RESEARCHERID
THOMSON REUTERS
[Durgesh al. , 4(2), Feb 2019]
ISSN : 2455-9679
Impact Factor : 2.865

IJRTSM

INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

"EFFECT OF EROSIVE WEAR ON TRBOLOGICAL PROPERTIES OF DUCTILE IRON"

Durgesh Kumar [1], Sunil Shukla [2]

[1]M.Tech Scholar, Dept. of Mechanical Engineering, NRI Institute of Information Science & Technology Bhopal, MP, India

[2]Assistant Professor, Dept. of Mechanical Engineering, NRI Institute of Information Science & Technology Bhopal, MP, India

ABSTRACT

In present day materials, surface properties needs to be changed, keeping the properties of base material as same. Especially, sometimes hardness is of utmost importance and needs to be enhanced. In present thesis, hardness of carbon samples fabricated is determined before and after the erosive wear test. Surface characterization of the eroded surface is also analysed. It is seen that the hardness of surface increased considerably after erosion. At the same time the hardness is measured with considering impact angle of erosion particles, pressure of particles and stand-off distance of the nozzle during the wear test. It is seen that hardness increased considerable after erosion due to effect of strain hardening. Further effect of hardness on different samples synthesized is analysed with parameters like impact angle, pressure and stand off distance of the erosive particles

Keyword: *Pressure, Impingement, Iron, Graphite, Nodule, Cast Iron, Hardness, SEM, Erosion.*

I. INTRODUCTION

Ductile iron or spheroidal graphite cast irons, which have been developing over the past few decades, are of considerable current attention because they can proposal a better combination of strength and toughness as compared with gray cast irons. Such a necessary combination of mechanical properties of ductile iron coupled with the intrinsic cost advantage of the casting process has resulted in an increased use of ductile iron in recent years, even replacing fabricated steel components in some cases.Austempered Ductile Iron (ADI) is described by improved mechanical properties but low machinability compared to conventional ductile iron materials and steels of same strengths. The mechanical properties of ADI are achieved by a very fine austenitic-ferritic microstructure.

Nodular cast iron is a heterogeneous material. The macroscopic properties of this material have been often measured using a traction test. Nevertheless, the microscopic study showed that destruction is produced by the plastic cavitation and the uncertainty of the ductile matrix surrounding the graphitic spheroids that act like a wide cavity. Severe damage can be produced by the growth of the cavitation that surrounds the presences in the ferretic phase.

II. LITERATURE SURVEY

ISSN : 2455-9679
Impact Factor : 2.865

Ductile iron is defined as a high carbon containing, iron based alloy in which the graphite exists in compact, spherical shapes rather than in the shape of flakes, the latter being typical of gray cast iron. As ductile iron, occasionally referred to as nodular or spheroidal graphite cast iron, constitutes a family of cast irons in which the graphite is present in a nodular or spheroidal form. The graphite nodules are small and constitute only small areas of weakness in a steel-like matrix. Because of this the mechanical properties of ductile irons associated directly to the strength and ductility of the matrix present—as is the case of steels.

The main difference between ductile iron and grey iron is the morphology of graphite particles which take on a nodular or almost spherical form after appropriate treatments are made to the melt. The chief microstructural constituents of ductile iron are: the chemical and morphological forms taken by carbon, and the continuous metal matrix in which the carbon and/or carbide are dispersed. The following significant microstructural components are found in ductile iron.

III. EXPERIMENTATION

The materials were melted in a 250 kg induction furnace with medium frequency. Charges consisting 50kg pig iron (C=4.17%, Si=1.66%, Mn=0.138%, S=0.024%, P=0.060%), 100kg S.G return (C=3.62%, Si=2.12%, Mn=.19%, S=0.010%, P=0.026%) and 150kg steel scrap (C=0.038%, Si=0.037%, Mn=0.135%, S=0.005%, P=0.015%) were melted in furnace. At this time the sample was taken from the melt for final chemical analysis. The pouring temperature was 1380˚C. Similarly other five melts were prepared with varying chemical composition and all melts were properly post inoculated. The chemical compositions of all the raw materials used are obtained from manufacturer's analysis.

An Air jet erosion test rig was used to test erosive wear of target materials in the present investigation. Angular (irregularly shaped) silica sand was used as impact particles. The specimens were mounted into the test stage directly below the nozzle with using different stand of distance (distance between tip of the nozzle to surface of the specimen) and also Samples were eroded with silica sand at different impingement angles (i.e. 30˚, 45˚, and 60˚).

The samples were tested for hardness measurement. Vickers Hardness test was carried out at room temperature before and after erosion to measure the hardness of the SG iron samples. The load was applied through the diamond indenter for 10 seconds during testing of all the treated and untreated samples.

IV. RESULTS & DISCUSSION

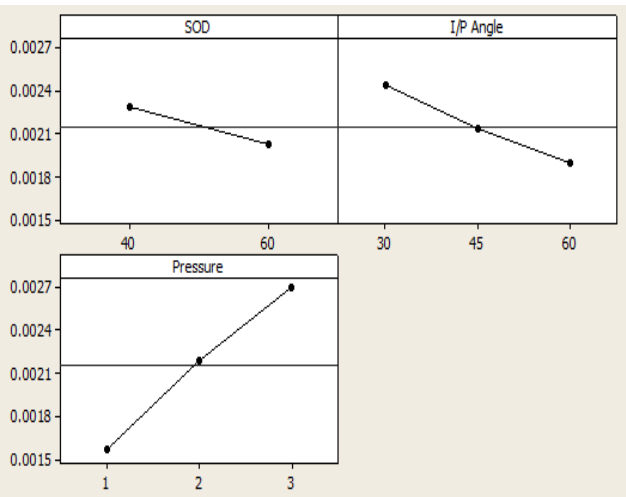

Fig. 4.1- Effect of control factors on erosion rate. (For sample 1)

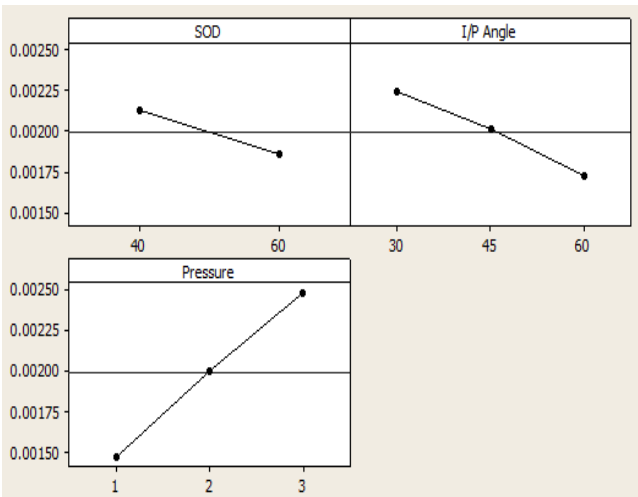

Fig. 4.2- Effect of control factors on erosion rate. (For sample 2)

ISSN : 2455-9679
Impact Factor : 2.865

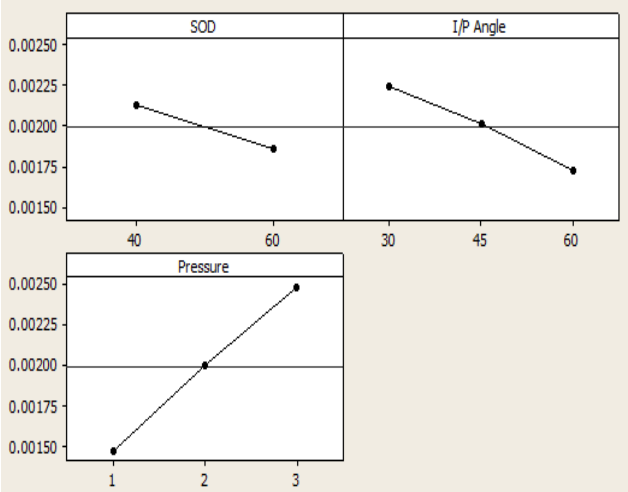

Fig. 4.3- Effect of control factors on erosion rate. (For sample 3)

Surface Morphology of Synthesized Sample

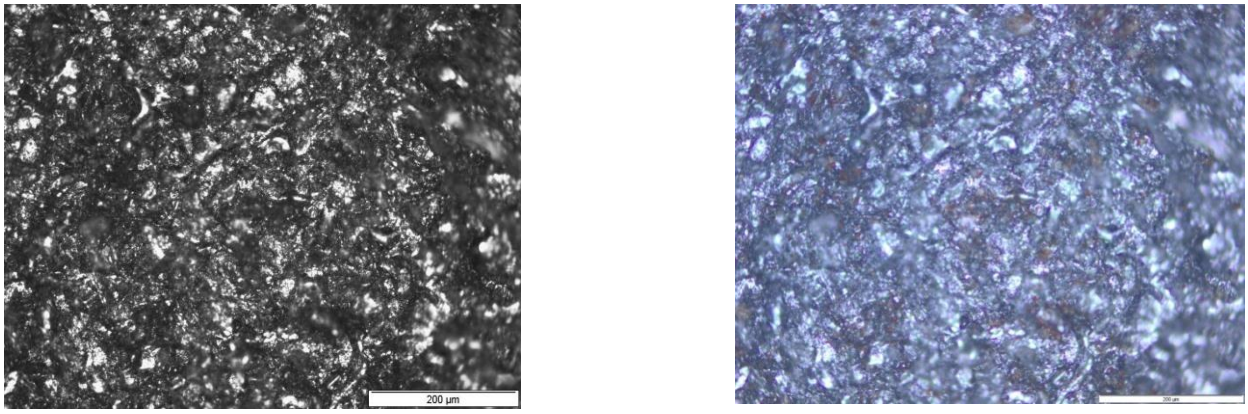

Fig. 4.4 SEM images of sample before and after erosion

Microhardness of Nanocomposite coatings

In the present thesis, samples of EN8 are coated with nickel and nickel-tungsten carbide nanocomposites. These coatings are subjected to the microhardness test. Test was done so as to ascertain the increasing value of hardness in of the surface of the coating as the percentage of tungsten carbide ceramic particles increase in it.
Six hardness values are calculated for each sample using formula for Vicker's hardness:

$$HV = \frac{0.1854\,F}{d^2}$$

Where:

F = Test load (N)
D = Average diagonal length of an indentation (mm)

If the test load is in Kgf then,

$$HV = \frac{0.1854\,F}{S}$$

Where:

S = Surface area of an indentation (mm^2)

ISSN : 2455-9679
Impact Factor : 2.865

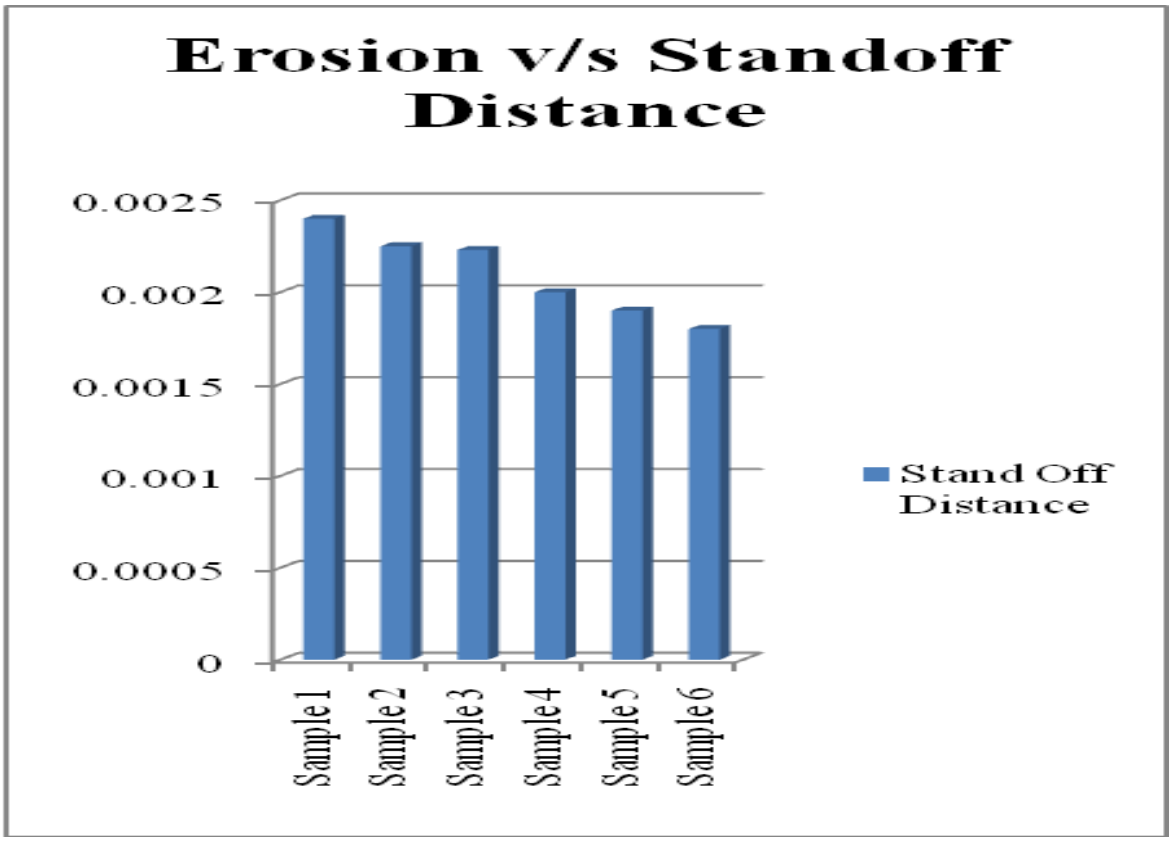

Fig. 4.5 Comparison chart of Erosion under effect of Standoff Distance

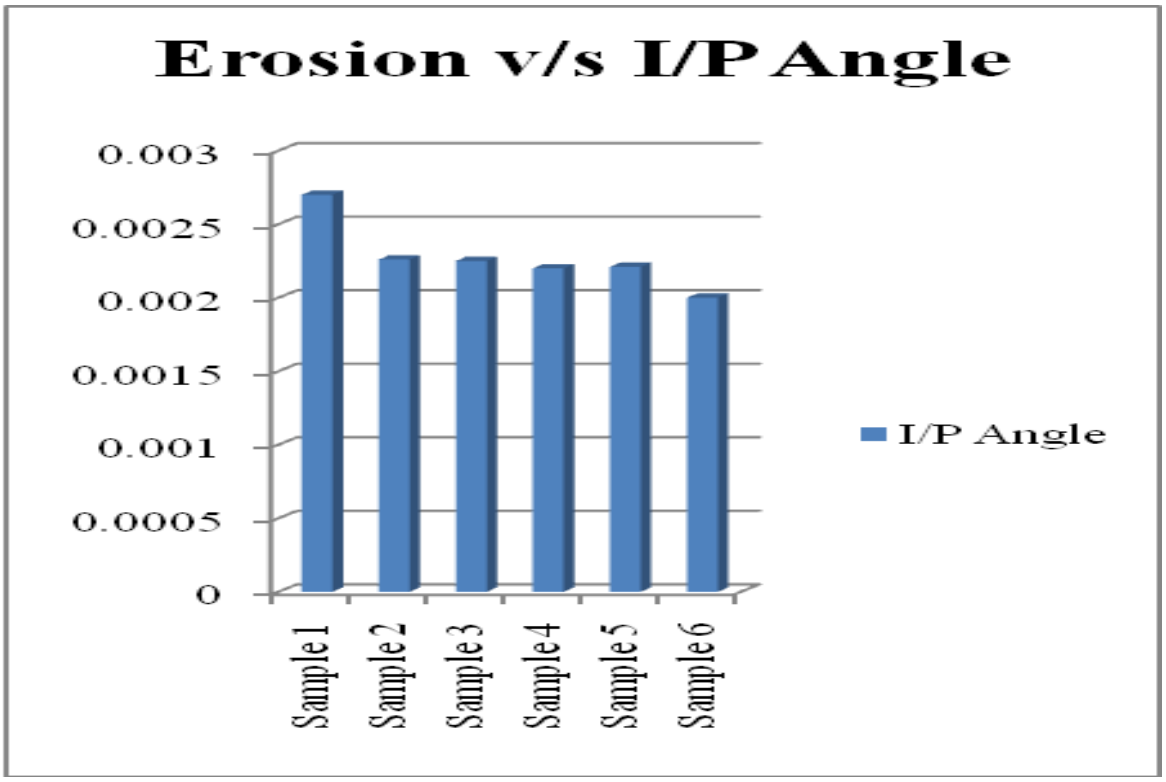

Fig. 4.6 Comparison chart of Erosion under effect of I/P angle

ISSN : 2455-9679
Impact Factor : 2.865

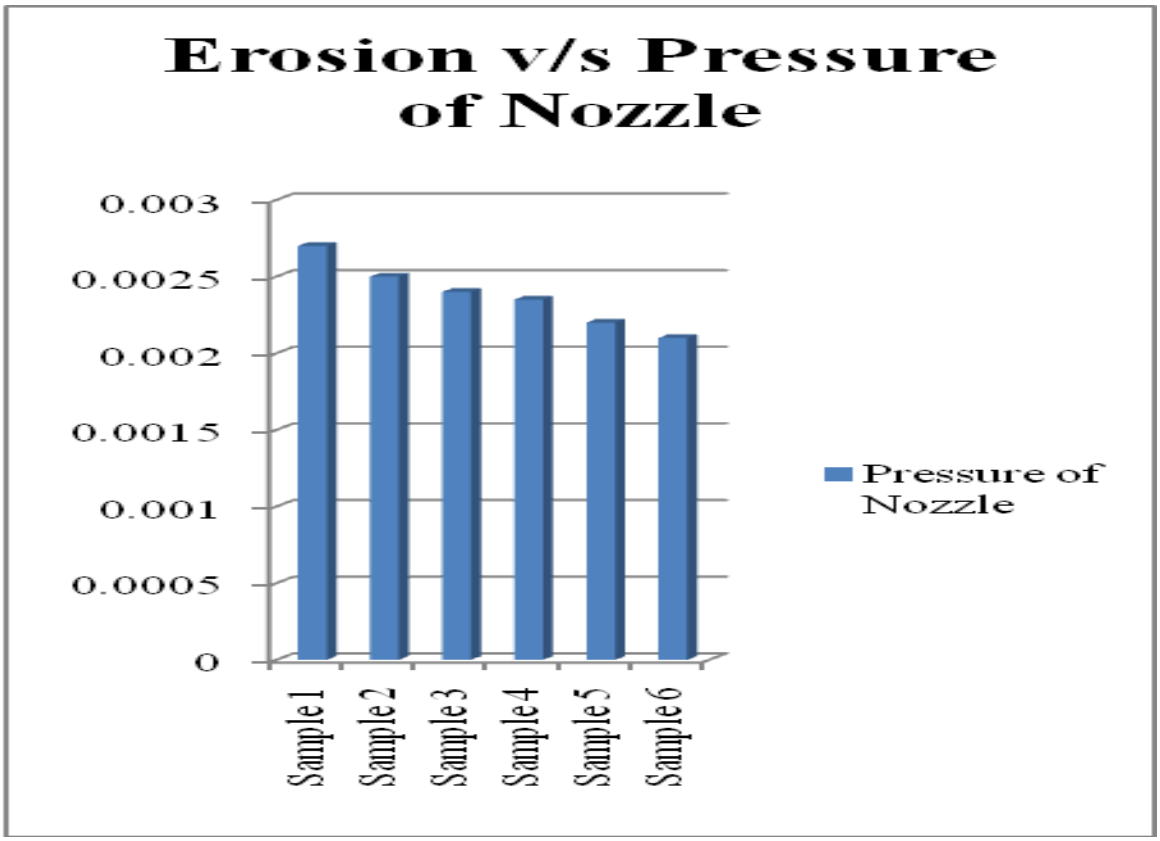

Fig. 4.7 Comparison chart of Erosion under effect of Pressure

V. CONCLUSION

Result show that the differences of hardness before and after test, we can see that there were happened the work-hardening effects on the material surface. The results of Vickers hardness were dramatically increased after erosion test for all samples. The surface hardness of samples before erosion test is 183.5HV20, 199HV20, 125.5HV20, 228HV20, 206.5HV20 and 214HV20 but after erosion test hardness are increases 225.5HV20, 250.5HV20, 175.8HV20, 286.5HV20, and 295HV20 respectively.From this fact, we can understand that it is true that erosion rate depends heavily on hardness of surface of material [62]; however, initial hardness of samples increases due to work hardening.

REFERENCES

[1] J. Jault, Fontes à graphite sphéroïdal: propriétésd'utilisation, Techniques de l'ingénieur (M 4 610) (2009) 1–25.

[2] Nicola Bonora, AndrewRuggiero, Micromechanical modeling of ductile cast iron incorporating damage, Part 1: Ferritic ductile cast iron, international Journal of Solids and Structures 42 (2011) 1401–1424.

[3] J.S.L. Magalhaes, C. Sa, Experimental observations of contact fatigue crack mechanisms for austempered ductile iron (ADI) discs, Wear 246 (1–2) (2000) 134–148.

[4] M. Hatate, T. Shoita, N. Takahashi, K. Shimizu, Influence of graphite shapes on wear characteristics of austempered cast iron, Wear 251 (2001) 885–889.

ISSN : 2455-9679
Impact Factor : 2.865

[5] R.C. Dommarco, J.D. Salvande, Contact fatigue resistance of austempered and partially chilled ductile irons, Wear 254 (2012) 230–236.

[6] L. Collini, Micromechanical modeling of the elasto-plastic behavior of heterogeneous nodular cast iron, doctarat en genie industrilel, Universita'DegliStudi di Parma, 2010.

[7] Forrest R D. Austempered Ductile Iron for Both Strength and Toughness. Machine Design. 1985. 57(22), 95.

[8] Crane FAA. Charls J A. Selection and Use of Engineering Materials. London, Butterworth. 1984.

[9] Dorazil E. Barta B. Munsterova E. High Strength Bainitic Ductile Cast Iron. AFS International Cast Metals Journal. 1982. 7(2): 52.

[10] ASM. Metals Handbook. 8th ed. Metals Park, ASM. 1974

[11] Jolley G. Gilbert G N J. Segragation in Nodular Iron and Its Influence on Mechanical Properties. The British Foundryman. 2014. 60(3), 79.

[12]John R. Keough, PE Kathy L. Hayrynen, PhD Applied Process Inc. Technologies Div. Livonia, Michigan, USA

[13] Gahr KH. Wear by hard particles. TribolInt 1998; 31(10):587–96.

[14] Robinowicz ED. Friction and wear of materials. New York: Wiley; 1965. p. 18.

[15] Islam MA, Haseeb ASMA, Kurny ASW. Study of as cast and heat treated spheroidal graphite cast iron under dry sliding conditions. Wear 2000; 244:15–9.