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A REVIEW ON HARDFACING AND WEAR REDUCING TECHNIQUES ON INDUSTRIAL VALVES

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ABSTRACT

Surface engineering for tribological applications aims at two basic objectives:

- To improve the applications of friction, lubrication and wear.
- To modify overall surface hardness.

Tribology comes from the Greek word, “tribos”, meaning “rubbing” or “to rub”And from the suffix, “ology” means “the study of” Therefore, Tribology is the study of rubbing, or “the study of things that rub”. The process leading to loss of material is known as "wear". Major types of wear include abrasion, friction (adhesion and cohesion), erosion, and corrosion. Wear can be minimized by modifying the surface properties of solids by one or more of "surface engineering" processes (also called surface finishing) or by use of lubricants (for frictional or adhesive wear). If a component is not completely separated from its counter-face by a fluid film, its tribological behavior critically depends on the properties of the contacting surfaces and hence the choice of contacting materials becomes important. Thus, a material selected on the basis of strength and bulk properties may be unsuitable for its tribological properties. It is well known that wear resistance of surface increases with hardness and hence to resist wear one should go for a material of high hardness. Materials with good tribological characteristics are often very expensive and difficult to fabricate.

The method used in surface engineering may be broadly divided into two categories:

- Treatment of surfaces
- Coating of surfaces.

KEYWORDS: Hard Facing, Valve

INTRODUCTION

HARD FACING

Hard facing is a metalworking process where harder or tougher material is applied to a base metal to resist wear and prolongs working life. Hard facing is also known as hard surfacing. The harder material is welded to the base material, and is generally takes the form of specialized electrodes for arc welding or filler rod for TIG and oxyacetylene welding.

Hard facing is one of the most useful and economical ways to improve the performance of components submitted to severe wear conditions. An alloy is homogeneously deposited onto the surface of a soft material (usually low or medium carbon steels) by welding, with the purpose of increasing hardness and wear resistance without significant loss in ductility and toughness of the substrate. Hard facing may be applied to a new part during its production, or it may be used to restore a worn-down surface. The base metal, the type of wear, the welding process, and quality control in welding are equally important factors in achieving success.

Applications of Hardfacing

- Hard facing is commonly used on heavy machinery in the following industries: Construction and Excavation: Tractor and shovel parts, buckets, excavator teeth, drive sprockets, etc.
- Mining, crushing and grinding: Dragline chains and buckets, shaker pan conveyers, ball mill scoops, etc.
- Cement and Brick: Screw conveyers, pulverizer mill components, vibratory screens, etc.
- Iron and Steel: Machine rails, sintering plant pallets, tap hole drill bits, etc.

History of Hard Facing

- In Sep 26, 1882, US Pat. No. 265106, issued to Robert Bristow Lee, discloses a device for forming lattice pillars, in which wire was wrapped around a cylindrical object in a spiral pattern. The instant invention was distinguishable, in that the hard-facing was welded to the pole in vertical strips.
- In Jan 1949 “Hard Facing with Inert & Gas Arc Welding” invented by, KH Koopman.
- In Jan 10, 1956 The American manganese steel division of American brake shoe, which makes welding rod and mechanical equipment for hard facing, contended that process can increase the life of metal parts from two to 25 times.
- In 1984 Deposition of a first relatively hard material on a second material that was relatively soft using a rotating rod, bar, tube or other body without translation of the rotating body relative to a work piece of the second material was achieved by positively cooling the interface between the body and the work piece such that a shear layer at which heat was being generated moves away from the surface in the direction of the rotating body. On removal of the rotating body from contact with the work piece, the work piece is found to be rotating with material from the rotating body.
- In Oct 7, 1993 US patent application Ser. No. 08/133450, entitled "Welded Metal Hard-facing Pattern for Cone Crusher Surface.
- In Sep 6, 2012 Cobalt-free hard-facing alloys with improved welding characteristics: Patented by Howard Ocken, Shane J. Findlan and Michael K. Phillips.
- In Aug 1, 2013 - Mechanically shaped hard facing cutting/wear structures: Patented by James L. Overstreet. A hard facing material was applied to cutting elements formed on the surface of cutters of an earth-boring bit. The hard facing material formed the outer surface of the teeth, and also substantially formed scrapers on the shell of

each of the cutters. The adding of the hard facing material to the outer surface of the teeth and formed the scrapers.

- In Feb 2014 Gupta Dheeraj, Gandhi BK, Gupta SR, Paul CP and Nath AK, had done hard facing of AISI 304L Stainless Steel using High Power CO Laser.

WEAR

The study of friction, wear, and lubrication has long been of enormous practical importance, since the functioning of many mechanical, electromechanical and biological systems depends on the appropriate wear values. From tribological considerations, wear is the most important reason amongst the three. Wear has been defined in different ways by different persons and agencies but all, at the end, mean the same. Few definitions are given below:

- "Damage or loss of quality by usage" - Dictionary definition and general concept of
- Wear.
- "The destruction of material, produced as a result of repeated disturbances of friction bonds" - Mr. Kragelski.
- "The progressive loss of the substance from the operating surface of a body, occurring as a result of a relative motion of surfaces" - OECD Scientific Committee.

Wear Reducing Techniques

Although wear cannot be eliminated completely, yet it can be reduced to some extent by different wear prevention methodologies.

Few of such methods are stated below:

- **Better Material:** Select suitable wear resistant materials checking technological or economic factors.
- **Coatings:** As wear is a surface phenomenon, it can be reduced using protective coatings on the contacting surfaces. There are so many coating methods according to particular need and requirements.
- **Lubrication:** Lubrication is the most important factor for wear considerations. The main objective of lubrication is to reduce the severity of friction and wear in addition to performing other functions.
- **Contact Pressure:** Ensure that the actual contact pressure does not exceed the allowable contact pressure for that material and for that application. This may have different values for different materials. Some hand books specify such allowable contact stresses.
- **Temperature:** Ensure that working temperature remains within limits as higher temperature softens most metals and lower temperature embrittles some materials.
- **Misalignment:** Try to avoid misalignment, if some misalignment is a must, use materials/ designs which can accommodate the same.
- **Environment:** Reduce abrasive, corrosive and other hostile environment.
- **Maintenance:** Use proper maintenance schedules, procedures, methods to minimize wear problem

DUAL PLATE CHECK VALVE

The Dual Plate Check Valve design is the result of attempts to solve the problems associated with swing check valve and lift check valve. The Dual Plate Check Valve employs two spring-loaded plates hinged on a central hinge pin. When the flow decreases, the plates close by torsion spring action without requiring reverse flow.

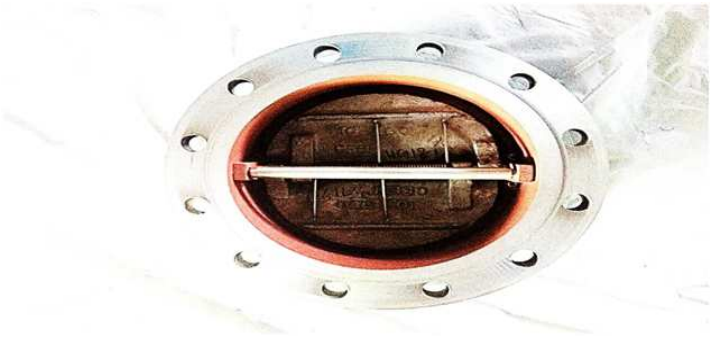

Figure 1: Damage at the Seal Seat of a Dual Plate Check Valve Due to Wear

Figure 2: Wear Occurrence Place of Dual Plate Check Valve

CONCLUSIONS

- The best and effective method found to remove wear is to use coating.
- For food carrying products the coating should not react with the material.
- Hard facing can be used for coating purpose.

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