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NOISE REDUCTION BY AIRINLET IN THE PROPELLER DUCT.

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INTRODUCTION.

During the last few years growing attention has been paid to noise problems on fishing vessel. In general, the propeller noise problem is more critical on smaller ships where the accommodation is closer to the propeller.

However, the most important problem on fishing vessels due to propeller noise is the influence and disturbances on hydroacoustic equipment.

Based on the results from a larger research project where 150 ships were investigated the following main conclusions were found:

- Noise induced by propeller cavitation is the main source to the problems described. Noise from main and auxiliary enginens give only secondary effects. On most of the ships at full speed the noise level was lower than 65 dBA in only 20-30 % of the cabins.
- The ship hull form has a large influence on the noise levels from the propeller. On full form ships the noise levels are higher than on slender ships.
- Cavitation erosion of the blades was found on 17 % of the ships.

In this paper air injection as a mean to reduce propeller cavitation noise is discussed.

FULL SCALE EXPERIENCE.

Air injection equipment has been installed on a lot of ships-with ducted propeller systems. Fig. 1 illustrates the injection system and pipe arrangement. On most of the ships the suction on the blades and on the duct profile is large enough to ensure the neccessary amount of air. It is recommended to install a regulating value to control the injected air volume.

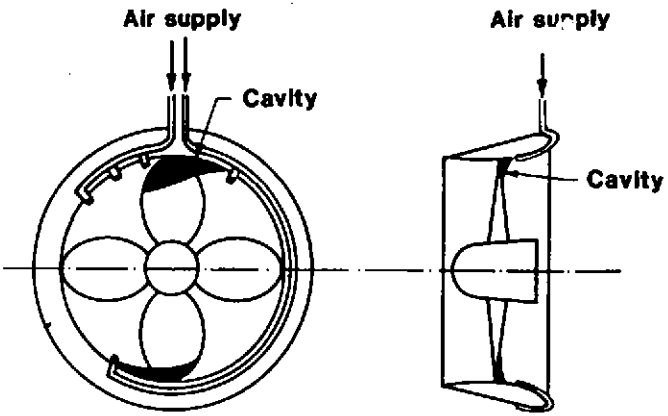

Fig. 1. Air injection system.

In this paper we will concentrate on three ships on which such system have been installed.

The main particulars of the ships are:

	SHIP A	SHIP B	SHIP C
Type of ships	Tanker	Fishing vessel	Fishing vessel
Length (m)	320	20	31
SHP	34200	450	1200

On ship A the air injection equipment was primarily installed to solve the cavitation erosion problems of the duct. However, a hydrophone was installed in the afterbody and noise measurements were also done inside the ship. On ship A only two air outlets were installed, $\phi=0^{o}$ and 15^{o}. Results from hydrophone measurements are given in Fig. 2 presented as level differences for 0,5 and 10 m^3/min. flow rates.

On ship B the air injection equipment was installed to increase the critical ship speed, the maximum speed at which the ship may operate without unacceptable noise levels on the echosounder. On this ship 3 air outlets were installed in the upper part of the duct and one outlet in the lower part. The reason for the lower outlet was that due to ship hull form there was a high wake peak - low inflow velocities to the propeller in this area giving dynamic blade cavitation.

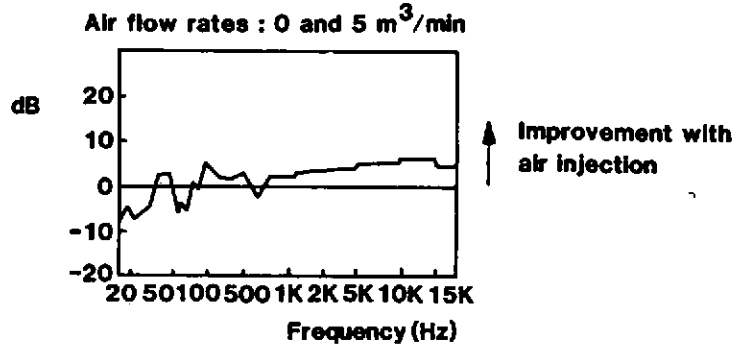

Fig. 2. Improvement in noiselevel as a function of frequency.

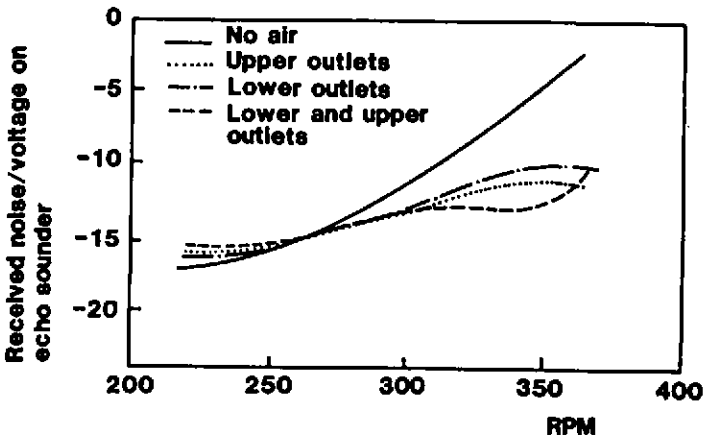

Fig. 3. Received noisevoltage on echosounder as a function of ships RPM.

Noise measurements were carried out applying a hydrophone in the after peak tank area and microphones inside the ship. Results are presented in Fig. 3 and 4. As may be observed the noise level inside the ship is significantly lower for frequencies above 100 Hz by injecting air.

For lower frequencies there is an increase of the noise level - the same as experienced on ship A. The same results are also obtained from the hydrophone measurements. For ship C - a fishing research vessel approximately the same arrangement as on ship B was installed except for the lower outlet.

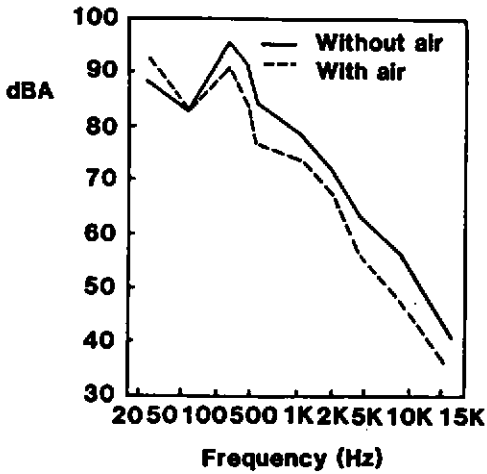

Fig. 4. Noise level (dBA) as a function frequency.

CONCLUSION.

For ducted propellers the application of air injecton systems to reduce cavitation induced noise has shown:

- On most of the ships the propeller/duct suction force is high enough to get enough air mixing with the cavities. A regulating valve is however recommended to control and optimize the injected air volume.
- The necessary amount of installation work and cost are quite low.
- In general, the noiselevel or hull pressure fluctuation of lower frequencies may increase with increasing amount of injected air.
- Noise levels of higher frequencies - above 100-150 Hz - are significantly reduced. The reduction may be of the order of 10-15 dB.
- On a typical fishing vessel the critical speed was increased by 1.5 kts.