

Investigation of Strength and Mechanical Properties of Natural Zeolite Based High Performance Concrete (HPC)

The chloride induced corrosion of steel reinforcement embedded in concrete is a significant issue that threatens anticipated service life of concrete structures. Very little research has been done for durability investigation of zeolite as a supplementary cementitious material. Due to severe weathering problems in nation's concrete infrastructures namely bridges and pavements, it has become very important to develop HPC. HPC generally increases the durability against the chloride induced corrosion as well as long term strength. Natural pozzolanic cementitious material known as natural zeolite is being used for enhancing the performance of HPC. Natural zeolite, a crystalline hydrated alumino-silicate processed (volcanic ash) mineral that has a unique three-dimensional honeycomb framework, is currently used as partial replacement for cement in concrete all around the world.

The purpose of this study is to investigate compressive strength, tensile strength, shrinkage, electrical resistivity and modulus of elasticity, which is related to durability and strength of zeolite based HPC mixtures to enhance the performance and serviceability of reinforced concrete bridges and pavements. Concrete resistance of zeolite materials against chloride penetration retards the corrosion initiation and slows down active corrosion propagation. Electrical resistivity data of zeolite would be an essential added component in the service life model and this model is aimed to provide first insight into the beneficial effect of High Performance Concrete (HPC) mixtures in delaying corrosion induced cracking. Overall, zeolite based concrete mixtures will be expected to provide promising results in terms of modulus of elasticity, resistivity, compressive strength and tensile strength. Further, substitution of zeolite with cement in concrete mixtures will reduce carbon dioxide (CO₂) emission and promote sustainability.

For this project, I will need 3-4 students in summer 2017 for laboratory investigation and numerical analysis. They will gather short and long term durability data namely compressive strength, tensile strength, shrinkage, resistivity and conductivity data for various zeolite based concrete mixtures.