INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: NOVEL INVESTIGATIONS ON POTENTIAL OF BALANITES AEGYPTIACA AND SESAMUM INDICUM FOR SURFACTANT PREPARATION AND APPLICATION IN FOAM CONCRETE

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Thesis Submitted to the Department/ Center	:	
Date of completion of Thesis Viva-Voce Exam	:	6th March 2023
Key words for description of Thesis Work	:	Foam concrete, natural surfactant, hingot fruit, sesame seed, density, density ratio, surfactant concentration, foam generation pressure, foam stability, viscosity of surfactant solution, response surface methodology, water solids ratio, air void parameter, image analysis, compressive strength, water absorption, mineralogical

SHORT ABSTRACT

Synthetic surfactants commonly used in foam concrete production is reported to exhibit serious environmental threat. Hence utilization of natural surfactants could present new sight in improving the environmental impact of foam concrete. However, studies on valorization and extraction of natural surfactants from different plant and animal sources for use in foam concrete is very scarce from Indian context. Considering the above facts, the current study aims to use natural surfactants valorized and extracted from two different biological sources, namely sesame seed (rich in protein) and hingot fruit (rich in saponin) as prospective supplementary alternative to conventional synthetic foaming agents in foam concrete production. Balanites aegyptiaca also known as hingot is found all over the world and studies on phytochemistry of various parts of plant indicate that fruit, seeds and bark part of plant has 22-27% of saponin. Adding to above, excellent plant's adaptability, high yield features and abundant availability are other added reasons for selection of this plant for this study as it can add economical as well as environmental benefits. Another plant source used for surfactant extraction in the present study is Sesamum indicum commonly known as sesame seed. Studies have proved that sesame seed has rich protein content of 20 to 25% and hence has excellent potential foamability. Despite the huge potential foamability of above surfactants (sesame and hingot), it is surprising to find that to date, its potential has not been assessed for use in foam concrete production. The first phase of present study comprises of the optimization of surfactant extraction and foam production processes through systematic experiment design based on

response surface methodology (RSM). The possible response surface models have been developed for prediction of various foam and surfactant characteristics such as initial foam density (IFD), foam stability, foam bubble size and viscosity of surfactant solution. The validity of models is tested by ANOVA and verified experimentally. Analysis of influence of various input parameters on responses indicated that surfactant concentration has significant effect on all the responses studied. Further the parameters associated with heating process (heating temperature and duration) also have substantial influence on various foam and surfactant characteristics as it promotes the hydrolysis of protein and saponin. The obtained results established that increase in surfactant concentration, heating temperature and heating duration resulted in increase in viscosity of surfactant solution eventually leading to reduction in foam liquid fraction, foam drainage and bubble size. Hence good correlation is established between above mentioned foam and surfactant parameters. Furthermore, performance of surfactants in foam cement paste was assessed and ASTM requirements are found to be met confirming foam stability. The outcomes of the present study could help the industry to gain confidence in the usage of recommended natural surfactant for foam concrete production.

Studies on relative behavior of concrete produced using these surfactants could help the industry to gain confidence in the usage of recommended natural surfactants presenting new sight in improving the environmental impact of foam concrete. Another main facet of this work is to carry out an extensive experimental investigation on the effect of water-solids ratio on the various characteristics of foam concrete on which only very limited studies are available in literature. The role of water-solids ratio on various physical, mineralogical and mechanical properties of foam concrete have been considered for range of densities. The results show that performance of foam concrete with different foaming agents varies greatly due to creation of different void structure in concrete. The consistency of hingot foam concrete mixes is relatively higher than that of sesame foam concrete mixes due to the relatively lesser viscosity of the hingot surfactant solution. Due to the above-mentioned reason, hingot foam concrete mixes exhibit bigger size air voids when compared to sesame. Another important observation is that there is an optimum water-solids for a particular density of foam concrete which results in maximum strength. The optimized water- solids ratio derived for various mixes is justified with air void structure. The experimental out- comes proved the insight that the mechanical behavior of porous material depends not only on porosity but also on the pore size distribution.