ANALYSIS OF SURFACE DEFECTS OF FERROUS CASTINGS BY USING MAGNETIC PARTICLE INSPECTION

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Abstract - *Magnetic particle inspection is one of the most commonly used non-destructive testing methods for detecting surface and limited subsurface indications in ferromagnetic materials. The magnetic field provides the means by which indications are formed and detected. It is thus essential that the magnetic field be optimized, not only in magnitude, but also in direction when detection of specific indications is required. For example, too low a field strength would not result in adequate particle build-up and would thus reduce the probability of detection for small indications. This paper discusses the magnitude, direction and special distribution of the magnetic field for various different magnetization techniques utilized. Special attention is given to the correct usage of various field detection instruments. Instead of using the electric field, the magnetic field should used to detect the defects.To identify the surface and as well as inner surface defects in ferrous materials.To rectify the surface and as well as inner surface defects in ferrous materials.The rectify operation done through the heat treatment process.*

1. INTRODUCTION

In theory, magnetic particle inspection (MPI) is a relatively simple concept. It can be considered as a combination of two nondestructive testing methods: magnetic flux leakage testing and visual testing. Consider the case of a bar magnet. It has a magnetic field in and around the magnet. Any place that a magnetic line of force exits or enters the magnet is called a pole. A pole where a magnetic line of force exits the magnet is called a north pole and a pole where a line of force enters the magnet is called a south pole. When a bar magnet is broken in the center of its length, two complete bar magnets with magnetic poles on each end of each piece will result. If the magnet is just cracked but not broken completely in two, a north and south pole will form at each edge of the crack. The magnetic field exits the north pole and reenters at the south pole. The magnetic field spreads out when it encounters the small air gap created by the crack because the air cannot support as much magnetic field per unit volume as the magnet can. When the field spreads out, it appears to leak out of the material and, thus is called a flux leakage field.

2. OBJECTIVES

Instead of using the electric field, the magnetic field should used to detect the defects. To identify the surface and as well as inner surface defects in ferrous materials. To rectify the surface and as well as inner surface defects in ferrous materials. The rectify operation done through the heat treatment process.

3. PROBLEM STATEMENT

Iron casting is a ferrous alloy made from pig iron, which is melted in a furnace along with alloying elements like carbon and silicon. The liquid molten iron is poured into molds to be casted for manufacturing an array of products. These cast iron products are used in a variety of industries ranging from agriculture to automobiles and hydraulics.

During the process of casting, some defects may be found in the products. Defects are usually undesirable in any casting product as they affect the quality of the product. The type of defect decides whether the fault can be tolerated, corrected or eliminated. It is very important to identify the type of defect so that you can decide what you need to do with them. More often, recognizing the defect correctly can help the quality control department to identify the root cause of the defect and find ways to fix them. Here are the common types of defects that may be seen in casting products.

Shrinkage defects

As the metal solidifies after being poured into the molds or casts, it is bound to shrink. When there is not enough metal available, shrinkage of cast iron products will lead to holes in the casting product. There are many types of shrinkage depending upon its cause.

Axial shrinkage

When the casting iron in the center (axis) takes a longer time to solidify or freeze in comparison to the metal on the sides, it leads to a cavity in the middle known as axial shrinkage. This can be caused due to various factors like the temperature at which the molten iron is poured, the speed at which it poured the type and quality of alloy present and any defect in the thickness of the casting mold.

Dispersed shrinkage

A variation in the alloy elements can lead to this type of shrinkage where cavities are formed perpendicular to the casting surface. High nitrogen content or low carbon content can lead to this type of casting defect.

Improper shrinkage

Sometimes, all the casting products may have the same type of defect variation in the dimensions. When the various alloy elements that were added to the furnace solidify at different rates, it leads to improper shrinkage. When this type of defect is found in the casting product, the product has to be remade.

Seams or scars

It is a metallurgical defect, which is characterized by the presence of depressions on the surface of the casted product. When the graphite moves into shrinkage cavities, it leads to scars or seams.

Slag inclusions

They are shallow spots or drops found on the surface of the casting products caused due to inclusion of contaminations like metal carbides, calcites, oxides and sulfides from ladles, furnaces and casting molds.

Rat tail

If you find tiny projections on the surface of the casted products, it could be the rat tail defect. It usually occurs in sand casting ferrous products. Altering the sand mixture will eliminate this type of defect.

Blowholes and pinholes

When you find cavities on the surface of the casting products, they are called blowholes or pinholes depending upon the size of the cavities. They are caused when gas gets trapped in the casting products during solidification. Solidifying the casting products in vacuum can eliminate this defect.

Coldshuts and misruns

When there are unfilled portions leading to cavities of varying depths on the product surface, they are called coldshuts. This defect is often accompanied with another defect called misruns, where the edges of the casting are ill-formed. Both these defects are commonly caused due to the lack of fluidity of metal alloys.

4. ELECTROMAGNETIC HYPERSENSITIVE

A systematic review in 2005 showed no convincing scientific evidence for symptoms being caused by electromagnetic fields. Since then, several double-blind experiments have shown that people who report electromagnetic hypersensitivity are unable to detect the presence of electromagnetic fields and are as likely to report ill health following a sham exposure as they are following exposure to genuine electromagnetic fields, suggesting the cause in these cases to be the nocebo effect.

A 2005 review by the UK Health Protection Agency and a 2006 systematic review each evaluated the evidence for various medical, psychological, behavioral, and alternative treatments for EHS and each found that the evidence-base was limited and not generalizable, but that the best evidence favored cognitive behavioural therapy. As of 2005, WHO recommended that people presenting with claims of EHS be evaluated to determine if they have a medical condition that may be causing the symptoms the person is attributing to EHS, that they have a psychological evaluation, and that the person's environment be evaluated for issues like air or noise pollution that may be causing problems.

Some people who feel they are sensitive to electromagnetic fields may seek to reduce their exposure or use alternative medicine. Government agencies have enforced false advertising claims against companies selling devices to shield against EM radiation

5. LITERATURE SURVEY

A review of the available literature on the reliability of magnetic particle testing identified some 20 references relevant to POD between 1968 and 2011. After critical examination, four published studies were considered both sufficiently well-documented and applicable to detection of fatigue cracks in high-strength steel aerospace components. As the statistical analysis methods used in these four studies were either outdated or deficient in other aspects, the original POD data were reanalysed using currently accepted techniques to give a series of six independent a90 and a90/95 values. The data apply to wet fluorescent particle inspection using the continuous magnetisation method. The MPT POD trials showed a spread of performance between the organisations involved in the various trials. Following a meta-analysis, it was concluded that the average performance of MPT derived from the available literature corresponds to a90 = 2.0 mm, with 50% of the trials resulting in a larger a90 than this median value. The RAAF standard limitation for MPT is 2.0 mm. The largest a90 consistent with most implementations of MPT is 2.6 mm, based on the 90th percentile value for the six a90 values. On this basis, the results do not support a reduction in the standard limitation for MPT.

The literature review also identified a study in which it was found that the two different methods of magnetisation commonly used in MPT (contour probes and particle benches) had a negligible effect on a90 and a90/95 for detecting external flaws.In terms of reliability, the equivalence in performance of the two methods of magnetisation may depend on the flaw location. A general observation from this survey is the paucity of recent reliability studies for MPT.

This module is intended to present information on the widely used method of magnetic particle inspection.

Magnetic particle inspection can detect both production discontinuities (seams, laps, grinding cracks and quenching cracks) and in-service damage (fatigue and overload cracks).

6. INTRODUCTION TO MAGNETISM

Magnetism is the ability of matter to attract other matter to itself. Objects that possess the property of magnetism are said to be magnetic or magnetized and magnetic lines of force can be found in and around the objects. A magnetic pole is a point where the a magnetic line of force exits or enters a material.

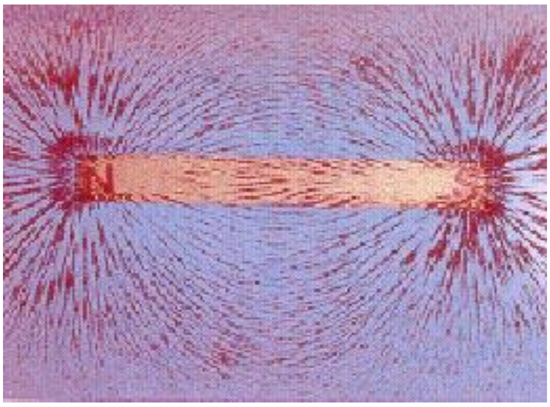

Fig 1 Magnetic lines of force around a bar magnet

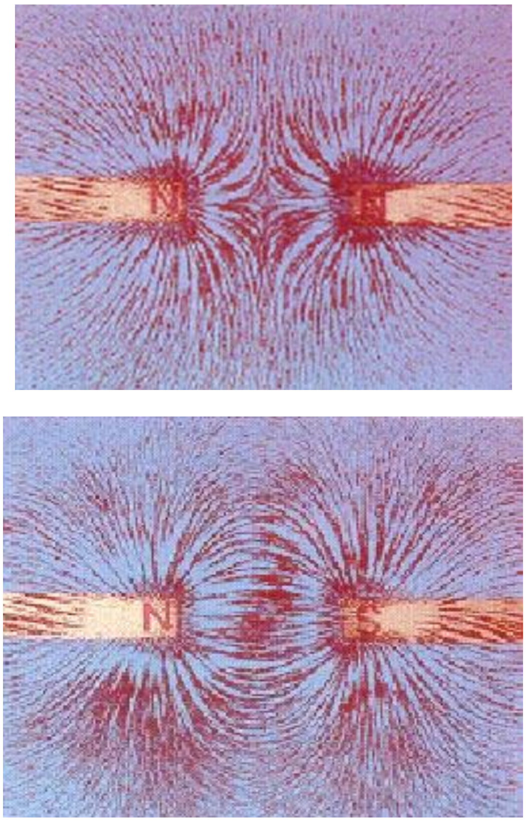

Fig 2 Similar force repelling

7. FERROMAGNETIC MATERIALS

A material is considered ferromagnetic if it can be magnetized. Materials with a significant Iron, nickelor cobalt content are generally ferromagnetic. Ferromagnetic materials are made up of many regions in which the magnetic fields of atoms are aligned. These regions are call magnetic domains. Magnetic domains point randomly in demagnetized material, but can be aligned using electrical current or an external magnetic field to magnetize the material.

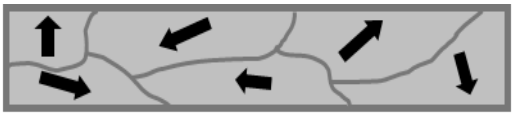

Fig 3 demagnetised

8. PROCESS OF MAGNETIC PARTICLE INSPECTION

A ferromagnetic test specimen is magnetized with a strongmagnetic field created by a magnet or special equipment. If the specimen has a discontinuity, the discontinuity will interrupt the magnetic field flowing through the specimen and a leakage field will occur.

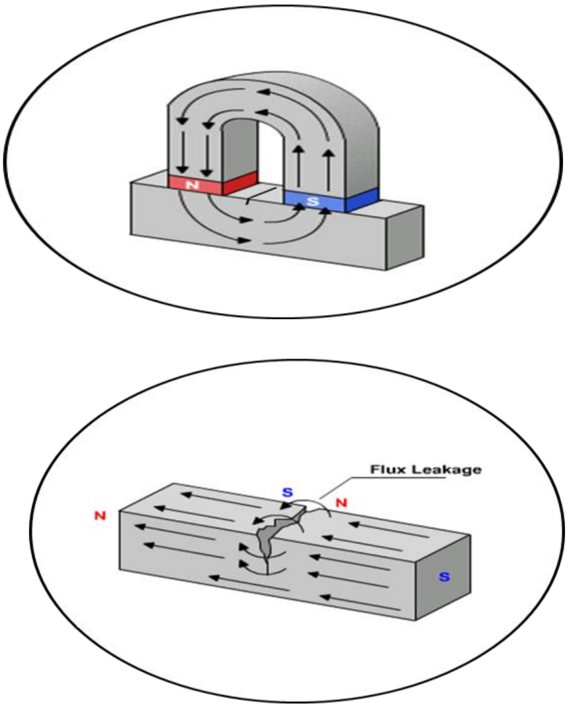

Fig 4 magnetic particle inspection

9. INSPECTION WORK

Finely milled iron particles coated with a dye pigment are applied to the test specimen. These particles are attracted to leakage fields and will cluster to form an indication directly over the discontinuity. This indication can be visually detected under proper lighting conditions

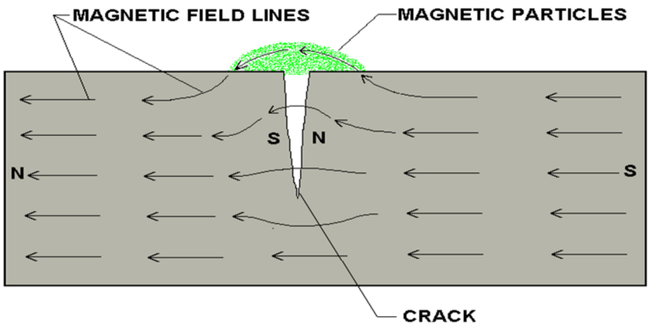

Fig 5 inspection work

10. DEMAGNITIZER

There are two types of demagnetizers: one uses electricity, and the other is an actual magnet. Electrical demagnetizers consist of two basic types: a hand-held pencil point and a tabletop model. The pencil-point demagnetizers are used for small items such as tape-recording heads. Tabletop models are used for heavier items such as large-bearing assemblies or automotive parts. The actual magnet demagnetizer uses a hole down its center for magnetizing small hand tools such as screwdrivers or pliers. By following a basic procedure, you can use all three of the devices for various applications.

Fig 6 Demagnetizer

11. TRANSFER BLOCK

Transfer block is used to transfer the magnetic force from one end to another end. It transfer the maximum number of energy from one end to another end compared to other materials. The reason why do we go for the transfer block is the main reason of our project to do because if the use electro magnet cryogenic diseases can be caused. if we use permanent magnet then it will not transfer the magnetic force completely from one end to another end. Thats why we are using the transfer block to transfer magnetic force from one end to another end.

Fig 7 Transfer block

Fig 8 V Transfer block

12. 3D MODELLING

In 3D computer graphics, **3Ddimensional modeling**) is the process of developing a mathematical representation of any *surface* of an object (either inanimate or living) in three dimensions via specialized software. The product is called a **3D model**. Someone who works with 3D models may be referred to as a **3D artist**. It can be displayed as a two-dimensional image through a process called *3D rendering* or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

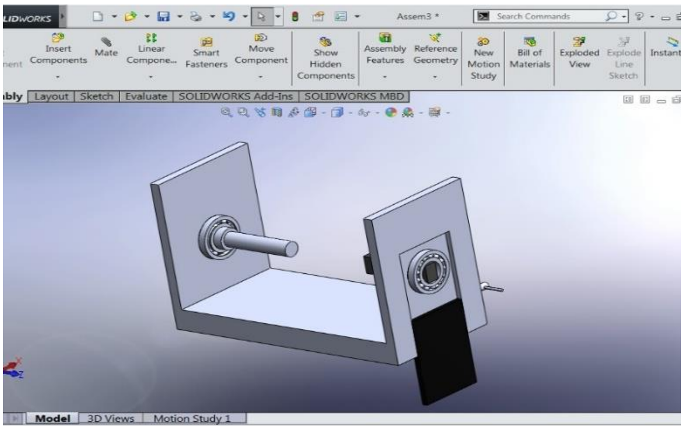

Fig 9 3d modelling

13. REQUIRED MATERIALS

Aluminium
Permanent magnet
Transfer block
Nuts and bolts
Lever
Ball bearings
Iron powder

WORKING PROCESS:

Test materials should be placed in between the two rotating shafts, one side is connected to the transfer block and the permanent magnet is connected to the transfer block to transfer the magnetic properties to the test specimen and other side is connected the end of the wall. Both the shafts are fitted in ball bearing for rotation.

A lever is connected to side of the wall is connected with permanent magnet with internal linkages to give an tranverse motion. Transverse motion is mainly given to avoid damages in an test specimen.

The iron particles of sprinkled on magnetized test specimen and now the defects on the test specimen is clearly viewed.

14. CONCLUSION

As per the design electromagnetic hypersensitive diseases is not affect wok as and also the presence of transfer block the magnetic force is completely trasnsfer to the test specimen.

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