Noise Generation by Agitated Industrial Liquid Masses

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1. INTRODUCTION:

Quite often liquid masses are subjected to agitation in industrial processes such as in liquid baths used for cooling of parts heated during working them, centrifuges, turbulent fluid flow. Invariably, such agitated liquid masses generate noise. An analytical treatment of such noise is quite difficult in view of the various parameters involved, the shape of the containers, depth of the liquid mass, agitating mechanism, frequency of agitation etc.

When a mass of fluid flows past another fluid mass or a rigid or flexible solid with considerable relative velocity, the shear causes flow separation resulting in turbulence and pressure fluctuations. When these pressure fluctuations are transmitted through the surrounding air to the human ear, it gives the sensation of noise.

This phenomenon is quite common and can be seen in jet noise, wind noise in automobile and airplanes and when wind blows past our ears. The motivation for the present study came from the high noise levels from industrial liquid baths used to cool the drawn wires in the wire drawing industry. The noise from the drawing operation itself is muffled by the oil surrounding the drawing dies in a tank, however, the noise from the liquid baths were excessive and reached levels of 108 dB. The drawn wires passed through idler pulleys which agitated the cooling liquid in which they were submerged.

In the present study the noise generated in such agitated liquid masses is measured. A container filled with liquid is agitated using rotating blades. Noise measurements are carried out with the lid of the container open and closed at different speeds. Measured results are presented and discussed.

2. EXPERIMENTAL SET UP:

Preliminary studies are done using a simple kitchen blender shown in Fig. 1. The blender jar was filled with water and the noise was measured at a distance of 30 cm and a height of 50 cm from the base of the jar. Initially the background was measured and then the noise generated by the motor alone was measured without the jar. Subsequently, the noise generated by the agitated water was measured with and without the lid of the jar, at different speeds of rotation of the blades and for different levels of water.

3. RESULTS AND DISCUSSION:

The results are presented in Table 1. The motor noise is about 6 dB higher than the background noise. When the lid of the jar is closed the noise is not significant in comparison with the background noise. However, when the lid is removed, the noise from the agitated liquid is about 5 to 6 dB higher than the motor noise.

4. CONCLUSIONS:

Agitated liquids are capable of generating high noise levels. More investigations are needed with spectral decomposition of the noise and relating it to the motor speed, number of blades, density of the liquid, presence of vortices etc.

5. REFERENCE:

C.J. Hemond, Jr., "Engineering Acoustics and Noise Control", Prentice Hall, Inc., Englewood, New Jersey, 1983

L.B. Freund, S. Leibovitch and V. Tvergaard, "Acoustics of Fluid Structure Interactions" Cambridge University press, 1998.

Table 1. Measured Noise levels

	jar 0.25 full		jar 0.5 full		jar full		motor only	room only
Speed	Lid (dB)	No Lid (dB	Lid (dB)	No Lid (dB	Lid (dB)	No Lid (dB	(dB)	74 dB
1	82	86.8	81.2	86.6	80	87.2	79.2	range from
2	82.3	87.3	81.4	86.2	80.1	87	79.7	73.5
3	83.1	87.3	81.8	86.6	91	87.2	79.8	to
4	82	87.4	82.1	86.5	82	87.3	80	74.3
5	81.6	86.9	82.4	86.9	82.4	87.5	80	
6	81	86.9	82.5	87.1	83.1	87.5	80.2	
7	81.1	86.8	82.2	87.3	83.1	87.4	80.7	

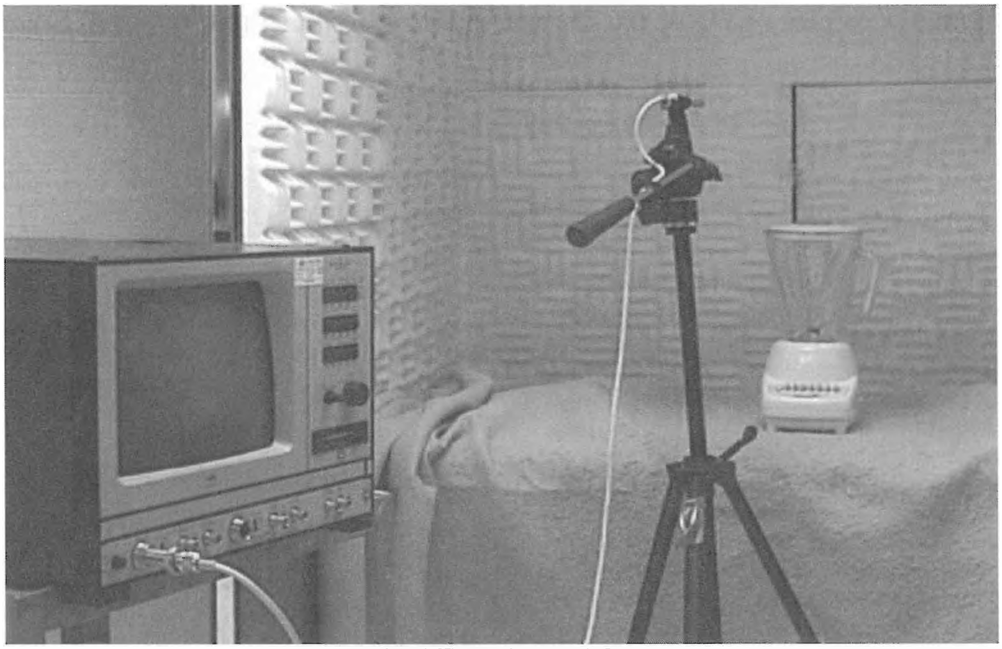

Fig. 1 Experimental Setup