DOI 10.5162/SMSI2025/P24

Add-on kit for non-invasive pressure measurement on process pipes

A. Cyriax, Th. Frank, A. Grün, St. Hermann, M. Kermann, St. Jagomast, A. Grün
CiS Forschungsinstitut für Mikrosensorik, Konrad-Zuse-Straße 14, 99099 Erfurt, Deutschland
tfrank@cismst.de

Summary:
This article presents a sensor system for non-invasive pressure measurement in process pipes. This is a back-fitting kit in the form of a sensitive sleeve with an integrated pressure sensor system. The direct coupling detects the exact changes in expansion of process pipes. When used as a monitoring system, statements can be made about material changes, wear mechanisms, maintenance, energy consumption under operating conditions or reactions to external influencing factors.

Keywords: non-invasive, silicon, piezoresistive, strain, force, pressure

Strain-based, non-invasive approaches for measuring pressure in piping systems are of great interest in the industrial plant sector due to their convenience and non-destructive installation.

Applications are possible for process pipes in systems for recording, digitizing, storing and evaluating condition variables. This provides information on material changes, wear mechanisms, maintenance, energy consumption under operating conditions or reactions to external influencing factors.

For non-invasive pressure measurement in process pipes, the back-fitting kit in the form of a sensitive sleeve with an integrated pressure sensor system should be used. The integrated pressure sensor system is realized on the basis of 500 x 500 µm small silicon-based strain sensors, shown in Fig. 1. These are applied to the sensitive area of the pipe sleeve using a micro-technical joining process.

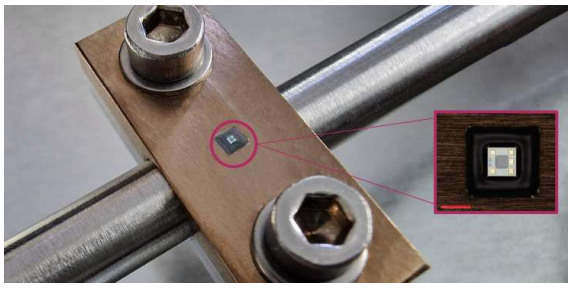

Fig. 1. Strain sensor joined to sensitive sleeve using glass frit

The direct coupling allows the exact expansion changes of the process pipe to be detected. Fig. 2 shows a simulation of the transfer of the pressure-dependent change in expansion of a process pipe to the sensitive pipe sleeve.

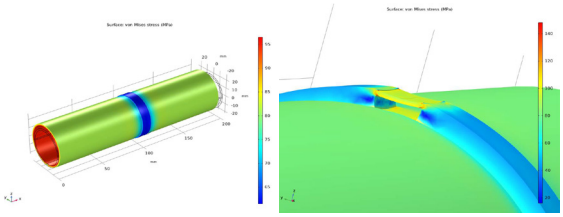

Fig. 2. Model of the direct coupling of the sensor system via a sensitive area in the pipe sleeve

The sensor system performs the following requirements:

- Non-invasive pressure measurement in pipes or pressure vessels without media contact

- subsequent installation on the process pipes (free mounting, surface mounting)

- Various geometry sizes/shapes possible depending on the application

- Easy installation, but slight loss of accuracy

- Measuring accuracy approx. 1% - 3% of the measuring range (4 to 300 bar)

- Possibility of temperature compensation of the raw signal

Source:

[1] Nachrüstsatz zur nichtinvasiven Druckmessung an Prozessrohren, Hannover Messe 2024, April 2024