

Accepted Manuscript

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PII: S1359-8368(17)32186-8

DOI: [10.1016/j.compositesb.2017.10.006](https://doi.org/10.1016/j.compositesb.2017.10.006)

Reference: JCOMB 5326

To appear in: *Composites Part B*

Received Date: 28 June 2017

Revised Date: 6 October 2017

Accepted Date: 6 October 2017

Please cite this article as: Shahapurkar K, Garcia CD, Doddamani M, Mohan Kumar GC, Prabhakar P, Compressive behavior of cenosphere/epoxy syntactic foams in arctic conditions, *Composites Part B* (2017), doi: 10.1016/j.compositesb.2017.10.006.

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Compressive behavior of Cenosphere/Epoxy syntactic foams in Arctic Conditions

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Abstract

In this paper, the effects of arctic condition on the compressive response of cenosphere/epoxy syntactic foams are investigated. Understanding the behavior of such foams under extreme conditions is critical for exploring their suitability for constructing lightweight platforms used in arctic explorations, which are exposed to subzero temperatures for extended periods of time potentially degrading their mechanical properties. In the research study presented here, samples of cenosphere/epoxy syntactic foams were conditioned under arctic environment at a temperature of -60°C for a period of 57 days. Compression tests were then conducted at room temperature as well as in-situ -60°C on the conditioned samples and compared against unconditioned samples tested at room temperature. Combinations of surface modification and cenosphere volume fractions were considered. For the case of unconditioned samples, compressive strength decreased with increasing cenosphere volume fraction for both surface modified and unmodified cenospheres. For the arctic conditioned samples, cenospheres/epoxy foams did not present visible signs of degradation prior to testing, but manifested a reduction in compressive modulus in a range of 47-57% and 47-65% for untreated and treated cenospheres/epoxy syntactic foams as compared to their unconditioned counterparts. On the other hand, the compressive strength increased in a range between 32-68% for untreated and 59-80% for treated cenosphere foams in arctic environment, which can be attributed to the matrix hardening introduced by frigid in-situ environment. Also, under in-situ arctic compressive loading, the post peak response for all foam types have shifted from a progressive failure to a brittle type behavior.

Keywords: Syntactic foam, cenospheres, compression, arctic temperature, cenosphere/Epoxy

1. Introduction

Sandwich composites have gained significant importance in recent years in the context of replacing conventional engineering materials for naval applications due to favorable properties such as lightweight and the ability to tailor mechanical properties. These sandwich composites typically consist of a lightweight core which is sandwiched between two fiber-reinforced laminated

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