THE RELATIONSHIP BETWEEN

FRACTURE TOUGHNESS

AND

SHEAR LIP SIZE

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ABSTRACT

The plane strain fracture toughness of a high strength low alloy steel, En 25, tempered from the as-quenched state to 650^{0}C, and a high strength aluminium alloy, 7075-T6, have been determined using compact tension specimens of varying thicknesses from 4 to 25mm. The size of the shear lips, B_{SL}, measured at the free surfaces of the specimens was found to be independent of the specimen thickness and to be related to the true plane strain fracture toughness, K_{IC}, through the expression

$$B_{SL} = 0.41(K_{IC}/\sigma_{ys})^{2.02},$$

where σ_{ys} is the 0.2% proof stress of the material. A rationale for this behaviour is that B_{SL} is approximately equal to the size of the plane stress plastic zone, r_y, at the surfaces of a plate specimen, which from theoretical analysis, has been shown to be

$$r_y = \frac{\pi}{8} (K_{IC}/\sigma_{ys})^2.$$

The ASTM standard plane strain fracture toughness test method has been proven to be insensitive to detect excess yielding in the specimens tempered at temperatures higher than 450^{0}C. At high tempers, yielding fracture mechanics approaches were used to determine the true K_{IC} values.

The fracture toughness versus shear lip size relationship is believed to have considerable importance in the analysis of service failures and in the preliminary study of specimen size effect in plane strain fracture toughness determination.

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