NOVATEUR PUBLICATIONS
INTERNATIONAL JOURNAL OF INNOVATION IN ENGINEERING, RESEARCH AND TECHNOLOGY [IJIERT]
NATIONAL CONFERENCE ON INNOVATIVE TRENDS IN ENGINEERING & TECHNOLOGY-2016
11TH & 12TH MARCH 2016
CONFERENCE PROCEEDINGS ISSN NO - 2394-3696

Paper ID: NITETMECH05

ASSESSMENT OF CASTING DEFECTS BY RADIOGRAPH INTERPRETATION- A REVIEW

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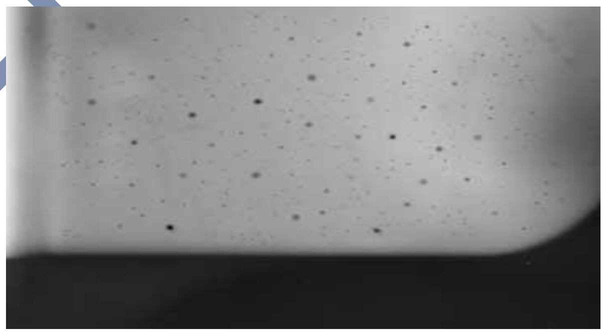
ABSTRACT

The major objective of radiographic testing of castings is the disclosure of defects that adversely affect the strength of the product. Castings are a product form that often receive radiographic inspection since many of the defects produced by the casting process are volumetric in nature, and are thus relatively easy to detect with this method. These discontinuities of course, are related to casting process deficiencies, which, if properly understood, can lead to accurate accept-reject decisions as well as to suitable corrective measures. Since different types and sizes of defects have different effects of the performance of the casting, it is important that the radiographer is able to identify the type and size of the defects. The castings used to produce the standard radiographs have been destructively analyzed to confirm the size and type of discontinuities present. The following is a brief description of the most common discontinuity types included in existing reference radiograph documents (in graded types or as single illustrations).

INTRODUCTION

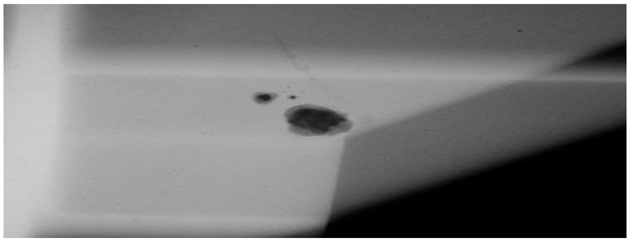
RADIOGRAPHIC INDICATIONS FOR CASTINGS

Gas porosity or blow holes are caused by accumulated gas or air which is trapped by the metal. These discontinuities are usually smooth-walled rounded cavities of a spherical, elongated or flattened shape. If the sprue is not high enough to provide the necessary heat transfer needed to force the gas or air out of the mold, the gas or air will be trapped as the molten metal begins to solidify. Blows can also be caused by sand that is too fine, too wet, or by sand that has a low permeability so that gas cannot escape. Too high moisture content in the sand makes it difficult to carry the excessive volumes of water vapor away from the casting. Another cause of blows can be attributed to using green ladles, rusty or damp chills and chaplets.



Gas porosity or blow holes

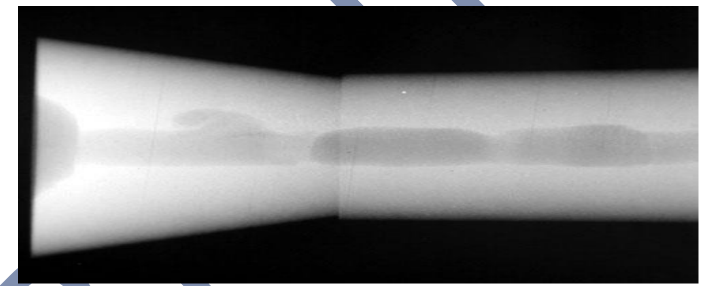
Sand inclusions and dross are nonmetallic oxides, which appear on the radiograph as irregular, dark blotches. These come from disintegrated portions of mold or core walls and/or from oxides (formed in the melt) which have not been skimmed off prior to the introduction of the metal into the mold gates. Careful control of the melt, proper holding time in the ladle and skimming of the melt during pouring will minimize or obviate this source of trouble



Sand inclusions and dross

Shrinkage is a form of discontinuity that appears as dark spots on the radiograph. Shrinkage assumes various forms, but in all cases it occurs because molten metal shrinks as it solidifies, in all portions of the final casting. Shrinkage is avoided by making sure that the volume of the casting is adequately fed by risers which sacrificially retain the shrinkage. Shrinkage in its various forms can be recognized by a number of characteristics on radiographs. There are at least four types of shrinkage: (1) cavity; (2) dendritic; (3) filamentary; and (4) sponge types. Some documents designate these types by numbers, without actual names, to avoid possible misunderstanding.

Cavity shrinkage appears as areas with distinct jagged boundaries. It may be produced when metal solidifies between two original streams of melt coming from opposite directions to join a common front. Cavity shrinkage usually occurs at a time when the melt has almost reached solidification temperature and there is no source of supplementary liquid to feed possible cavities.



Cavity shrinkage

Dendritic shrinkage is a distribution of very fine lines or small elongated cavities that may vary in density and are usually unconnected.

Filamentary shrinkage usually occurs as a continuous structure of connected lines or branches of variable length, width and density, or occasionally as a network.

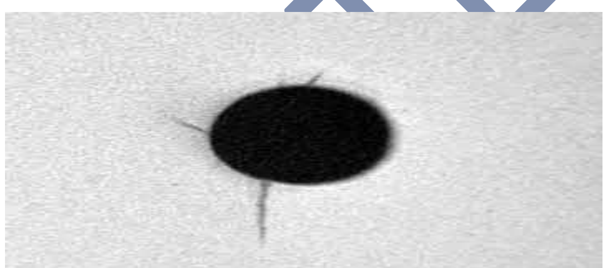
Dendritic shrinkage & Filamentary shrinkage

Sponge shrinkage shows itself as areas of lacy texture with diffuse outlines, generally toward the mid-thickness of heavier casting sections. Sponge shrinkage may be dendritic or filamentary shrinkage. Filamentary sponge shrinkage appears more blurred because it is projected through the relatively thick coating between the discontinuities and the film surface.

Sponge shrinkage

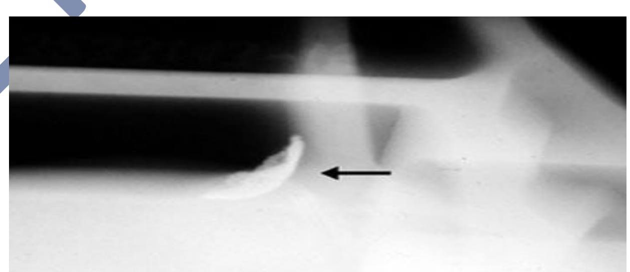
Cracks are thin (straight or jagged) linearly disposed discontinuities that occur after the melt has solidified. They generally appear singly and originate at casting surfaces.

Cold shuts generally appear on or near a surface of cast metal as a result of two streams of liquid meeting and failing to unite. They may appear on a radiograph as cracks or seams with smooth or rounded edges.



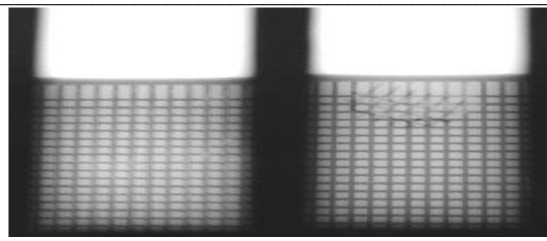
Cracks & Cold shuts

Inclusions are nonmetallic materials in an otherwise solid metallic matrix. They may be less or denser than the matrix alloy and will appear on the radiograph, respectively, as darker or lighter indications. The latter type is more common in light metal casting.



Inclusions

Core shift shows itself thickness, usually on radiographic views representing diametrically opposite portions of cylindrical casting portions.



Core shift

Hot tears are linearly disposed indications that represent fractures formed in a metal during solidification because of hindered contraction. The latter may occur due to overly hard (completely unyielding) mold or core walls. The effect of hot tears as a stress concentration is similar to that of an ordinary crack, and hot tears are usually systematic flaws. If flaws are identified as hot tears in larger runs of a casting type, explicit improvements in the casting technique will be required.
Misruns appear on the radiograph as prominent dense areas of variable dimensions with a definite smooth outline. They are mostly random in occurrence and not readily eliminated by specific remedial actions in the process.
Mottling is a radiographic indication that appears as an indistinct area of more or less dense images. The condition is a diffraction effect that occurs on relatively vague, thin-section radiographs, most often with austenitic stainless steel. Mottling is caused by interaction of the object's grain boundary material with low-energy X-rays (300 kV or lower). Inexperienced interpreters may incorrectly consider mottling as indications of unacceptable casting flaws. Even experienced interpreters often have to check the condition by re-radiography from slightly different source-film angles. Shifts in mottling are then very pronounced, while true casting discontinuities change only slightly in appearance.

LITERATURE REVIEW

Sunil Chaudhari, Hemant Thakkar[1] this paper include Some foundries are working with trial and error method and get their work done. Factually, most of the foundries have very less control on rejections, as they are always on the toes of production urgency; hence they ignore the rejections and salvage the castings. Majority foundries are failed to maintain a satisfactory quality control level.
Marcello Colledani, Tullio Tolio, Anath Fischer Benoit Iung , Gisela Lanza, Robert Schmitt, Jo zsef Vancz [2] this paper include companies are continuously facing the challenge of operating their manufacturing processes and systems in order to deliver the required production rates of high quality products, while minimizing the use of resources. Production quality is proposed in this paper as a new paradigm aiming at going beyond traditional six-sigma approaches. This new paradigm is extremely relevant in technology intensive and emerging strategic manufacturing sectors, such as aeronautics, automotive, energy, medical technology, micro-manufacturing, electronics and mechatronics.
T. R. Vijayaram, S. Sulaiman, A. M. S. Hamouda, M.H.M. Ahmad [3] In this review paper, some of the solutions and quality control aspects are explained in a simplified manner to eliminate the unawareness of the foundry industrial personnel who work in the casting manufacturing quality control departments. This review paper provides very valuable information to the young manufacturing and mechanical engineers who have interest to start their career in the manufacturing concerns of medium and large scale captive foundries.
ANIRUDDHA JOSHI, L.M.JUGULKAR [4] This paper presents all data of manual metal casting operations and defects leads to rejection for this organization. The paper also represents analysis of these defects with Pareto and Cause and Effect diagrams to know correct cause and correct remedial factors to improve quality level and productivity of organization. Today’s competitive environment has, lower manufacturing cost, more productivity in less time, high quality product, defect free operation are required to follow to every foundry man.
Monica Izverciana, Alina Radua, Larisa Ivascua, Ben-Oni Ardeleanb [5] this paper presents the view of the authors with respect to the relationship that exists between total quality management, human resources management, competitiveness and ISO 9000 and the impact of this relationship on the sustainability of the enterprise. The proposed conceptual models will help the persons of interest to have a better understanding of the relationship between the practices and step by step implementation to improve business performance.

Raghwendra Banchhor, S.K. Ganguly [6] This paper extensively reviews published research on green sand casting process. The effects of riser design, gating system, moulding sand, oxidation and deformation of casting during heat treatment, machining allowance, etc., on the economical manufacture quality castings were reviewed. Determining the optimal process parameter setting will significantly improve the mould yield, output ratio of metal, shorten manufacturing period, save energy and resource, reduce pollution, and improve the competitiveness of enterprises.
Raguramsingh.M, Syath Abuthakeer.S [7] A case study is carried out for a foundry, where Six Sigma methodology is implemented for the defect reduction. The optimized parameters are considered to perform the practical run for the automobile castings. Proposed technique is about optimizing the control factors, resulting in superior quality and stability. This study aims to implement a novel approach to improve the quality (reducing the defects) of a foundry by Six Sigma methodology on the selected projects.
Nicolas PERRY, Magali MAUCHAND, Alain BERNARD [8] in this paper, In the early phases of the product life cycle, the costs controls became a major decision tool in the competitiveness of the companies due to the world competition. After defining the problems related to this control difficulties, we will present an approach using a concept of cost entity related to the design and realization activities of the product. We will try to apply this approach to the fields of the sand casting foundry. This work will highlight the enterprise modeling difficulties and some specifics limitations of the tool used for this development. Finally we will discuss on the limits of a generic approach.
Dr.M.Arasu [9] the approach taken by this paper I expected to motivate the foundries to use a standard classification system to describe undesirable casting artifacts for more effective failure analysis. It will also encourage foundries to develop systems to measure process parameters relating to the defects that occur in the foundries and pool the resources of domain experts. Any reduction in the scrap and rework also positively influences the environmental impact of our industry. In this paper, it deals the various aspects of a systematic approach to understanding and development of quality cost system in cast iron foundries.
Lakshmanan singaram [10] outcome of the paper is the optimized process parameters of the green sand casting process which leads to improved process performance, reduced process variability and thus minimum casting defects, also a neural network modal is improved process performance, reduced process variability and thus minimum casting defects

CONCLUSION

By referring various papers different casting defects are studied and briefly described of some major volumetric defects that we can disclose or find out very easily and accurately. Quality Control Department of casting Industries may use same analysis to find out defect.

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