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Evaluation of casting defect and analysis on mechanical properties for die cast by using 3D computed tomography

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In the present study, statistical evaluation of casting defects in die cast and effect of the defect on physical properties such as yield strength, tensile strength, and elongation is investigated. Die Casting parts are widely used in automotive and electronics industry. Defects in the die cast is inevitable, and influence the mechanical properties of the parts. Nowadays, computed tomography (CT) was widely used to investigate the defect of the die cast, but there are still no standardization for CT analysis. In the present study, test specimen with various casting defects were manufactured by using die casting process, and all specimens were CT scanned and mechanically tested. Statistical analysis was carried out for the relation analysis between the characteristics of casting defects in the die cast and mechanical properties.

Keywords: *computed tomography, casting defects, die casting, physical properties*

1. Introduction

Die Casting parts are widely used in automotive and electronics industry. Defects in the diecast is inevitable, and influence the mechanical properties of the parts. Usually the metal products have the defects during manufacturing and are inevitable. In the NDT system, ability for evaluate the casting defects such as cracks and pores is also very important. Nowadays, computed tomography (CT) was widely used to investigate the defect of the die cast, but there are still no standardization for CT analysis. – The increasing use of computed tomography (CT) as a diagnostic tool creates the need for an efficient means of evaluating the performance of the CT systems now in use.

2. Experiment

2.1 Diecasting Experiment and preparation of specimen

In order to make specimens for the die cast defects, control of defects in the die cast is necessary. Generally defects in the die cast is affected by the existense of vacuum channel and thickness of the die cast. A mold die was prepared. The mold equipped vacuum block at the top side, and 6 specimen cavities with various thickness from 4mm to 14mm. Diecast specimens were produced by using the mold, as shown in Fig. 1. The materials used were Silafont 55 and ALDC12.

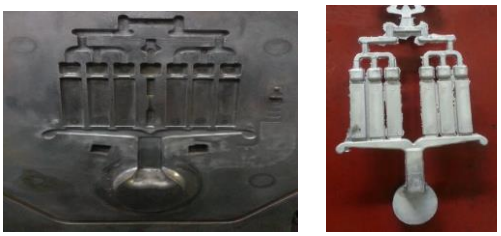


Fig. 1 Diecast mold for specimen preparation.

The die cast specimens were inspected by selected and machined by 3mm thickness test specimen with regards to the ASTM standard[1]. The CT scanned data were analysed by using VX3D software. VX3D has a function of labelling the object (Fig. 2). It is very useful when multiple specimen are scanned for one time. VX3D also has a fast analysis module for porosity detection by using GPU in the NVIDIA graphics card.

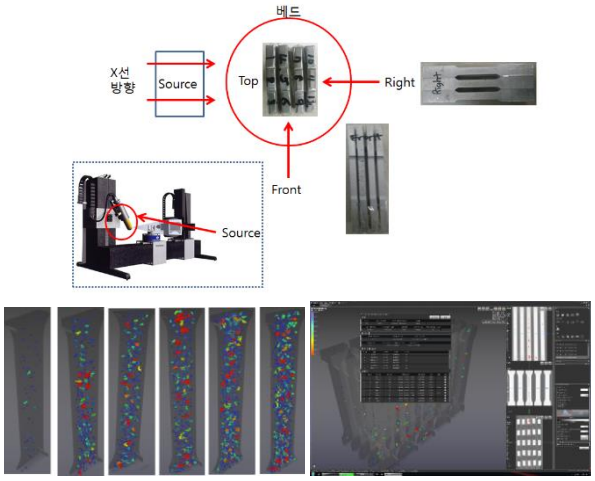
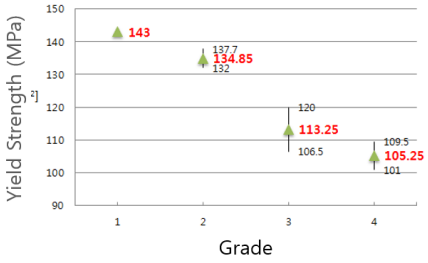


Fig. 2 CT scan for test specimen.

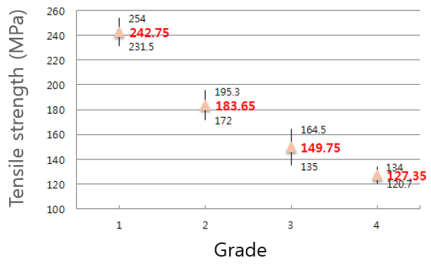
3. Results and Discussion

3.1 Silafont 55

Fig. 3 shows the mechanical properties with repect to the defect grades. 48 test specimens were prepared. The defect grades is categorized by number and size of porosity defects. Determination of defect grades was refenenced and modified by using the standard[2]. Grade 1 has small size of the defects (<0.5 mm) and Grade 4 has large size (>1mm) of porosity. With increase the grade number, decrase of yield strnegth, tensile trength, elongation were found.



(a) Yield strength



(b) Tensile strength

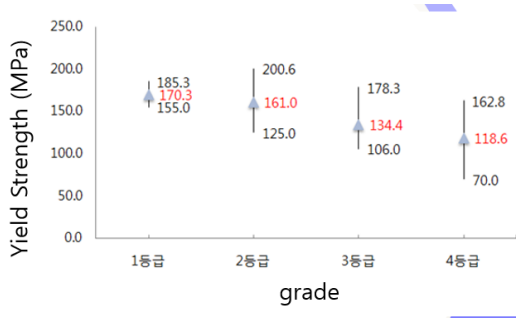
Fig. 3 Mechnical properties with Grade number of Silafont 55.

3.2 ALDC 12

Fig. 4 shows the mechanical properties with defect grades of ALDC12. 216 test specimens were used and analysed. With increase of the defect grade number, decrease of mechanical properties such as tensile strength, yield strength and elongation decrease. However, elasticity has no dependency with the defect grades. Compared to the case of Silafont 55, wider range of mechnical properties of each grades were found. It is considered that other defects than porosity may affect the mechanical properties.

Fig. 5 shows the in the specimen. CT scan Figure 10 shows the relation of mechanical properties with total porosity volume. Both analyses show same result. Therefore, CT volume analysis is considered to be used and replaced by density measurement experiment.

(a) Tensile strength



(c) Yield strength

Fig. 4 Mechanical properties with defect grades of ALDC12 test specimens.

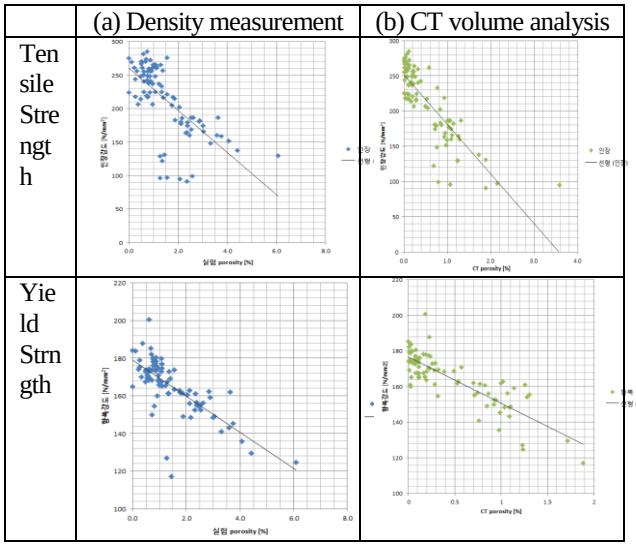


Fig. 5: Relationship of mechanical properties with total porosity volume by density measurement and CT volume analysis.

REFERENCES

[1] ASTM B557M, p. 2.

[2] ASTM E 93, p.3.

[3] http://www.3dii.kr