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Modelling of Dynamic Behaviour of Aluminium Alloys

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ABSTRACT

Accurate modelling of Aluminium alloys (AA) are of high interest due to their applications in light weight structures (aerospace, automotive). The ability to predict strain rate dependent mechanical behaviour of orthotropic AA is important for applications such as crashworthiness, impact protection and blast loading. Therefore, the focus of this research is modelling of behaviour for loading rates between quasi-static and including shock wave propagation.

The paper outlines a physically based damage and failure models based on the concept of thermally activated damage, the approach initially proposed by Klepaczko [1]. The damage model is combined with the Mechanical Threshold Strength (MTS) model [2-6] which was used as the strength part in the overall constitutive model. A shock equation of state [7] is coupled with the rest of the constitutive model to allow for modelling of shock wave propagation in the material. The coupling of the equation of state is based on the stress tensor decomposition [8]. The new model was implemented into non-linear transient finite element and SPH codes.

The new model was validated by performing a series of FE simulations of plate impact and Taylor tests performed for AA 7010. The tests were conducted using a gas gun at velocities of 200, 214, 244 and 400 m/s. The numerical analysis results clearly demonstrate the ability of the new model to predict experimentally observed damage and failure.

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