

Health monitoring of adhesive joints coating and steel substrate

Dariusz Ulbrich¹, Jaroslaw Selech¹, Jakub Kowalczyk¹, Przemyslaw Lopato², Dawid Romek¹

¹Faculty of Civil and Transport Engineering, Poznan University of Technology, Poland, ¹Center for Electromagnetic Fields Engineering and High Frequency Techniques, West Pomeranian University of Technology, Poland

Adhesive coatings are widely used at the stage of both manufacturing and repairing machine elements. They can improve the strength of machine elements, increase adhesion between individual coating layers, and provide protection against water and other aggressive factors – corrosion protection. In the automotive industry, adhesive coatings are used in the form of lacquer applied on car bodies during their production and as body putty, used during repair of damaged car bodies to smooth the surface of the car body sheet. In other industries, regenerative adhesive coatings are used, which allow, for example, to repair of losses in machine components (pumps, engine blocks, piston rods of hydraulic cylinders, tanks, etc.). Due to the wide use of adhesive coatings, in this paper, a comprehensive method of monitoring the state of such a joint using ultrasound waves has been proposed, with particular emphasis on the adhesion of the coating to the steel substrate. This adhesion largely determines the durability of the joint of the coating to the substrate. The study was performed with both longitudinal and surface (Rayleigh) waves, using 2-20 MHz frequency heads. The adhesion between the coating and the steel substrate was monitored throughout the lifetime of the joint – from the moment when the coating was applied to the substrate until it was completely de-bonded. Due to the nature of the study, an electrodynamic shaker was used, which allowed to generate cyclical deformations of the prepared samples – which resulted in the final de-bonding of the coating from the substrate. In addition, for specially prepared samples, a longitudinal wave pressure reflection coefficient has been determined, which allows to estimate the distribution of the adhesion of the coating to the substrate in the area on which the coating was applied. The performed study confirmed that the ultrasound surface waves enable continuous monitoring of the adhesive joint between coating and substrate at any moment of its existence, both during the constitution and degradation. In addition, the proposed method of assessing the condition of the coating and substrate joint allows to determine changes in its state and to distinguish individual stages of this process: production, stabilisation with slow degradation, as well as accelerated degradation with de-bonding of the coating from the substrate.