EROSION BEHAVIOUR OF STAINLESS STEEL

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Abstract - *In current year's big development has been made each in gaining a fundamental perception of the giant parameters of put on and in making use of a substances methodology to mitigate the troubles of wear. While this mission work will solely tackle strong particle erosion, it is properly to hold in thought that different put on processes, e.g., abrasive put on and oxidative wear, contain many comparable traits and possibly mechanisms. Progress in grasp any one of these techniques can also be relevant to others, and to the improvement of greater put on resistant substances and systems. Testing on ferrous and non-ferrous substances has been broadly carried out to find out about their erosion resistance. Venkataraman & Sundararajan [1] carried out a learn about about the stable particle erosion of copper at a vary of low have an effect on velocities. In this unique case, the eroded floor used to be absolutely blanketed with the erosion particles in the structure of flakes or platelets. These flakes regarded to be definitely separated or fractured from the cloth floor and have been flattened via subsequent impacts. For this reason, it used to be concluded that at low affect velocities the erosion harm was once characterized on the whole via lip or platelet fracture whereas it used to be distinctive with lip formation (rather than its subsequent fracture) at greater affect velocities. In this undertaking erosion conduct of the stainless metal is evaluated via exposing the metal substrate to erodent at predefined pace and pressure. Effect of have an effect on perspective and erodent speed on erosion resistance of the metal substrate is studied with the assist of strong particle erosion setup.*

*Key Words***:** Erosion, Stainless steel, SS, Steel, Material

1. INTRODUCTION

Studies on the erosion behaviour of AISI 4140 metal beneath more than a few warmth remedy stipulations used to be investigated by way of Ambrosini & Bahadur [2]. In this work, the investigation was once centred on the impact of a number of microstructures and mechanical homes on the erosion resistance. A regular speed of 50 m/s used to be used for all the erosion tests. The goal used to be impacted at an perspective of 30º to the specimen surface, the particle feed charge used to be 20 g/min, SiC particles, a hundred twenty five μm in size, had been used as the abrasive. From the results, it was once concluded that erosion fee will increase with growing hardness and final strength, however decreases with growing ductility. In this specific work, the warmness cure with the greatest aggregate of erosion resistance and mechanical homes used to be oil quenching accompanied by way of tempering in the temperature vary 480-595 ºC for two h. In addition, SEM research introduced extreme plastic deformation in the eroded zones collectively with abrasion marks, indicating that cloth subjected to erosion in the beginning undergoes plastic deformation and is later eliminated by way of abrasion. Harsha & Bhaskar [3] carried out lookup to learn about the erosion behaviour of ferrous and non-ferrous substances and additionally to take a look at the erosion mannequin developed for everyday and indirect affect angles via Hutchings [4]. The substances examined had been aluminium, brass, copper, slight steel, stainless metal and solid iron. They decided from the SEM research that the worn surfaces had printed quite a number put on mechanisms such as micro ploughing, lip formation, platelet, small craters of indentation and micro cracking. In addition to these studies, Morrison & Scattergood [5] carried out erosion exams on 304 stainless steel. In this work, it was once concluded from the SEM observations that comparable morphologies for low and excessive influence angles ought to be determined in ductile metals when they had been subjected to the affect of sharp particles. The surfaces displayed a peak-andvalley topology collectively with connected platelet mechanisms. In addition, the bodily foundation for a single-mechanism to erosion in ductile metals was once viewed to be associated to shear deformations that manage cloth displacement inside a technique region for a everyday set of influence activities producing at all have an effect on angles.

1.1 Essentials of Wear

Wear reasons an widespread annual expenditure by means of enterprise and consumers. For some industries such as agriculture, as many as 40% of the elements changed on equipments have failed by using wear. Estimates of direct value of put on to industrial international locations fluctuate from 1% to four percent of GNP and it is estimated that 10% of all electricity generated by means of man is dissipated in a range of friction processes. Thus the magnitude of losses prompted to mankind (which can be expressed in proportion factors of GDP) makes it really indispensable to learn about approaches to decrease it. Thus minimizing

wear, impacts the economics of manufacturing in a main way.

1.2 Wear Measures: -

Previously put on was once described as broken to a surface. The most frequent structure of that injury is loss or displacement of cloth and quantity can be used as a measure of wear—volume of fabric eliminated or extent of fabric displaced. For scientific functions this is often the measure used to quantify wear. In many studies, in particular fabric investigations, mass loss is regularly the measure used as an alternative of volume. This is executed due to the fact of the relative ease of performing a weight loss measurement. However there are some troubles in the use of mass as important measure of wear.

1. Direct contrast of substances can solely be finished if their densities are same. For bulk fabric this is no longer a fundamental obstacle, considering that the density is both recognized or without difficulty determined. In the case of coatings however, this can be a main problem. The different issues are greater intrinsic ones.

2. A mass dimension does no longer measure displaced materials. In addition it is touchy to put on particles and transferred fabric that will become connected to the floor and can't be removed. This fabric does now not always have to be from the equal surface; it can from the counter face as well.

From the above it can be viewed that quantity is the integral measure for put on when put on is calculated with loss or displacement of material. However, in engineering applications, is normally with the loss of a dimension, the extend in clearance or alternate in contour now not the extent loss, Volume, mass loss and a dimension are no longer the solely measures for put on that are used in engineering. Life, vibration level, roughness, appearance, friction level, and diploma of floor crack or crazing are some of the operational measures that are encountered.

2. EXPERIMENTAL PROCEDURE

2.1 Erosion Test

In the existing investigation a self-made erosion equipment of the sand blast kind was once used. It was once designed and fabricated in our laboratory.

2.1.1 CONSTRUCTION

The erosion trying out desktop has many parameters which can be varied. It has some awesome parts.

Nozzle: The nozzle is related with the steel tube thru which compelled air enters the nozzle mouth. As pressurized air enters the nozzle alongside with the sand so the sand flows with excessive speed and consequently with excessive momentum, Thus eroding whatever coming on its way.

Reciprocating Air Compressor: High compelled air is furnished from the reciprocating air compressor, current beside the erosion trying out machine. It as a two cylinder compressor, the larger cylinder carries air of low stress and excessive volume. The smaller cylinder consists of excessive forced air. The desktop sucks air from the ecosystem and first shops in the large cylinder with excessive pressure, and then it strikes to the smaller cylinder with pipes.

Fixture Arrangement: The fixture association is supplied to maintain the sample or specimen at specific angles to the nozzle. The fixture association has one metallic plate which strikes over a progressively marked arrangement.

The fixture can be organized at unique angles and it can also be moved linearly to come across the specimen precisely beneath the nozzle

N.B.:- Angle is measured with recognize to the nozzle and now not the base line.

Funnel Arrangement: Funnel related with a pipe to the nozzle is furnished at the top. The funnel is used to pour sand in it.

2.2 Experimental Parameters

Angle: The attitude can be assorted by way of the use of the fixture arrangement. Different angles which can be used are 30º, 60º, 90º.

Pressure: Different values of stress which can be used are 4Kgf/mm2, 5 Kgf/mm2 and 6 Kgf/mm2.

Stand off distance: It is the distance between the nozzle tip and the specimen of the surface. The stand off distance can be diverse through adjusting nozzle top the use of the screw arrangement. The exclusive values of stand off distance used have been 100mm and 200mm.

Erodent size: Sand particles of specific measurement can be carried out via sieving. Mesh dimension used was once four hundred microns.

2.3 EROSION TEST PROCEDURE

1. Before conducting the take a look at the specimen floor used to be cleaned properly.
2. The pattern is clamped at the fixture. The required attitude and stand off distance used to be adjusted.

3. The air at required strain is blended with the erosive particle and is directed to the a specimen for specific time duration.
4. The preliminary mass and the mass of the specimen after erosion had been observed out the use of the weighing machine.
5. The above steps are repeated for exclusive parameters mentioned.

3. RESULTS AND DISCUSSION

3.1 Results:

Mild Steel

SOD=10mm,   PRESSURE= 1Mpa

Time	30^0	60^0	90^0
0	27.770	27.750	27.740
2	27.760	27.740	27.740
4	27.750	27.740	27.730
6	27.750	27.740	27.730

Table 3.1
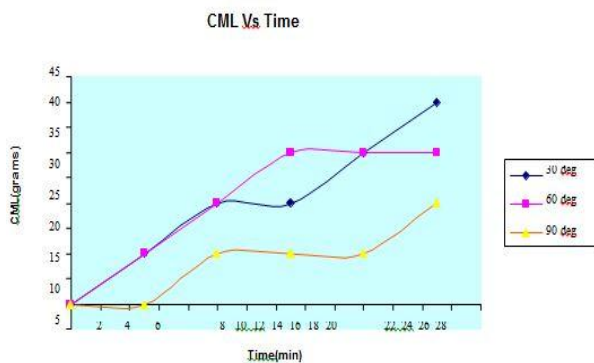
Figure 3.1

SOD=10mm   PRESSURE=2Mpa

Time	30^0	60^0	90^0
0	28.540	28.560	28.580
2	28.540	28.550	28.570
4	28.530	28.550	28.570
6	28.530	28.540	28.560

Table 3.2
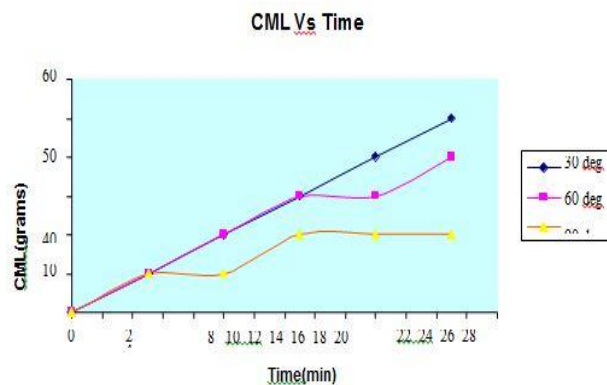
Figure 3.2

SOD=10mm   PRESSURE=3Mpa

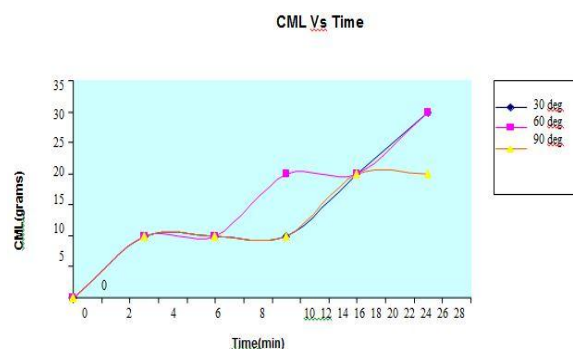| Time	30^0	60^0	90^0
0	28.530	28.510	28.490
2	28.520	28.500	28.490
4	28.510	28.500	28.480
6	28.510	28.490	28.480

Table 3.3

Figure 3.3

3.2 DISCUSSION:

The usual incremental erosion curve is introduced in preceding page. The erodent particles strike the lined samples at a variety of perspective of impact. It is viewed that at first the cumulative mass loss will increase unexpectedly and later on will become nearly stagnant. This style is located in case of erosion carried out at all different influence angles i.e. 600 and 900. In all these cases, a transient regime in the erosion system appears to exist, for the duration of which the mass loss will increase monotonically and tends to reap a steady regular kingdom value. This consistent price is referred to as the constant nation erosion rate.

The cumulative increment in cloth loss due to erosion put on with publicity time (or erodent dose) has been mentioned previously by means of Levy [7]. He has proven that, the incremental erosion fee curves of substances begin with a excessive fee at the first measurable quantity of erosion and then decreases to a an awful lot decrease regular kingdom fee [8].

In the existing work also, this style is determined in case of all three metals subjected to erosion check at a range of have an effect on angles. This can be attributed to the reality that the exceptional protrusions on the floor of metals are tremendously unfastened and can be eliminated with much less power than what would be quintessential to take away a comparable phase from the bulk of the metal. Consequently, the preliminary put on fee is high. With growing publicity time the price of put on starts offevolved lowering and in the transient erosion regime, a sharp drop in the put on charge is obtained. As the coating floor progressively receives smoothened, the fee of erosion tends to grow to be steady.

Figure a (previous page) illustrates the impact of have an effect on attitude (α) on the erosion price of metals subjected to strong particle erosion. The erosion outcomes for metals (MILD STEEL, STAINLESS STEEL AND ALUMUNIUM) at have an effect on angles of 30, 60 and ninety levels are shown. The erosion mass loss is greater at smaller perspective of have an effect on and the most erosion takes vicinity at $\alpha = 300$.

This is ordinary of all ductile materials. The outcomes bought in the current work exhibit that for 300 influence attitude the metals lose most mass as compared to that of $\alpha = 600$ and $\alpha = 300$ at a regular SOD and pressure. This variant of erosion put on loss confirms that the perspective at which the circulation of strong particles impinges the metallic floor influences the fee at which the fabric is removed. It similarly suggests that, this dependency is additionally influenced with the aid of the nature of the material. The perspective of have an effect on determines the relative magnitude of the two factors of the have an impact on speed namely, the thing regular to the floor and parallel to the surface. The ordinary issue will decide how long the have an effect on will ultimate (i.e. contact time) and the load. The product of this contact time and the tangential (parallel) speed factor determines the quantity of sliding that takes place. The tangential speed aspect additionally affords a shear loading to the surface, which is in addition to the regular load that the ordinary pace issue causes. Hence as this perspective adjustments the quantity of sliding that takes location additionally modifications as does the nature and magnitude of the stress system. Both of these factors impact the way a metallic wears. These modifications suggest that distinct kinds of cloth would showcase exclusive angular dependency.

4. CONCLUSIONS:

• Erosion charge with recognize to attitude of have an impact on is most at 30degree and minimal at 90degree.

• Erosion price with appreciate to Pressure will increase as the price of erosion increases.

• From the anticipated mechanism it is determined that the erosion conduct is legitimate for ductile materials. Hence our statement additionally follows the identical rule.

Having calculated the perfect attitude of contact, pressure of impingement and the distance of fall for an Mild Steel, Aluminium, Stainless Steel, we would now be in a role to predict the circumstance that have to be maintained to reduce wear. However it must be referred to that put on being distinctly precise to geometry, bodily properties, metallurgy and a host of different elements all our predictions will pertain to the samples used only. As such it can't be generalized to all samples. This is one of the important impediments to put on studies. Also as indicated put on may additionally happen due to a range of motives and modes then again we would be in a role to find out about solely one mode i.e. erosion put on .Hence all our predications will be made beneath the assumption that put on is happening solely due to erosion and no different thing or mode is coming into effect.

REFERENCE:

[1] Effect of erodent properties on erosion wear of ductile type materials • ARTICLE Wear, Volume 261, Issues 7-8, 20 October 2006, Pages 914-921 Girish R. Desale, Bhupendra K. Gandhi and S.C. Jain

[2] Erosion wear behaviours of SiC/(W,Ti)C laminated ceramic nozzles in dry sand blasting processes • ARTICLE Materials Science and Engineering: A, In Press, Corrected Proof, Available online 25 September 2006,

[3] Development and Characterization of Metal Matrix Composite using red mud and Industrial waste for wear resistant applications

[4] Erosion wear mechanisms of coal–water–slurry (CWS) ceramic nozzles in industry boilers • SHORT SURVEY Materials Science and Engineering: A, Volume 417, Issues 1-2, 15 February 2006, Pages 1 -7 Deng Jianxin, Ding Zeliang and Yuan Dongling

[5] Nominal particle size of multi-sized particulate slurries for evaluation of erosion wear and effect of fine particles • ARTICLE Wear, Volume 257, Issues 1-2, July 2004, Pages 73-79 Bhupendra K. Gandhi and Satish V. Borse

[6] Effect of annealing and chemical strengthening on soda lime glass erosion wear by sand blasting • ARTICLE Journal of the European Ceramic Society, Volume 23, Issue 2, February 2003, Pages 331-343 Chabane Bousbaa, Abderrahim Madjoubi, Mohamed Hamidouche and Nourredine Bouaouadja

[7] Levy, A. V. The erosion corrosion behavior of protective coatings, Surf. and Coat. Techn., v. 36. p. 387 – 406, 1988

[8] Mechanical Wear Prediction and Prevention , Raymond G Bayer

[8] Erosion wear behavior and model of abradable seal coating • ARTICLE Wear, Volume 252, Issues 1-2, January 2002, Pages 9-15 Yi Maozhong, Huang Baiyun and He Jiawen

[9] FEM analysis of erosive wear • ARTICLE Wear, Volume 250, Issues 1-12, October 2001, Pages 779-784 K. Shimizu, T. Noguchi, H. Seitoh, M. Okada and Y. Matsub

[10] Erosion- and wear-corrosion behavior of Fe–Mn–Al alloys in NaCl solution • ARTICLE Materials Science and Engineering A, Volume 292, Issue 1, 15 November 2000,Pages 90-95 Her-Hsiung Huang and Tung-Han Chuang

[11] Erosive wear behaviour of aluminium based composites • ARTICLE Materials and Design, Volume 18, Issues 4-6, 1 December 1997, Pages 389-393 Q. Fang, P. Sidky and M. G. Hocking

[12] Sand erosion of wear-resistant materials: Erosion in choke valves • ARTICLE Wear, Volumes 186-187, Part 1, July 1995, Pages 179-188 K. Haugen, O. Kvernvold, A. Ronold and R. Sandber