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Synthesis & Kinetics of Nanostructured Calcium Silicate Hydrates (C-S-H) with high Ca/Si ratio for applications in eco-friendly cement & concrete

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Cement is one of the most widely used materials and its production is responsible for 5 - 8 % of yearly man-made global CO2 emissions. Calcium Silicate Hydrate (C-S-H) is the main product of the hydration of Portland cement and it's the key for the strength in cement based materials. A better understanding of the kinetics and growth mechanism will throw us some light in arriving at a new alternative material for substitution in cementitious material on a more scientific basis. Owing to the fact that the composition of real cementitious materials is complex with several different mineral phases, we have adopted a synthetic approach to precipitate C-S-H and gain more insight to its kinetics and growth mechanism. The contour of my master project starts with synthesising C-S-H via precipitation route at Ca/Si ratio varying from 1.0 to 1.75, based on the thermodynamics modelling predictions by Gibbs Energy Minimization Software (GEMS) and followed by Kinetic studies on C-S-H precipitation. The synthetic conditions adopted are focused to arrive as close as possible to real system C-S-H, in accordance to thermodynamic equilibrium conditions predicted by GEMS. The synthesised samples has been characterised by TGA, XRD, ICP-OES, FTIR, BET, TEM. The characterized sample helps in evaluating the prime conditions for arriving at C-S-H closest to the real system. The second part of the project deals with Kinetic studies aimed at elucidating the steps involved and evolution of the previously synthesised samples. It helps in understating the growth mechanism in formation of the precipitated C-S-H, it terms of morphology etc. Furthermore the kinetic data helps in development of population balance model for better prediction of the product formation for given starting conditions.

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