Offsetting Cold Temperature Effects during Concrete Setting using Cryophilic Microorganisms

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Introduction

Casting concrete in cold temperatures is very restrictive and sometimes impossible. The hydration process that brings the strength to the concrete becomes slower till a certain temperature where it is completely stopped.

The proposed solution would be to incorporate cryophilic microorganisms into the fresh concrete mixture. This study assesses the legitimacy of this hypothesis while evaluating other essential properties of the concrete mixture.

Methodology

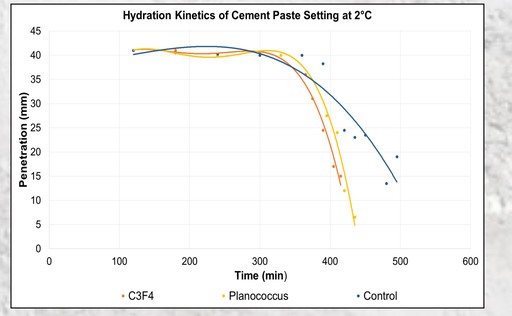
The testing is divided into 2 major sections:

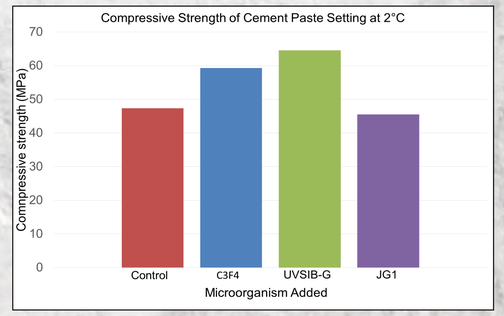
•Comparison of the hydration kinetics using Vicat penetration test on cement paste at cold temperatures, and assessing the effect of the incorporated organisms on the compressive strength of the resulting paste .

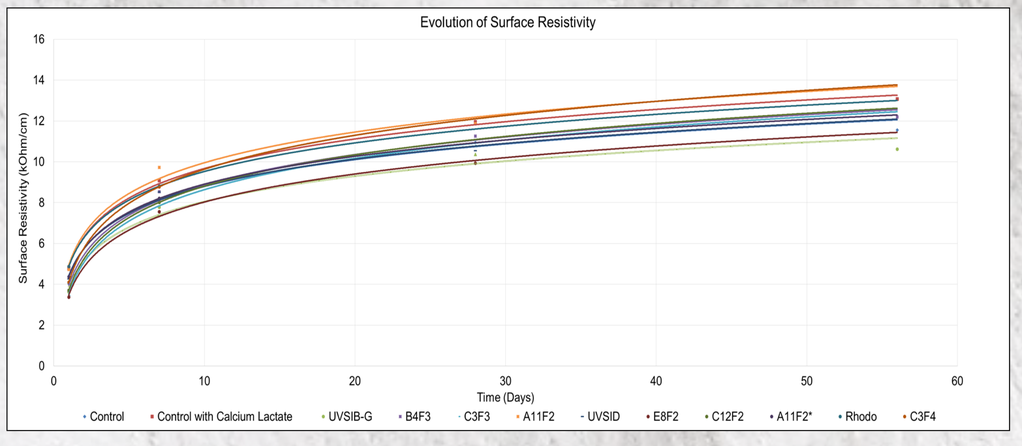
•Assessment of the surface resistivity in function of temperature change at early age and maturity dates, and assessing the effect of the incorporated organisms on the compressive strength of the concrete.

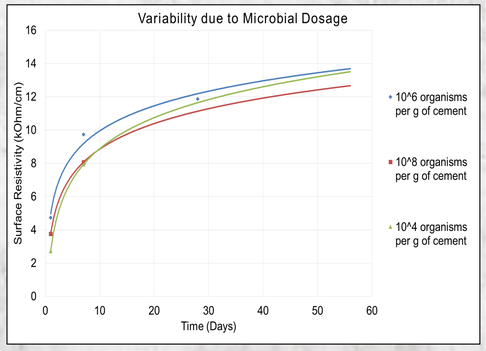
The surface resistivity testing is an indirect measure of the hypothetical production of calcium carbonate by the microorganisms. The produced calcium carbonate would improve the transport properties of the concrete, by reducing its porosity, and affect its strength depending on its brittleness.

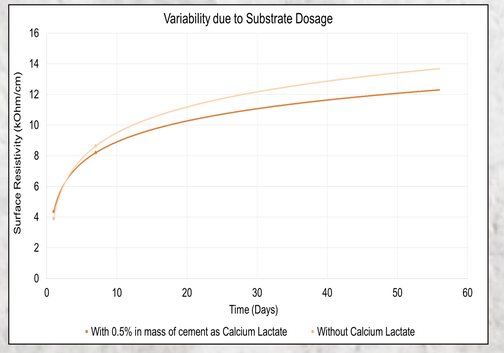
Results



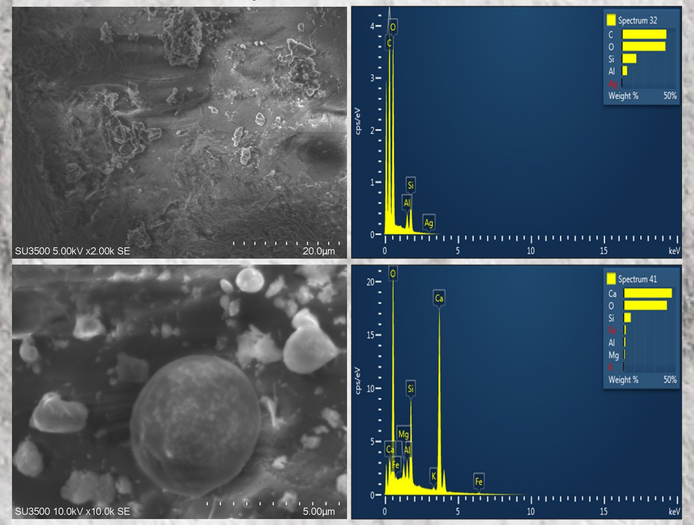








Scanning Electron Microscope images and spectral analysis



Conclusion

Some of the embedded microorganisms improved the hydration kinetics, however the results are not consistent enough to have a definitive conclusion.

The microorganisms are surviving the high alkaline medium of the concrete, however the porosity is increased therefore the hypothetical microbial induced calcium carbonate precipitation cannot be proved. We can also observe that the substrate dosage and the microbial concentration affect the microbial activity.

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