RELATION BETWEEN DYNAMIC STRENGTH AND TOUGHNESS PROPERTIES AND THE BEHAVIOR UNDER BLAST CONDITIONS OF HIGH STRENGTH STEELS

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Until now, material properties which are related to their blast behavior are widely unknown. Therefore, in technical specifications mostly strength properties are required by national authorities for the resistance of impact dynamic loading processes. Toughness properties are widely neglected.

Within the German national research group on mine protection, which is lead by the WTD91 in Meppen, the influence of toughness properties on blast behavior of high strength steels was investigated systematically. There, a significant influence of the toughness properties of the materials on a sudden impact failure under blast loading was found.

A newly developed testing device for the experimental simulation of blast loading conditions using a drop weight tower is introduced. There, a four ton falling weight impacts a circular blank high strength steel plate and introduces a biaxial tensile-tensile stress state using a special designed punch geometry. As a special feature, during the loading the force-time and displacement-time behavior is measured. Additionally, using two high speed cameras and a high speed deformation field measuring technique (ARAMIS) the local material deformation behavior from the beginning of plastic deformation until the occurrence of failure can be evaluated. There, a significant influence of the manufacturing history of high strength steels was observed.

Additionally, instrumented Charpy impact tests were performed and the Charpy impact toughness was measured. The total amount of Charpy impact energy was divided into a crack initiation and a crack propagation part.

Within the presentation the results of the mechanical material tests are compared and related to real blast loading processes. The results show an excellent agreement and prove a correlation between impact material toughness properties and blast behavior.