# CORRELATION OF POROSITY DETECTED BY COMPUTED TOMOGRAPHY AND FATIGUE STRENGTH OF ALUMINIUM ALLOYS

Thomas PABEL[1], Georg F. GEIER[1], Daniel HABE[1], Joerdis ROSC[1], Peter SCHUMACHER[1,2], Tose PETKOV[1]

[1]Austrian Foundry Research Institute, Leoben, Austria
[2]Chair of Casting Research, University of Leoben, Leoben, Austria

The aim of the current research was to verify the impact of a suboptimal melt quality on the static and dynamic mechanical properties of aluminium castings. The particular interest was to use the possibilities of computed tomography to describe volumetric casting defects and to compare these results with measured mechanical properties.

Melts of the aluminium alloy EN AC-Al Si7Mg0,3 were loaded with different levels of gas to obtain different porosity volumes and sizes in the samples (Fig. 1). The overall gas content was evaluated by the Straube Pfeiffer Test and the density index via the Archimedean Principle. The samples of this reduced pressure test and the mashined tensile bars and the samples for rotation bending fatigue tests ware evaluated by computed tomography for their volume porosity (Fig. 2).

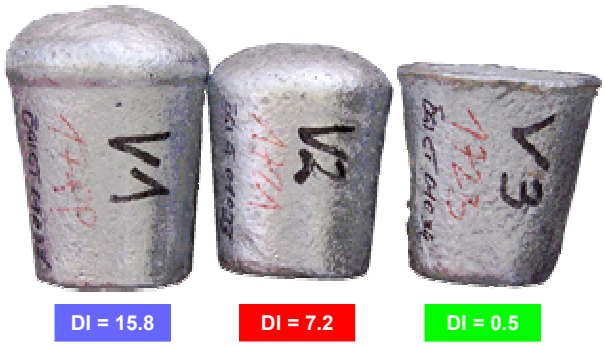


**Fig. 1:** Reduced pressure test samples; density index

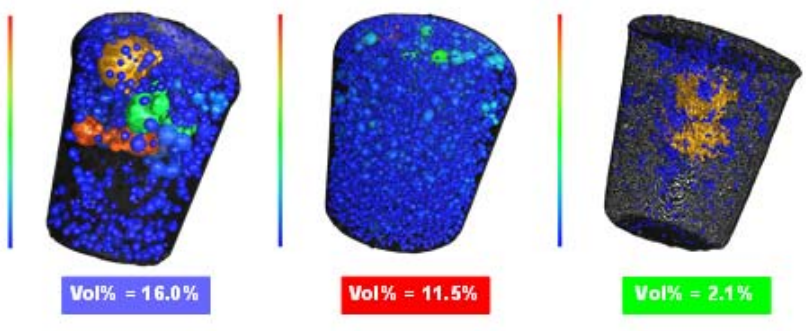


**Fig. 2:** Computed tomography reduced pressure test samples

The computed tomography was done on a micro focus x-ray tube with a 16 bit flat detector. The CT-model of the tensile test bars had a voxel size of (10 µm)³. The volume porosity (Fig. 3) was calculated by the defect analyses modulus of the VG StudioMAX software. Therefore

the necessary parameters ware evaluated at metallographic sections of the samples after testing.

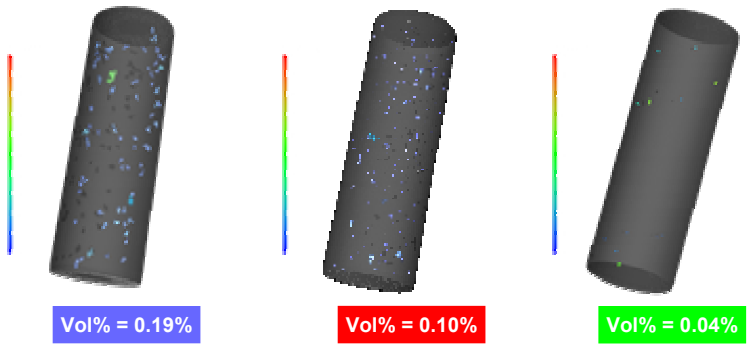


**Fig. 3:** Computed tomography tensile test bars

The results of static materials testing and the S/N curve are in excellent correlation with that of the CT evaluations as well as the density index (Fig. 4 to 7).

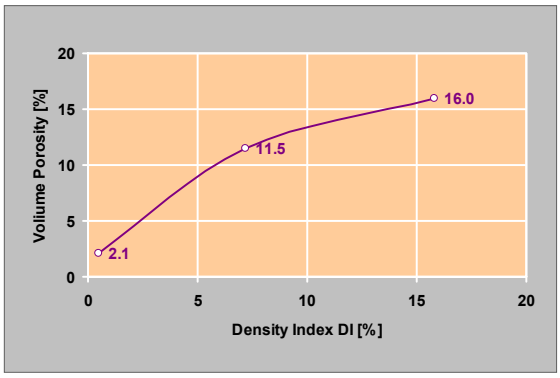


**Fig. 4:** Density index vs. polume porosity

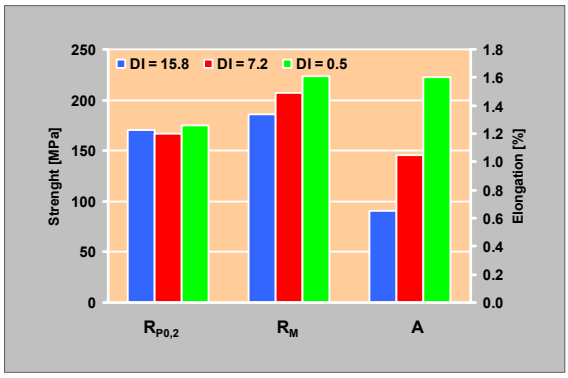


**Fig. 5:** Mechanical properties

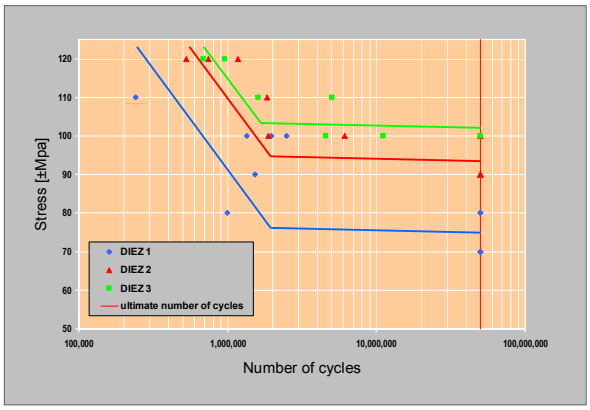


**Fig. 6:** S/N curves

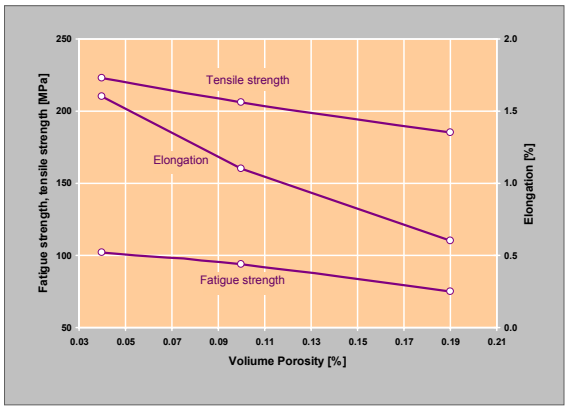


**Fig. 7:** Summery of mechanical properties

The selected resolution in the computed tomography gave an adequate description from the pore space. Furthermore this work shows that the selection of the parameters for the authentic defect detection is a crucial step for the analysis of the CT-model. Appropriate processes, like evaluations of metallographic cross sections on a comparable casting are inevitable for an optimized parameter selection.

In the future it should be possible to forecast the reduction of the mechanical properties due to an increased gas content based solely on NDT using computed tomography. The results can now be implemented in FEM analysis to calculate a maximum pore level for a given load situation.