Mixed mode fracture behavior of an aluminum alloy a6061 investigated by using compact tension shear specimens

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Abstrak

Aluminum alloys, such as A6061-T6, are widely used in engineering components. However, detailed knowledge is needed to understand the way they respond to a fracture due to mechanical loading. Fractures occur in the structural component from crack propagation, and it is important to understand the mixed mode fracture behavior of crack growth. In this research, mixed mode fracture testing was conducted on the aluminum alloy A6061-T6 by employing a compact tension shear specimen. Crack growth behavior was investigated by applying a quasi-static loading at a constant cross-head speed using a Servopulser universal testing machine. The crack growths were observed by a Keyence digital microscope, and the critical stress intensity factors of the material were examined. Results showed that the shear type of crack initiation preceded the opening-type fracture. The dimple-type fracture on the fracture surface occurred under mode I and mixed mode with a loading angle of about 60o and 75o, respectively. The transition of crack initiation behavior from the opening-type fracture to the shear-type fracture occurred at a loading angle from 15o to 30o. The experimental data followed the maximum hoop stress criterion under mode I and mixed mode at a loading angle 60o and 75o, respectively, for the compact tension shear specimen. Crack propagation behavior with three small holes occurring in a zigzag pattern ahead of the crack tip showed that crack initiation and propagation occurred only in the opening-type fracture. The experimental data followed the maximum hoop stress criterion under mode I and mixed mode with a lower mode II component at a loading angle of 75o. When the small holes occured inline, there were two types of fractures occurring: an opening fracture at crack initiation and then crack propagation caused by shear fracture.