1.3.86. VISUALIZATION OF SOUND PROPAGATION IN SOLIDS USING ELECTRODYNAMIC PROBES

Völz U., Mrasek H., Matthies K., Kreutzbruck M.,
BAM Federal Institute for Materials Research and Testing, Berlin, Germany

When dealing in ultrasonic testing with inhomogeneous and anisotropic material structure such as diverse types of welds made from austenitic steel or nickel based alloys, which are currently used for modern power plant concepts, data interpretation is quite difficult. For better understanding of the complex interaction between the sound field and the component under test, the visualisation of sound propagation in solids is a substantial task to increase the probability of detection of relevant defects.

However, there exist only a small number of appropriate techniques published today, such as scanning laser interferometer, piezoelectric pin transducer and optical approaches in case of transparent solids.

In this work we present an electrodynamic technique providing a simple use, a high signal to noise ratio and a large frequency bandwidth. We use the method of grazing incidence in which the movement of the particles in proximity to the steel-air interface is generated by a grazing sound beat, representing a sound field cross section as an approximation of the beat at its central axis. By detecting the grazing beat at the sample's surface with a small electrodynamic probe, we measured the particle displacement as a function of time with a spatial resolution in the order of 2 mt.

Adapting the electrodynamic probe and its coil alignment allows for measuring the displacement components in an three spatial directions. This comprises the detection of the horizontal and vertical particle displacement with respect to the surface and thus also the detection of longitudinal and shear waves is possible. A signal to noise ratio of higher than 40 dB could be achieved within ferromagnetic and high conductive chrome steel when using a shear wave generated by an angled beat transducer.

We report on measurements of the sound field in complex weld joints. One example shows an 80 mm thick test block with a 10 mt wide dissimilar narrow gap weld joining a nickel alloy (Alloy 617) with a chrome steel yielding a substantial anisotropy of the weld structure (see figs. 1 and 2). The test system enables us to visualize the wave propagation within the weld and indicates the reflection scenario and the energy losses due to both the anisotropic structure and material defects.

The electrodynamic technique provides a complete picture of the wave propagation and includes kinds of mode conversions and scattering inside complex inhomogeneous and anisotropic material structures. It can be regarded as a powerful tool to gain deeper insight into the interaction between the sound field and the weld and its defects. The visualization results furthermore support the theoretical activities to model the wave propagation and to find optima1 testing parameters for different components and configurations.

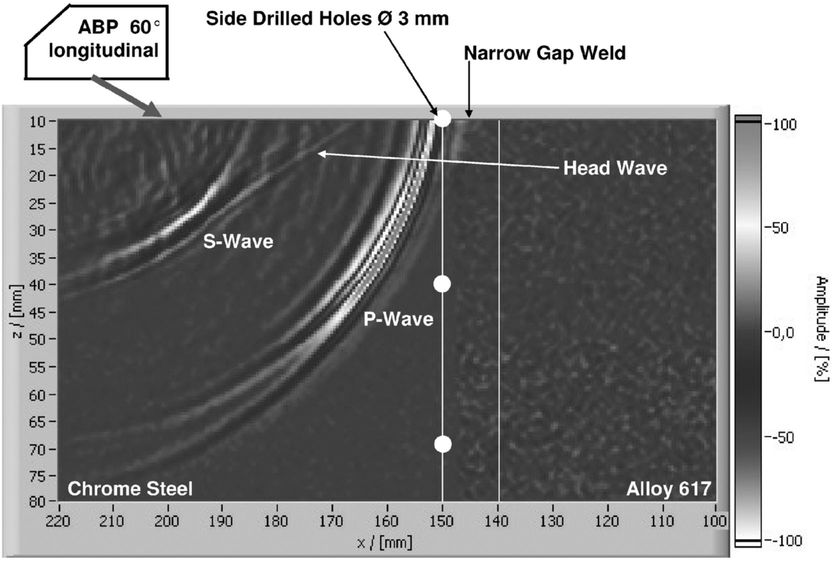

Fig. 1. Snapshot of the wave front from an 2 MHz angle beam probe (ABP)

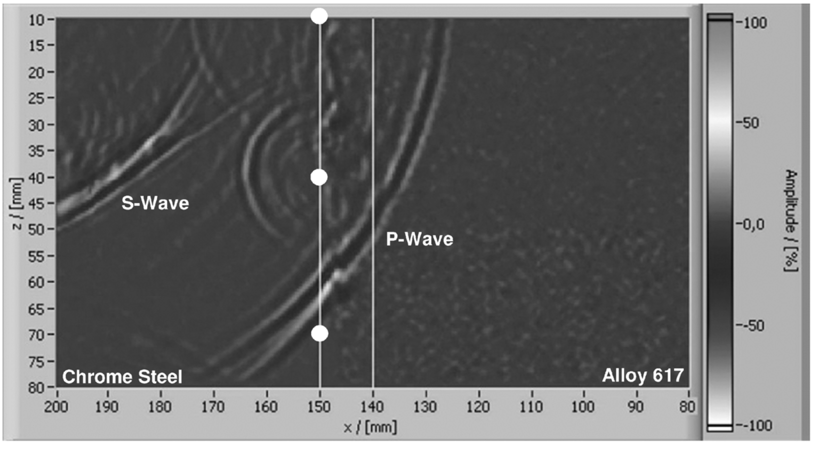

Fig. 2. **Snapshot of the scattering of the wave front at the narrow gap weld**