

Walter Lauriks goes on: research highlight



In high school we were taught that there are three forms of matter: solid, liquid and gas. Reality is, however, more complex. There exists a panoply of materials, whose behavior changes from solid-like, liquid-like to gas-like, depending on temperature, or on time and spatial scales of observation. In foamy materials the complexity is pronounced, leading to a rich phenomenology and many applications, from acoustic absorption and mechanical damping to thermal insulation. Describing and understanding the macroscopic behavior and complexity of artificial and natural poro-elastic materials is not only

of high interest for technology, but also challenging from a scientific point of view.

Professor Walter Lauriks pioneered the development of acoustic measurement techniques that unravel the complex physics of poro-elastic materials. In close collaboration with Université de Le Mans, France, and with other groups, he made a substantial contribution to the development of methodologies to extract all parameters relevant to the Biot-Allard theory, which describes in detail the air-borne and structure-borne acoustic wave propagation in poro-elastics. One highlight is a method for determining simultaneously and accurately the viscous and thermal characteristic lengths in the Biot-Allard theory [1]. Besides classical foams used for acoustic purposes in noise control applications, this research has also led to fruitful results in the biomedical field, related to the characterization of porous structures in trabecular and cancellous bone [2], and in bioengineering, in particular for the characterization of bread, which is crucial for optimizing the production process.

In recent years Walter Lauriks' research team has developed ways to measure the visco-elastic parameters of the structural frame of a material, based on non-contact optical detection of guided acoustic waves and analysis of the acoustic displacement field using different spatiotemporal variants of the excitation. Driven by a strong interest of partners in science and technology in monitoring material parameters during foam formation, substantial progress was made to apply the approach to different sample geometries and to study the temperature and frequency dependence of the viscoelasticity. By virtue of this progress, the acoustic characterization of poro-elastic materials is still a core expertise of the Laboratory for Acoustics and Thermal Physics, of which Walter Lauriks was the Head.

The impact of this research has not been limited to academia. Several of the young researchers trained in Walter Lauriks' group have found their way to industry, thus transferring the know-how on the physics and metrology of poroelastic materials to technology and society. The software for calculating the acoustic response of poro-elastic multilayers, as well as several design concepts, are being used today in industry.

1. "Determination of the viscous and thermal characteristic lengths of plastic foams by ultrasonic measurements in helium and air", Ph. Leclaire, L. Kelders, W. Lauriks, M. Melon, N. Brown and B. Castagnede, *Journal of Applied Physics* **80**, 2009 (1996).

2. "Ultrasonic wave propagation in human cancellous bone: Application of Biot theory", Z.E.A. Fellah, J.Y. Chapelon, S. Berger, W. Lauriks and C. Depollier, *Journal of the Acoustical Society of America* **116**, 61 (2004).

