

Casting Defects and Crack Propagation of Cast Aluminum under Applied Stress

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Die casted pure Aluminum samples which were having rectangular cross-sectional areas were studied experimentally. A steel die was prepared in the machine shop. Aluminum was melted at 800 °C in a graphite crucible and poured in to the die at room temperature under the gravity. The eight samples were casted and subjected to a normalizing or annealing process before the measurement. The mechanical properties of each sample were studied using the tensile tests and hardness tests. It was observed a significant reduction of the Modulus of Elasticity and Hardness due to the high density of defects. The calculated Modulus of Elasticity was in the range of 4.5-7.2GPa and the Tensile Strength was in the range of 115-170 GPa. The samples with high density of defects were used to study the crack propagation and failure under the applied stress. All the samples showed a brittle fracture. The surface morphology of the cracked surfaces was studied visually. It was observed that cracks were always originated from defected sites near the surface of each sample. The critical defects of each sample were identified with the visual observations and the x-ray radiographic imaging. The lowest Tensile Strength (115.5 MPa) was observed in the sample (sample C) which was not annealed or normalized. The critical defect was a void of diameter 7mm. Shrinkage defects and piping were also observed as dominating critical defects. The distribution of defects was widely varied in samples. Thus, the mechanical properties were mainly dependent on the distribution of defects. It is suggested that minimizing the surface defects would lead to improve the mechanical properties. It is also required to follow a more improved process of casting to control the defects and hence to study the effect of the type of defects on crack propagation and mechanical failure of cast Aluminum.

Keywords: Die-casting; Aluminum samples; Radiographic testing; Tensile test; Hardness test; Casting defects