

**AN EXPERIMENTAL STUDY OF DEVELOPMENT OF
PHENOL-FORMELDEHYDE RESIN IMPREGNATED CONCRETE**

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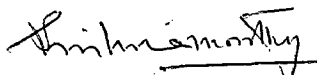
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C E R T I F I C A T E

This is to certify that the thesis entitled, "An Experimental Study of Development of Phenol-formaldehyde Resin Impregnated Concrete" being submitted by Chitra Kirtane to the Indian Institute of Technology, Delhi for the award of the "Doctor of Philosophy" in Chemistry, is a record of bonafide research work carried out by her under our guidance and supervision and has fulfilled the requirements for the submission of her thesis.

To the best of our knowledge the thesis has reached the requisite standard. The material presented in this thesis has not been submitted in part or full to any other University or Institution for award of any degree or diploma.



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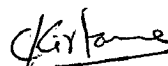
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A B S T R A C T

A systematic study has been done on the use of phenol-formaldehyde condensate, a thermosetting resin, to develop polymer impregnated concrete (PIC). An ordinary grade 1:2:4 concrete and commercially available phenol-formaldehyde resin have been used and the effect of various parameters have been studied to obtain 'optimum' conditions to develop PIC which include viscosity of resin solution, change in concentration of cross-linking agent, age of concrete prior to impregnation, drying temperatures for small-sized concrete specimens, cross-linking (curing) temperatures of impregnated resin, quality of concrete and type of cement. Use of special technique for impregnation of predried concrete specimens after evacuation to give better polymer loadings and strength improvements has been adopted. The PIC specimens exhibit strength improvements by 2 to 3 times over unimpregnated concrete at relatively lower polymer loadings of about 2% when the cross-linking (curing) temperatures are below 100°C.

The PIC developed under 'optimum' conditions are tested for compressive and tensile strengths, modulus of rupture, stress-strain behaviour, water absorption and durability against distilled water, 0.2% sodium hydroxide, 2% sulphuric acid and a mixed solution of 3.4% sodium

chloride and 0.5% magnesium sulphate for an exposure of 77 days.

Infrared spectra, X-ray diffractographs and scanning electron micrographs are also presented to appreciate the chemical interaction between resin and concrete responsible for observed strength improvements.

Appropriate conclusions have been drawn on the behaviour of phenol-formaldehyde resin impregnated concrete and comments have been made on limitation of the resin system to develop PIC, keeping also in mind that the only cement available then for the project was a low quality (portland pozzolan) cement.

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