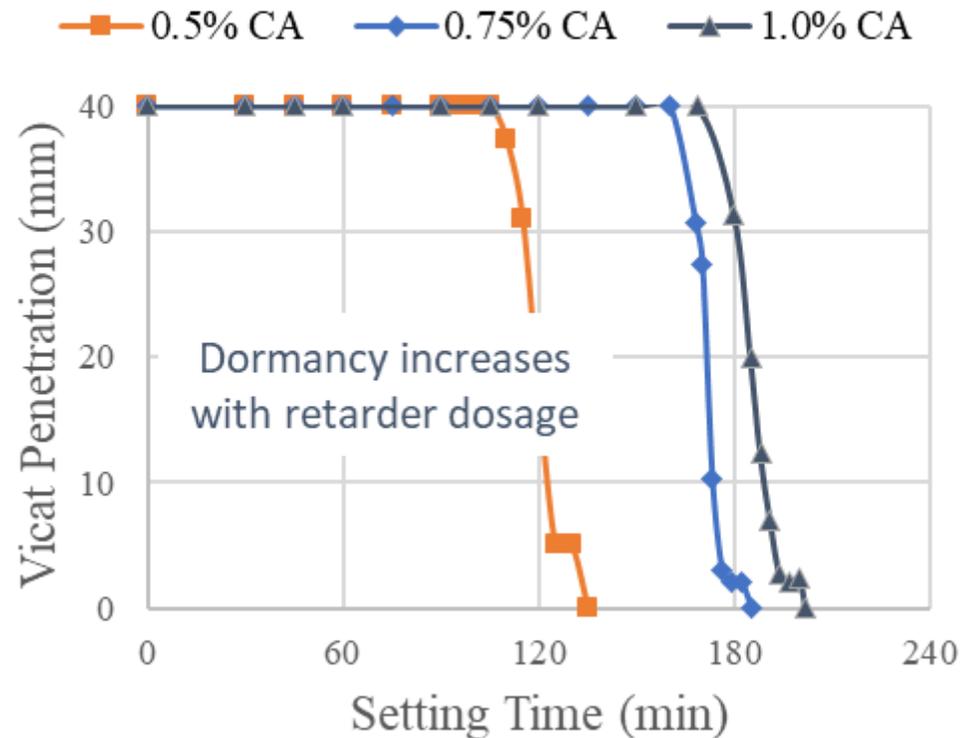


Vicat Penetration Results

Portland vs. BCSA (w/cm=0.3)

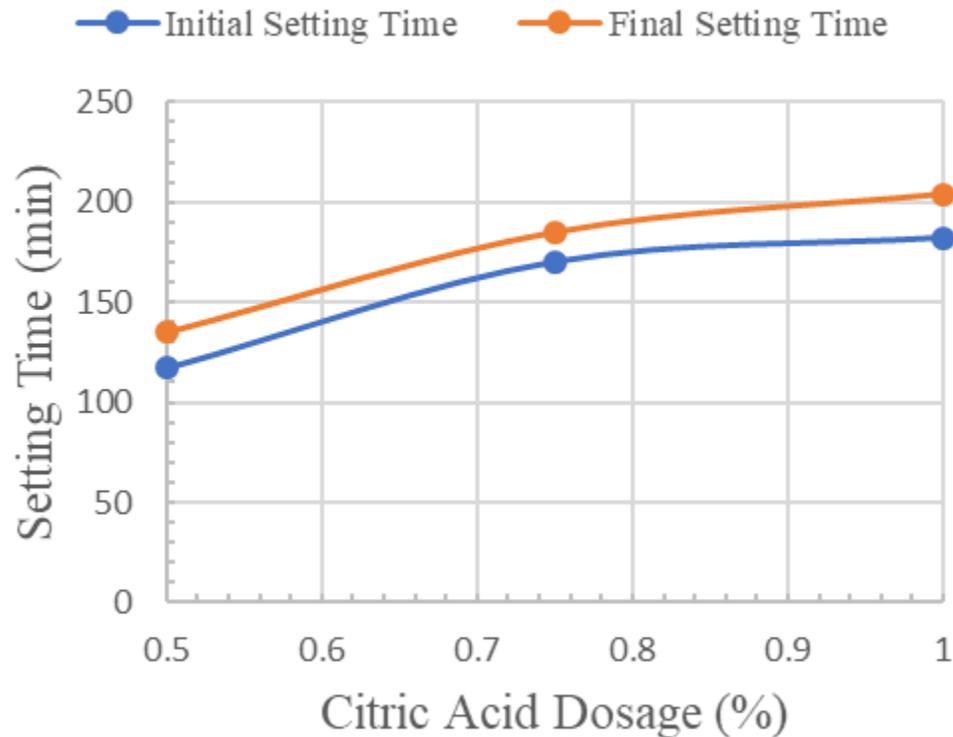


BCSA (w/cm=0.5)

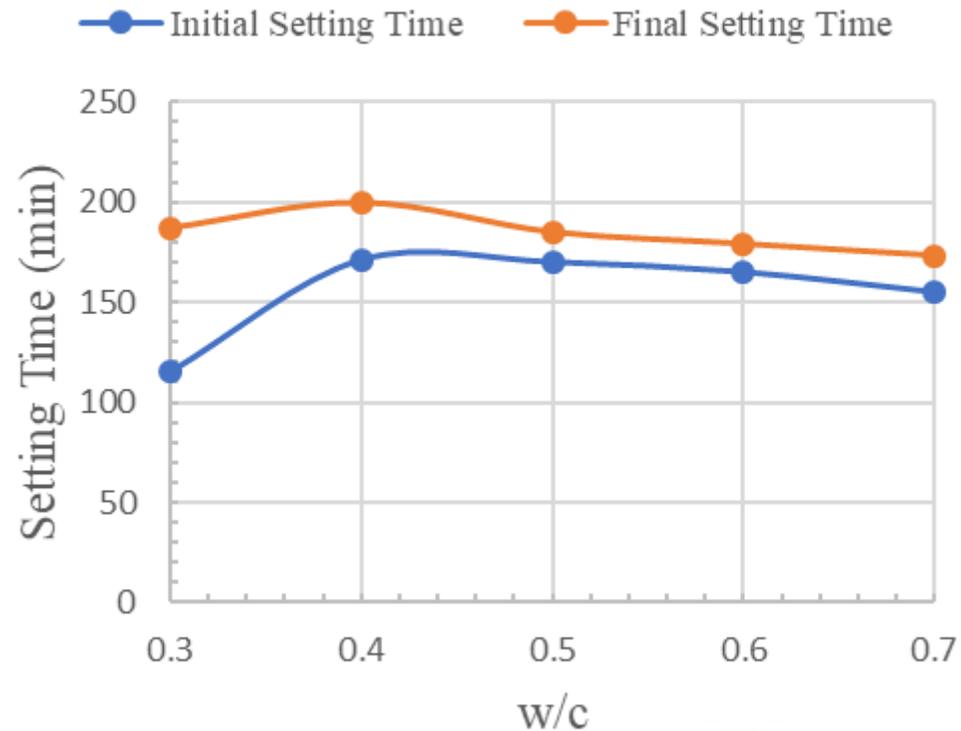


Effect of Citric Acid and Water/Cement Ratio

Effect of Citric Acid Retarder



Effect of Water/Cement Ratio



Setting Time Models

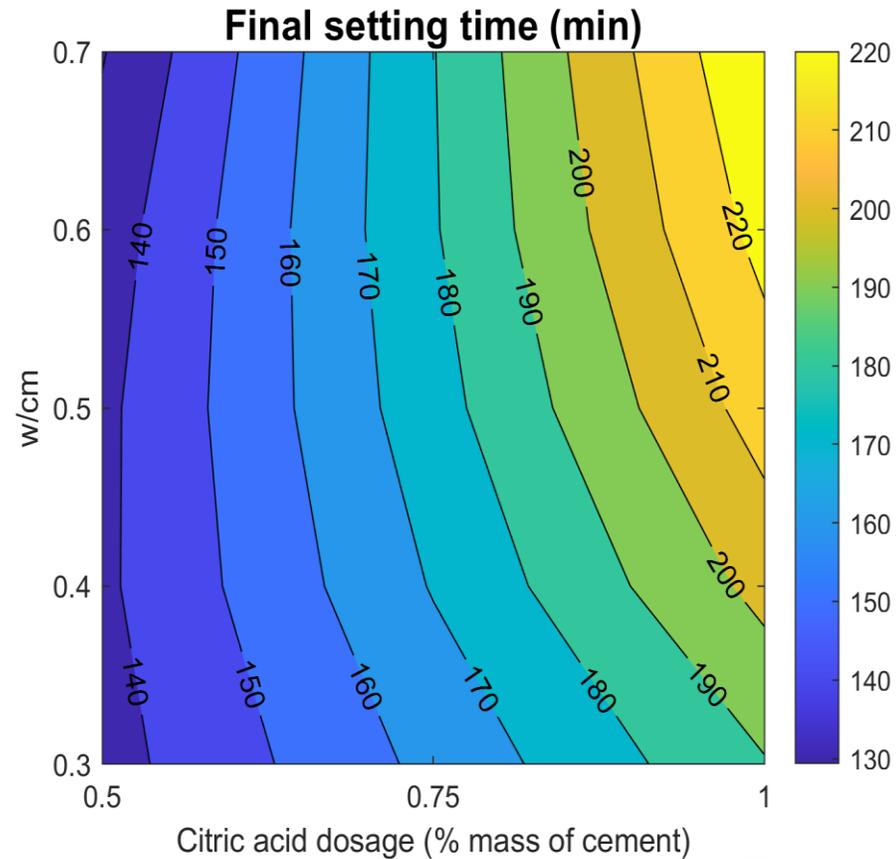
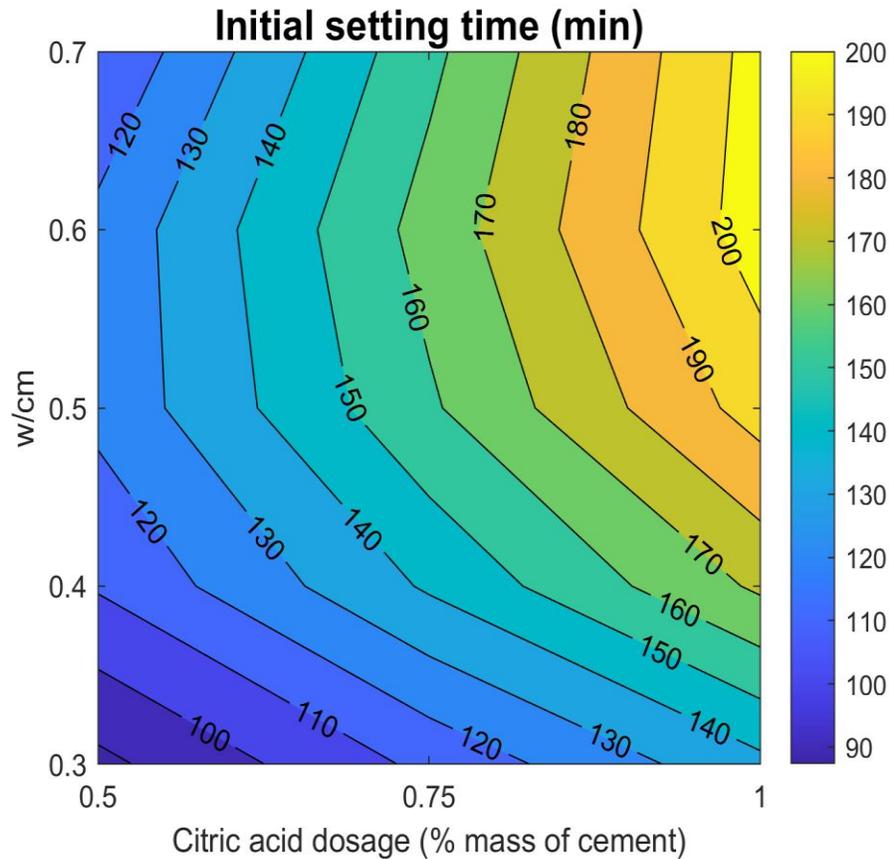
$$t_{initial} = -72 + 35(\%CA) + 543(w/cm) + 216(\%CA)(w/cm) - 592(w/cm)^2$$

$$R^2 = 0.87$$

$$t_{final} = 98 + 35(\%CA) - 11(w/cm) + 237(\%CA)(w/cm) - 125(w/cm)^2$$

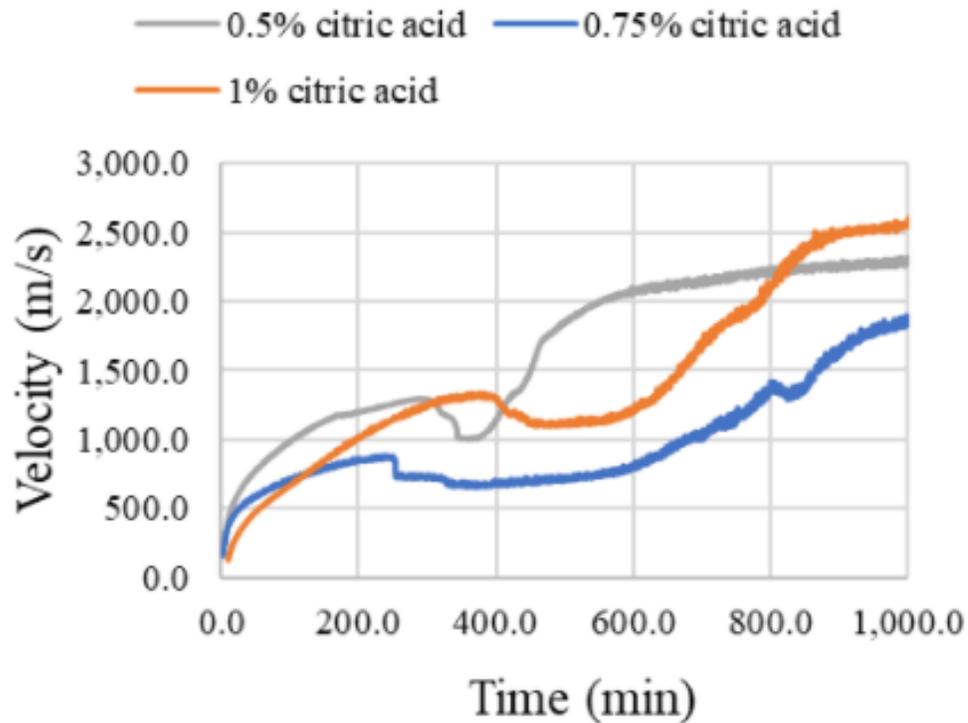
$$R^2 = 0.83$$

Setting Time Models

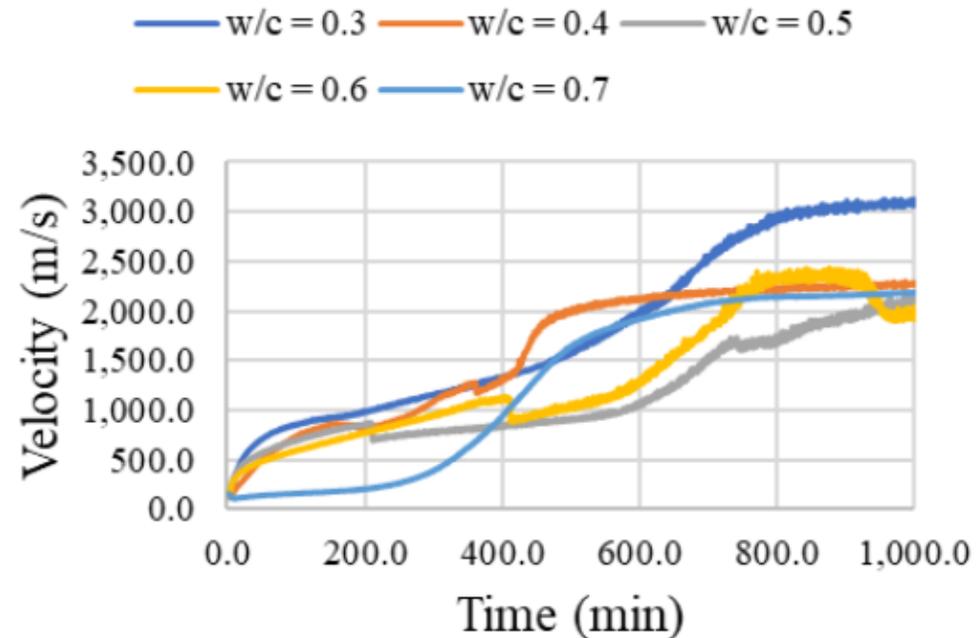


Ultrasonic Monitoring

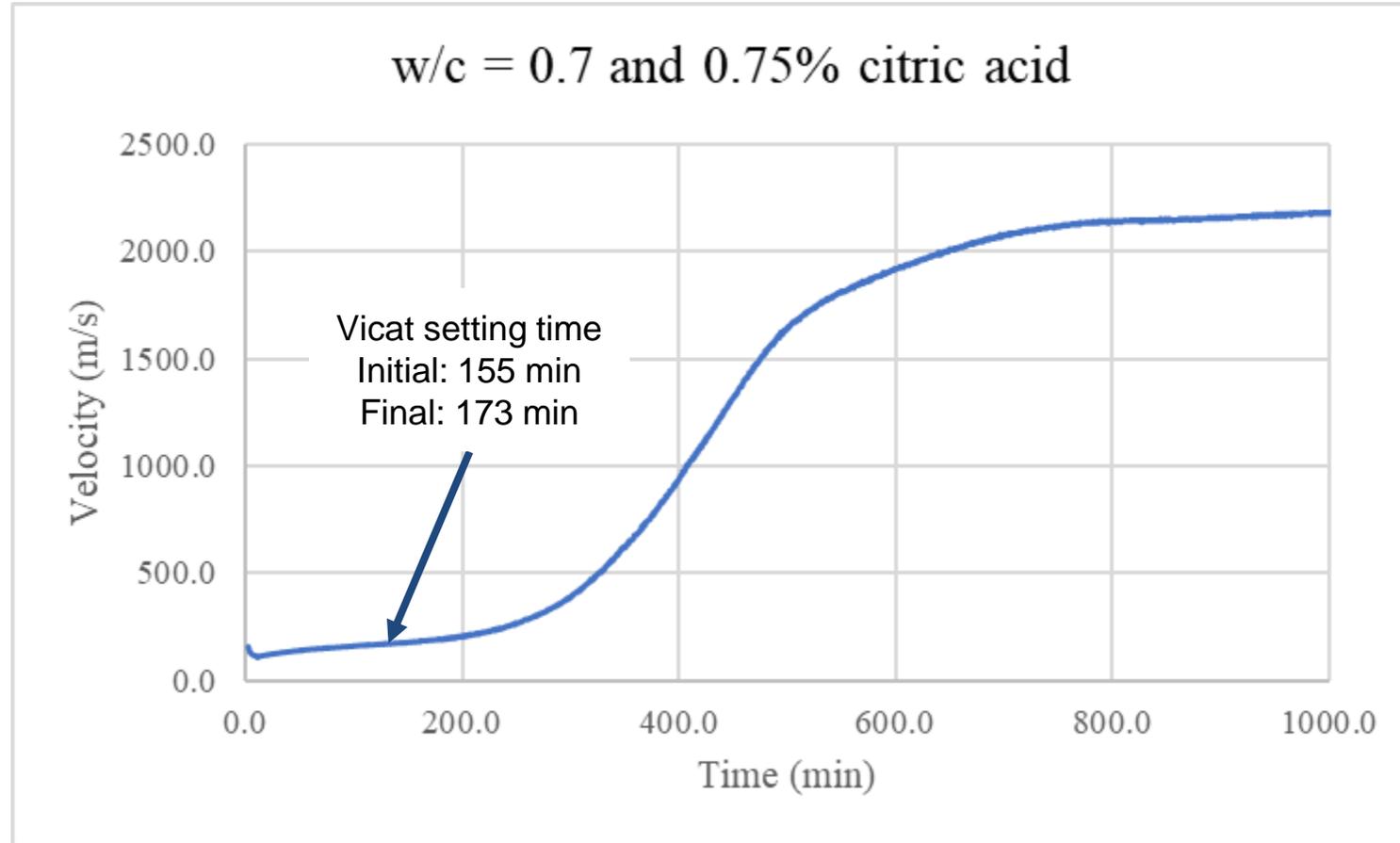
Ultrasonic Monitoring at w/c = 0.5



Ultrasonic Monitoring at 0.75% Citric Acid



Ultrasonic Monitoring Curve



Future Steps

Isothermal Calorimetry

- Observe heat of hydration reaction and identify correlation with other results



Thank You



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