INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.
Thesis Title	:	Evaluating the Influence of Production Parameters on the Performance of Microsurfacing Mix
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Thesis Submitted to the Department/ Center	:	Civil Engineering
Date of completion of Thesis Viva-Voce Exam	:	24 June 2022
Key words for description of Thesis Work	:	Microsurfacing, material properties, process control parameters, durability.

SHORT ABSTRACT

Microsurfacing is a mixture of crushed mineral aggregates, polymer modified emulsion, mineral filler, water and additive, mixed and produced at ambient temperature. The performance of microsurfacing depends on mix ingredient optimization and process control during production. Hence, the objective of this study was to investigate the influence of different production parameters on the performance of microsurfacing mix during the mix design stage, production stage, and service life.

Mix design involves the selection and assignment of dosages of different components. Parameters including aggregate-emulsion compatibility, early traffic damage, raveling, rutting and bleeding are investigated during the mix design stage. In this study, the challenges faced during mix design were rapid emulsion breaking, lower cohesion, higher raveling, and rutting. A combination of fillers, harder asphalt binder, and solvent was used to address the compatibility and performance issues. This highlights the importance of selection of proper material type and emulsion production process. Six mix design parameters were evaluated at 4 emulsion contents (total specimens = 72, considering 3 replicates) to determine the job mix formula. A narrow range diagram illustrating the acceptable range of emulsion content was proposed to determine optimum emulsion content (OEC).

During production, process control involving tight control of quality control/ quality assurance (QC/QA) is vital to assure the fulfilment of quality and regulatory requirements. In this study, a total of 35 combinations of aggregate gradation, emulsion content, and water content, were produced. Aggregate gradation was varied within mean ± tolerance limit specified by International Slurry Seal Association (ISSA). Emulsion content was varied within OEC ± 1.5%, i.e., 12.5% to 15.5%. Water content was varied from OWC – 1% to OWC + 2%, i.e., 5.4% to 8.4%. Each combination was tested for workability, strength, raveling, rutting, and bleeding in terms of consistency, cohesion, abrasion loss, lateral displacement, and sand adhesion, respectively. The relative contribution of each parameter was

quantified using Artificial Neural Network (ANN) and Garson's algorithm. The parameter having the highest relative contribution on performance was quantified by developing a model using Multigene Symbolic Genetic Programming (MSGP). Finally, probability of failure was determined using reliability analysis.

The outcomes of the laboratory investigation highlighted that controlling the parameters within the tolerance limits might not be sufficient to ensure desirable characteristics. In particular, mix produced with the combination of coarse aggregate gradation having lower mineral filler content and lower emulsion content had the highest risk of failure. Hence, this study proposes that during mix design, the critical combinations of process control parameters should be identified with the integrated use of ANN and MSGP. The associated risk of failure should be benchmarked using reliability analysis and appropriate quality control measures should be suggested to enhance quality and performance of microsurfacing.

Finally, durability was assessed by subjecting the mix to 30 combinations of aging and moisture conditioning. Performance was quantified in terms of raveling resistance. It was observed that until the specimen had the presence of moisture, raveling was influenced by moisture conditioning. But once the specimen was fully cured and subjected to further aging, the effect of moisture on raveling was minimal. Thus, this study recommends that microsurfacing shall be applied during favorable environmental conditions, facilitating faster moisture loss and strength gain to ensure durability.