Technology Update

A Method to Evaluate Surface Roughness of As-Castings

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This article discusses a simple experimental procedure to determine the surface roughness of as-castings.

INTRODUCTION

Surface finish is one of the important factors deciding the quality of non-machined surfaces. Surface finish of casting represents the degree of smoothness of the as-cat surface. This is measured in terms of the surface roughness which is the mean deviation of surface at different locations [1, 2]. The as-cast surface especially from green sand moulds is irregular and random in nature [3]. The measurement of the deviation can be accomplished in various ways. These can be broadly classified into the following groups: i) destructive methods and (ii) non-destructive methods.

Swing (4) has reviewed 21 methods of surface roughness measurement and describes the evaluation of Roughness High Rating (RHR) values by a cross-section method which is known as destructive method. He states that, while measurement of surface roughness on machined surface could be consider5ed as a two-dimensional exercise, in case of as-cast surface it is a three-dimensional. Nelson (5) has measured the heights of peaks and valleys at lower magnification by cutting the specimen at an angle. The destructive method of assessing the surface finish of castings is accurate, readings may be repeated on the samples and permanent records can be obtained. But a large number of samples are required to provide a random effort and also part is to be destroyed. This method is difficult and time consuming one. To overcome the drawbacks of destructive methods, the following non-destructive methods [6, 7, 8] are employed.

i) Visual comparison with a standard surface. This method is based on appearance, which involves more than the surface roughness.
ii) Tracer method, which employs a stylus that is dragged across the surface.
iii) Photo method of viewing enlarged photographs of surface has proven valuable when comparing the surfaces. Photos at a magnification of 15x or 20x have been used in studies by AFS sand division committee to compare casting surfaces.
iv) Reflection of light from the surface measured by a photo cell.
v) Parallel-plane clearance. Leakage of low-viscosity liquid or gas between the subject surface and a reference flat is used as the measure of roughness.
vi) Electrolyte method. This assumes that the electrical capacitance is a function of the actual surface area, the tough surface providing a greater capacitance than a smooth surface.

Even though all these non-destructive methods are available for determining the surface roughness, most of them are better suited for machined surfaces which are very much smoother and also exhibit a definite repetitive pattern and orientation. Surface roughness comparators are generally used for assessing the surface roughness of as-cast surfaces. In sand moulding techniques the grain fineness of silica sand, mould wash and permeability have a greater influence on surface finish. A simple procedure working on the stylus-comparator principle has been designed and developed by the author to determine the surface roughness of as-cast procedure.

EXPERIMENTAL SET-UP

In the present investigation, a simple procedure has been designed and developed to determine the surface roughness of as-cast products by stylus comparator method. The readings of stylus comparator method were compared with a dial gauge method [9]. Plate castings of grey cast iron measuring 10 cm x 10 cm x 2.5 cm have been cast in green sand, CO2 sodium silicate and epoxy resin sand moulds. Mould washes were not employed.

1. Dial gauge method

The test specimen is kept on the leveling table which is mounted on a traversing bed. The surface of the specimen is leveled to be truly surface of the

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specimen is leveled to be truly horizontal with the help of spirit level. The dial gauge is then held above the specimen and the stylus is slowly of the dial gauge is capable of sensing minimum deviations of 0.015 mm.

2. Stylus comparator method

The set-up shown in Fig.1 consists of a stylus probe with a hardened steel ball tip with a nominal radius of 0.05 mm. The stylus probe is mounted on link, L_2 which is constrained by thin metal flexure strips, S_1 to move vertically with respect to link L_1. The link, L_1 is attached to a column. Because of their orientation relative to the motion, metal flexure strips, S_2 provide a large angular movement of the pointer. The scale was calibrated by dial gauge and test plate to measure the surface roughness of castings. The specimen to be tested is kept on a surface plate which is mounted which is mounted on the traversing bed. The specimen is leveled to be truly horizontal using the spirit level. The set-up is lowered till the stylus probe touches the specimen and a zero reading is obtained on the scale. When the casting is moved by the fine movement of the traversing bed, the vertical displacement of stylus is picked by the link, L_2 which activates the strips, S_2 to provide a larger angular movement of the pointer. Then, the readings on the scale are notes down.

In both the methods, the deviations are measured at intervals of 1.0 mm for a cut-off length of 10.0 mm along one particular direction. Such measurements are made at five random locations. Then the test specimen is rotated through 90^0. After leveling, the readings are similarly taken at random locations. The toot-mean – square (RMS) average values of the readings to each cut-off length are computed and the surface roughness rating of the test plate is considered as the mean of the above RMS values.

RESULTS AND DISCUSSION

Fig. 2 indicates the surface roughness vales of grey cast iron casting made in green sand, CO_2- sodium silicate and epoxy resin sand moulds. The roughness of cast surfaces made in CO_2 sodium silicate and green sand moulds is random in nature. The surfaces exhibit heterogeneity with respect to roughness which varies in the different areas of the same casting. Castings made in epoxy resin sand moulds show good surface finish. It is possible to make a qualitative and quantitative assessments of surface roughness values obtained with stylus comparator methods are reasonably accurate.

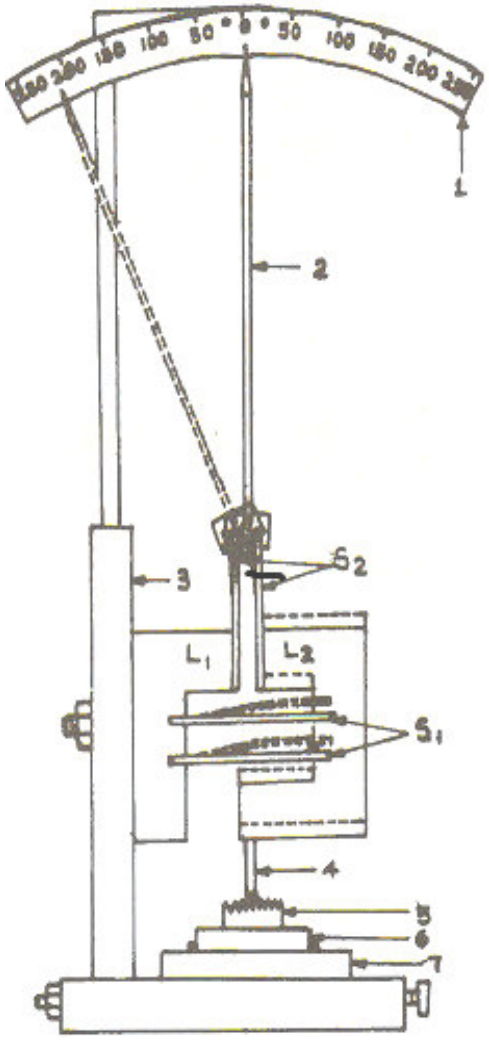

Fig.1 Schematic of Stylus comparator method with its zero and swing positions.

1. Scale, 2. Pointer, 3. Column, 4. Stylus Probe, 5. Casting, 6. Surface Plate and 7. Traversing bed.

CONCLUSION

The stylus comparator method is suitable for measuring the surface roughness of as-castings. Surface finish of castings cast in epoxy resin sound moulds is better than that of castings made sound moulds is better than that of castings made in green sand and CO_2-sodium silicate moulds.

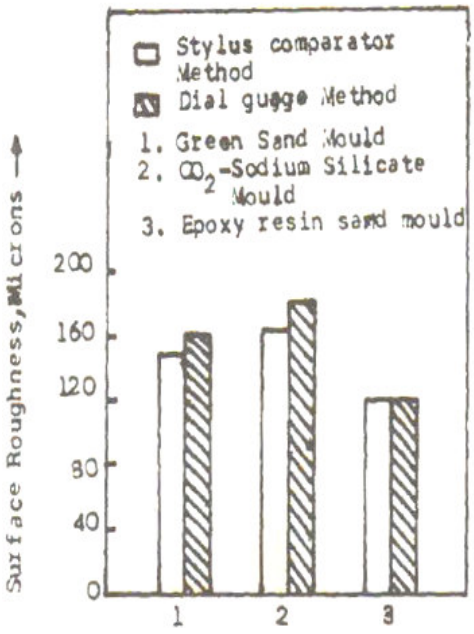

Fig. 2 Surface roughness of castings in different moulds

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