Image Analysis of Cymatic Patterns Formed by Sound in Water

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Abstract

The term of cymatics was coined by Swiss physician Hans Jenny [1,2]. Cymatics deals with image patterns created by sound vibrations in various media. Typically, the surface of a plate, diaphragm, membrane or liquid is vibrated, and regions of maximum and minimum displacement are made visible in a thin coating of particles, paste, or liquid surface. The first reported experiments of this kind were carried out by Galileo Galilei [3] and Robert Hooke [4] in the 17^{th} century. In the 18^{th} century, German musician and physicist Ernst Chladni performed systematic studies of the cymatic patterns using a sand-strewn brass plate, excited by a violin bow [5].

In liquids, e.g. in a bowl, English chemist and physicist Michael Faraday observed that the sound vibrations can generate standing waves forming regular patterns (i.e. cymatic patterns) and described them in 1831 [6]. These so-called Faraday waves are studied in various fields of research, e.g., fluid mechanics, tissue engineering and seismology. The cymatic patterns are for their beauty becoming to be popular among musicians and artists.

In our investigations we focus on image analysis of cymatic patterns formed by various sound frequencies in water. To our knowledge, just a few systematic studies in this field were reported [7], although a suitable equipment for performing such studies is available, namely the CymaScope Pro instrument (Sonic Age Ltd), invented by English acoustic physicist John S. Reid.

In this contribution we present pilot results of our study of cymatic patterns in various types of water acquired by using a simple cymatic device (Water Wonders Kit, Sonic Age Ltd, see Fig. 1), equipped with JKT tone generator (KV2 Audio International s.r.o.). We studied the cymatic patterns in distilled water, well water, tap water, and mineral water. Further, water before and after a special treatment by aquaSpin (H.Preiss International) was studied. AquaSpin is a flow-through device that is installed on the water supply to the property and imitates natural meandering of river flows, which improves the taste of water.

The shapes and stability of cymatic patterns depend on the specific sound frequencies and amplitude applied, shape and size of the vessel filled with water, resonance properties of all parts of the cymatic device, environment of the experiment and water properties. We adjusted our experiments with the aim to analyze water properties only, thus all other effects on pattern formation were eliminated as much as possible.

Several examples of cymatic patterns formed by various sound frequencies are shown in Figs 2-3. Our preliminary results suggest that cymatic patterns in water treated by aquaSpin are more stable than those formed in the water before treatment, although the results of the accredited water testing did not change. This hypothesis needs to be confirmed by further experiments, requiring more precise equipment and development of image analysis methods to measure characteristics of the dynamics of pattern formation.

References

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Fig. 1. Cymatic device used in the present study

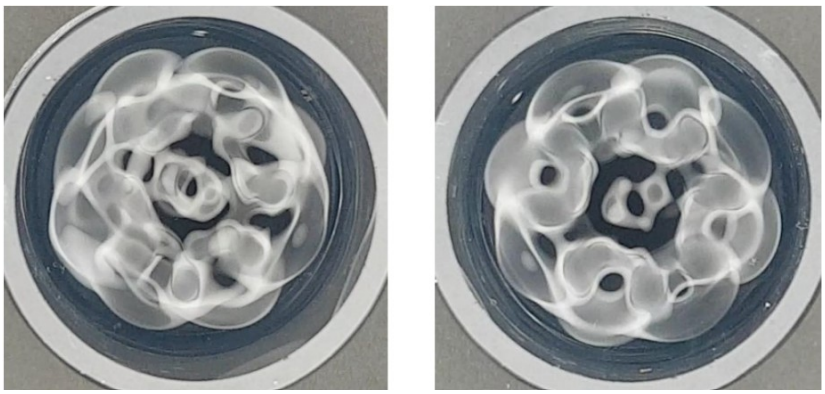

Fig. 2. Cymatic patterns generatd by 56 Hz frequency in distilled water (left) and aquaSpin treated water (right).

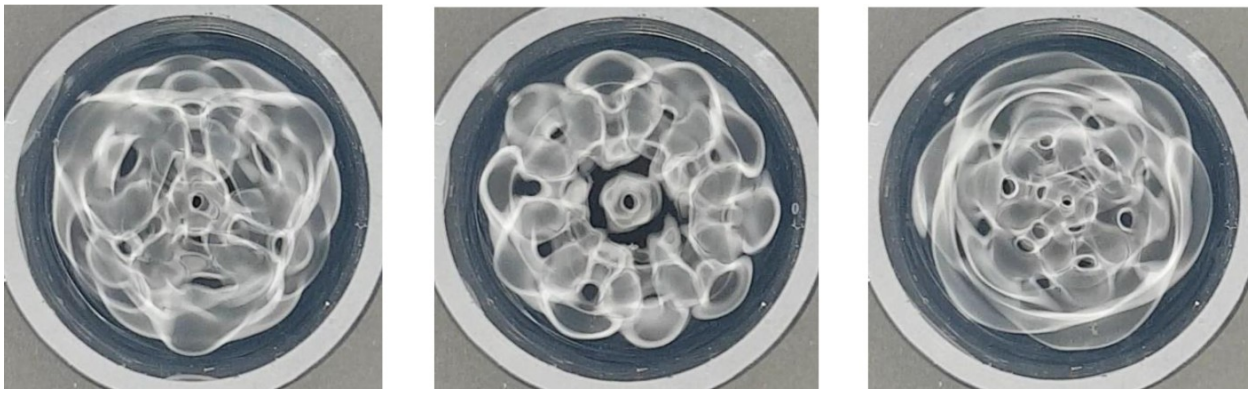

Fig. 3. Cymatic patterns generated by various sound frequencies in aquaSpin treated water: 53 Hz (left), 70 Hz (middle), 76 Hz (right).