Fatigue crack detection in railway axle through paint coating using ultrasound method

Jianping Peng[1], Yu Zhang[2], Kai Yang[2], Chaoyong Peng[1], Xiaorong Gao[2], Zeyong Wang[1], Yi Du[3], Bo Zhao[4], Zhen Wang[3]

[1]NDT Research Center, Southwest Jiaotong University, China, [1] School of Physical Science and Technology, Southwest Jiaotong University, China, [1] School of Physical Science and Technology, Chengdu Lead Science & Technology Co. Ltd., China, [1]NDT Research Center, Chengdu Lead Science & Technology Co. Ltd., China

In the high-speed railway transportation industry, epoxy resin paints are applied on railway axle for the improvement of its corrosion resistance and impact resistance. The amplitude and waveform of ultrasonic pulse echo signal will be affected by the attenuation of paint coating and multiple boundary reflection or refraction. Fatigue defects in railway axle can be hardly assess correctly because of the paint coating. Paint-steel dual-material model was simulated by Kirchhoff approximation and Geometrical Theory of Diffraction (GTD) simulation model. Ultrasonic wave mode conversion in surface paint boundary and the sound pressure reflection in bottom paint boundary are analyzed. Paint-steel test blocks were designed and railway axle with paint coating was made, and ultrasonic testing was applied on these test blocks and axle. Results show that, the interface of the paint layer will cause mode conversion when the steel surface is painted on epoxy resin paint and resulting in multiple defect echoes returned, and pulse echo hardly changed when epoxy resin paint applied on the bottom. The variation of pulse echo amplitude and waveform by straight beam testing is also measured. The relationship between the acoustic impedance of the paint coating and the coherent superposition of the returned multiple defect echoes were analyzed.