PROJECT OVERVIEW AISHA II AND DETECTION OF CORROSIVE AND HYDRAULIC LIQUIDS BY GAUGES BASED ON THE COLLAPSE OF PERCOLATION CONDUCTIVITY

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Abstract

A reliable gauge for detecting harmful liquids can help to enhance operational safety and can essentially contribute to reduce the maintenance costs. However, frequent problems concerning permanent gauges in aircraft structures are the limited space for installation, insufficient robustness of sensors with respect to baseline variations and finally an uncertain cost-benefit ratio. Furthermore, the gauges have to cover extended areas.

In the present paper, a concept for detecting harmful liquids is presented that is based on the collapse of percolation conductivity (COPC). Percolation means in this context the connectivity of conducting particles in randomised lattice structures (percolation network). For the sensing material, composites containing a conducting compound were used, whose matrix material is vulnerable to the liquid to detect. When these functionalised composites are exposed to harmful liquids, the matrix interacts with the liquid until the conductivity is essentially lost due to the collapse of the percolation network. The increase of the resistance after liquid ingress can be monitored by digital multimeters that are equipped with appropriate data logging facilities.

The excellent applicability of the integral system could already be shown in a relevant lab-environment for the floor beam area and hydraulic tubes. In the floor beam area, spilled aqueous liquids are known to cause heavy corrosion once dedicated sealing systems have been damaged. Another frequent problem is related to leaking phosphate-ester based hydraulic fluids. In both cases, small amounts of liquids (less than 1 ml) could be reliably detected, and the design of the gauges does not require to measure in-flight, i.e. there is no need for additional electronics on board.

Keywords Structural Health Monitoring; Leaking liquids; Electrical Resistance; Water; Hydraulic liquid