

RASHTREEYA VIDYALAYA COLLEGE OF ENGINEERING

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A STUDY ON BACTERIAL COMPOSITES (A KSCST FUNDED PROJECT)

Submitted by

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SYNOPSIS

Cracks are inevitable in concrete due to many reasons. Currently there exist several methods in practice to mitigate cracks which are uneconomical. This is where the need for bacterial concrete arises, since it is advisable to use an economical and environmental friendly solution which heals cracks naturally. On incorporation of bacteria to concrete as a crack healing material, it has been found that the microbially induced calcite precipitation heals the concrete automatically without any external means. It was found that the bacteria that can survive at a high pH (i.e. >12). The optimum dosage for the bacterial application in concrete was estimated to be 10^5 cells/ml of bacterial solution. It is reported that, in bacterial concrete, when water seeps into the concrete and comes in contact with bacteria, spores germinate which in turn aids the process of calcite precipitation. This precipitation was visible in Scanning Electron Microscope and X-Ray Diffraction analysis and was found to enhance the physical properties of concrete. Research on bacterial composites has been profound on bacterial mortar cubes. In view of this, we aim to study the performance of bacterial cement paste and concrete.

Two bacterial strains, namely *Bacillus Sphaericus* and *Sporosarcina Pasteurii*, were identified, procured, cultured and germinated. Several test like urease test, calcium carbonate test, haemocytometer test (live cell count test), spectrophotometer test and gram stain test were conducted to characterize bacteria and to check its ureolytic activity, so that it could give end product in a required manner. The experimental study includes the casting of conventional and bacterial cement paste cubes for various parameters like concentration (10^5 , 10^6 , 10^7 , 10^8 cells/ml of bacterial solution), age (1day, 7days, 28days) and methods of bacterial incorporation (fresh state, ponding, crack injection) for both the bacteria. The bacterial concrete was designed for a specific compressive strength and cubes, beams, cylinders and prisms were cast and tested.

It was found that both the bacteria, *Bacillus Sphaericus* and *Sporosarcina Pasteurii* could sustain concrete environment. The precipitation of calcite by bacteria was found to be in the range of 3mg/l for bacterial solution of 10^8 cells/ml concentration. Incorporation of bacteria by several methods like fresh state, by ponding and injection yielded positive results. This was further confirmed by studying the results of Scanning Electron Microscopy and X Ray Diffraction tests conducted at different ages for cement paste. The compressive, tensile and flexural strengths of bacterial concrete were found to increase by 28.78, 12.15, and 13.81% respectively over their conventional counterparts. Modulus of elasticity was found to increase by 20.12%. Therefore, as a construction material, bacterial paste/concrete was found to render a better performance. Bacterial concrete find a wide range of application in marine structures due to its chloride resistance and resistance towards water permeability.

Keywords: Bacteria, durability, crack, permeability, conventional concrete