Interferometric Technology in Flow Measurement at High Temperature

Henrik Krisch[1], Ernst von Lavante[2], Pouya Mirzaei[1,2]

[1] *KROHNE Messtechnik GmbH, Department Development Sensors, Ludwig-Krohne-Str. 5, 47058 Duisburg, Germany*
[2]*Faculty of Engineering Sciences, University of Duisburg-Essen, Duisburg, Germany*

h.krisch@krohne.com; phone +49 203 301 4239; www.krohne.com

This publication presents a novel solution in flow metering using photonic sensing methods. The technology applies fibre Mach-Zehnder interferometer for detecting the vortices of a von Karman Street generated by bluff body from a classical vortex flow meter. The frequency is detected through the deformation of a diaphragm located in a separate measuring chamber.

The present method is applicable for measuring the flow rates of liquids, gases and vapours at temperatures up to +700° C and pressures up to 300 bar.

Keywords: flow metering, fibre interferometer, photonic sensor, fibre optic sensors, pressure and stress sensors, deformating membrane, diaphragm, vortex flow meter.

In the interferometric detection of the vortex shedding frequencies, a diaphragm is used as a transducer to measure dynamic pressure differences acting on its surface. The pressure waves generated by the vortices are conducted to its surface via properly designed conduits leading from an optimized location in the measuring section. The resulting strain and elongation induced by the deflection of the diaphragm can be detected by a variety of strain gauge sensors. The use of silica optic fibre based interferometric sensor permits operation at high temperatures, offers high sensitivity, and wide dynamic range. A vibrating circular flat diaphragm or membrane is described by a well-known partial differential equation and in the present contribution was solved numerically by means of a finite element method. This allowed the optimization of the location of the optic fibre.

Fig.1 demonstrates a prototype of photonic vortex flow meter for high temperature and pressure measurements in size DN25.

Figure 1. Prototype of advance photonic flow meter

The form and location of the pressure conduits leading to the measurement chamber and the chamber itself were optimized using numerical flow simulations.

The full paper will discuss the details of the design as well as the optimization procedures applied to the various components of the photonic flow meter.