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TITLE: Mitigation of low-frequency underwater anthropogenic noise using stationary encapsulated gas bubbles

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ABSTRACT:

Collections of bubbles cause significant dispersion and attenuation of underwater sound near the individual bubbles' resonance frequencies and can potentially be used to abate low-frequency anthropogenic underwater noise. Such effects have been reported for large encapsulated bubbles with resonance frequencies below 100 Hz [J. Acoust. Soc. Am. {\bf{127}}:2015 (2010)] and significant attenuation due to bubble resonance phenomena and acoustic impedance mismatching was observed in experiments using a compact electromechanical acoustic source [J. Acoust. Soc. Am. {\bf{128}}:2279 (2010); J. Acoust. Soc. Am. {\bf{129}}:2462 (2011)]. We describe a method of shielding either a noise source or a receiver using screens or curtains of large encapsulated bubbles. This method was applied to two distinct types of real-world noise excitation: continuous wave noise radiated by a vibrating marine vessel and impact noise from marine pile driving. Experimental results show significant noise reduction ranging up to 40 dB can be attained using this method. In addition, a model of encapsulated bubble dynamics was developed and has been used in conjunction with numerical models to design the encapsulated bubble curtain systems. [Work supported by Shell Global Solutions and the ARL:UT IR&D Program.]

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