Regarding Influences of Production Processes on Material Parameters in Fatigue Life Prediction

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Abstract: *Fatigue life prediction has reached a high level in respect to practical handling and accuracy in the last decades. As a result of insecure or lacking input data deviations between numerical results and test results in terms of cycles till crack initiation are possible. On the one hand, the accuracy of Finite Element results gets better and better because of greatly increasing computer power and mesh density. Whereas on the other hand, the situation is much more critical regarding load data and especially regarding local material properties of the components.*

In the last few years also the possibilities of process simulation have improved in such, that at least a few local material properties or quality indicators can be predicted with sufficient reliability.

Both simulation technologies represent a current state of the art. Therefore it is reasonable to integrate the results of process simulation into fatigue analysis to improve the accuracy of fatigue life prediction. For forming simulation of steel sheet-metal as well as for sand and die casting of aluminum and magnesium this integration has recently been realized.

As an output of forming simulation the effective plastic strain can be used as an indicator for local material parameters. Also the distribution of the sheet metal thickness can be analyzed and used for stress analysis in Abaqus as well as the final fatigue analysis in FEMFAT.

With today's cast simulation tools distributions of local material parameters can be predicted. Furthermore the secondary dendrite arm spacing correlates significantly with porosity and endurance limit. For die casting, a pore free surface layer can be accounted for.

Keywords: *Fatigue Life Prediction, Fatigue Life Analysis, Finite Element Method, Vehicle Engineering, Forming Simulation, Effective Plastic Strain, Casting Simulation, Dendrite Arm Spacing.*

1. Introduction

In today's automotive engineering and development usually a long virtual simulation chain is performed before prototyping and testing phase starts (see fig. 1). This chain includes static and dynamic analysis of displacements, stresses, strains and temperature with Finite Element Analysis (FEA), Multibody Simulation (MBD), sheet-metal forming simulation, cast simulation, etc. The last limb is represented by the fatigue analysis to fix the weak points of a structure.