



Advanced Concrete Materials

CIVILEN 6510

Credit Hours:

3.00 - 3.00

Course Levels:

Graduate (5000-8000 level)

Course Components:

Lecture

Course Description:

This course takes a materials science-based approach to understanding the materials and processes involved in hydration and property development of cementitious materials. Students will then apply that learning to understand how to design systems which will prevent, and/or mitigate durability concerns common in concrete infrastructure.

Prerequisites and Co-requisites:

Prereq: Grad standing in CivilEn, or permission of instructor.

Course Goals / Objectives:

- Goal A - Understand basic materials science principles related to cementitious materials use Learning Outcome 1 - Understand the basics of cement production and how precursor materials influence formation of portland cement clinker. Learning
 - Goal B ? Understand the basics of cement clinkering, hydration, and property development Learning Outcome 3 - Understand the basics of cement hydration and the pozzolanic reaction and be able to use this information to relate heat release of
 - Goal C ? Recognize the most common deleterious reactions occurring in cementitious materials Learning Outcome 6 - Understand the mechanisms controlling the most common deleterious reactions affecting concrete durability, identify durability
 - Goal D ? Understand the principles behind common cement characterization and testing processes Learning Outcome 7 - Understand the tools structural and forensics engineers use to understand and track hydration and durability processes.
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Course Topics:

- Introduction to Materials Science Principles: Crystallography and Dissolution/Crystallization, Reaction Kinetics, Thermal Analysis
 - Cement Production and Clinkering Process and Reactions, XRD intro; Supplementary Cementitious Materials 'Production' and Properties
 - Tools of Cement and SCM Characterization (SEM, PSD); Hydration (chemistry, chemical shrinkage, dissolution and hydrated phase formation, pozzolanic reactivity)
 - Hydration (temperature effects, porosity, strength development); Concrete Mixture Fresh Properties (workability, rheology, basics of pumping, advanced mixture design principles)
 - Concrete Mixture Fresh Properties (workability, rheology, basics of pumping, advanced mixture design principles; Tracking hydration: calorimetry, maturity determination methods, electrical methods
 - Admixture Principles and Fiber Usage; Durability: Ion transport; Durability: alkali aggregate reactions, freezing and thawing
 - Durability: sulfate attack, salt crystallization, carbonation; Durability testing: optical microscopy, SEM of hydrated pastes, TGA?
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Designation:

Elective