

Study of Acoustics Properties of SK One Component Polyurethane and its Application in Arctic Marine Structures

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Abstract

Marine noise reduction tends to be challenging and requires a comprehensive engineering approach. The soundproofing materials for marine noise reduction are usually exposed to high temperatures, potential fluid or oil spills, engine maintenance and a high airflow environment. This work looks into the acoustic proofing properties of a non-toxic material 'SK One Component Polyurethane' developed by China Institute of Water Resources & Hydropower Research (IWHR) in Beijing.

It is intended to perform experimental and numerical analysis in this research. In the acoustic proofing test, energy absorption property of material will be tested under the influence of acoustic waves and for Sound Transmission Class (STC) for a large range of frequency (low, mid and high frequencies). In addition, numerical model will be set up to perform Statistical Energy Analysis (SEA). SEA has proven to solve vibratory behaviour of complex structures. It is reported that higher frequency (i.e. shorter length-scale) modes are more sensitive to the inevitable small variations in structural details, even in nominally identical structures. Hence, it is more challenging to predict structural behaviours reliably; however, with development in currently existing SEA method, these can be captured. LS DYNA® simulation software will be used to model the acoustic behaviour.

The study will provide reliable data on vibrations, isolating element, acoustic proofing properties and solving high-frequency structural acoustic-vibration problems of Marine structures. These results will be extremely valuable for predicting the environmental impact of the ever-increasing sea traffic in the Arctic region.

Feynman Acoustic Wave Equation

$$\nabla^2 p = \frac{1}{c^2} \frac{\partial^2 p}{\partial t^2}$$

where p is acoustic pressure (Pa),

c is speed of sound ($\frac{m}{s}$),

t is time (t), and

∇ refers to Laplace operator.

Acoustic Absorbing Foam



Properties of SK One Component Polyurethane

- Good aging resistance
- Non-toxic
- Good anti-seepage and anti-abrasion performance
- High strength, high elongation and good bonding with base concrete
- Good chemical resistance
- Good anti-freezing performance
- Simple and convenient construction

Statistical Energy Analysis (SEA)

Statistical energy analysis (SEA) is a method for predicting the transmission of sound and vibration through complex structural acoustic systems (Lyon and Smith, 1959). To solve a noise and vibration problem with SEA, the system is partitioned into a number of components (such as plates, shells, beams and acoustic cavities) that are coupled together at various junctions. Each component supports different propagating wave types.

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