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Wear Test of Cast Iron (Brittle Material) Due To Solid-Liquid Mixture Using Slurry Jet Erosion Tester

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***Abstract*: A Jet erosion is normally used to study the relative erosion behaviour of different material at moderate solid concentration, velocity, and particle size and impact angle. A slurry pot is then fabricated by inserting propeller from the bottom of the cylinder and is rotated at the speed required for uniform distribution. The test specimens are then mounted on test fixture which is fixed and has a provision to move in different angular position to find out the wear for different angles. Erosion of materials is occurs due to the impact of high velocity of slurry which is comes out from the nozzle and impacting on the test specimen. The results were obtained for brittle material and are found in good arrangement with the literature.**

***Keywords*: Jet Erosion tester, Nozzle, Slurry erosion, Material Brittle.**

I. INTRODUCTION

Wear is defined as the progressive volume loss of material from a target surface. It may occur due to corrosion, abrasion or erosion. The wear due to corrosion is caused by chemical reactions, which can be prevented by adopting suitable measures; whereas the wear due to abrasion and/or erosion can only be minimized by controlling the affecting parameters. Erosion wear is a very crucial parameter for selection and design of slurry transportation systems as it affects directly to the economy of hydraulic conveyance of solids. [1] The service life of equipment handling solid-liquid mixtures is limited due to erosion wear and therefore efforts have been made in past few decades to predict the erosion loss of materials. Erosion wear is a complex phenomenon, which depends on large number of parameters. Erosive wear is the dominant process which can be defined as the removal of material from a solid surface. It is due to mechanical interaction between the surface and the impinging particles in a liquid stream. In Erosion process there is a transfer of kinetic energy to the surface. With the increase in kinetic energy of the particles impacting at the target surface, it leads to increase in the material loss due to erosion.[5-7]It depends on the predominant impact angle of particle impingement with the material surface and it will vary from15^0 to 90^0.Impact angle depend on both fluid particle and particle –particle interaction. This type of wear can be practically found in slurry pumps, angled pipe bends, turbines, pipes and pipefitting, nozzles, burners etc.The material loss due to erosion increases with the increase in kinetic energy of the particles impacting at the target surface.[4]

SLURRY EROSION:

It is defined as that type of wear, or loss of mass, that is experienced by a material exposed to a stream of slurry. This erosion occurs when the material moves at a certain velocity through the slurry or when the slurry moves past the material at a certain velocity. Slurries erode by the action of abrasive particles in the liquid which results in the failure of the surface of material in one or the other mode depending upon the conditions to which the system is exposed. Slurry erosion is a serious problem for the industries, which deals with the liquids having solid particles entrained in them. When

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such a mixture of liquid and solid particles termed as slurry come in contact with the machine element, the removal of material takes place from the surface making the component redundant from the surface.[11]

PARAMETERS AFFECTING ON EROSION WEAR:

1. Impact angle

2. Velocity of solid particles

3. Hardness

4. Particle size and shape

5. Solid concentration

2. LITERATURE REVIEW

Erosion may take place due to mechanical interaction between the target surface and fluid. The erosion wear has categories as solid particle erosion, liquid impingement erosion and cavitation erosion. Solid particle erosion occurs due to direct impact of solid particles (present in slurry) on the pipelines, pumps and its components. Liquid impingement erosion is associated with the continuous impact of liquid jet on the target surface and capitation erosion is defined as the repeated nucleation, growth and violent collapse of cavities, or bubbles, in the liquid resulting in localized removal of material from the target surface.

Many researchers have been trying to reduce the wear through various techniques but it has been difficult to find out the common cause and remedy of this problem due to its variation and dependency on large number of parameters. The parameters that affect the erosion wear in slurry transportation system are impact velocity, impact angle, size and shape of solid particle impacting on target surface, concentration of slurry, material of target surface and particle size distribution in the slurry, slurry viscosity and combination of all of these.

Pramod A.Thakur [1] A Jet erosion is normally used to study the relative erosion behaviour of different material at moderate solid concentration, velocity, and particle size and impact angle. A slurry pot t is then fabricated by inserting propeller from the bottom of the cylinder and is rotated at the speed required for uniform distribution. The test specimens are then mounted on test fixture which is fixed and has a provision to move in different angular position to find out the wear for different angles. Erosion of materials is occurs due to the impact of high velocity of slurry which is comes out from the nozzle and impacting on the test specimen. Two different experiments are conducted preliminarily first for repeatability test for fix parameters such as 450,particle size 655micron,angle and 10% solid concentration for 60 minutes and another one for authentication. The results were obtained for ductile material and are found in good arrangement with the literature.

Dalbir Singh Dhindsa [2], this report concludes that erosion wear is a function of velocity of slurry, as velocity increases erosion wear rate proportionally increases. 16Cr-5Ni stainless steel has the least erosion wear compared to other selected materials MildSteel, Grey Cast Iron, 13Cr-4Ni Stainless Steel and grey cast iron erosion wear is found maximum. Maximum erosion wear rate is found at impact angle 30^0 and minimum at impact angle 90^0. Erosion wear weight loss is the function of time. The materials 13Cr-4Ni Stainless Steel and 16Cr-5Ni Stainless Steel shows similar behavior towards erosion and Mild Steel and Grey Cast iron also shows identical behavior.

Mr. Brent Augustine [3], this report which were to design and build an abrasive wear test machine that can be used to test wear from several types of granular media. The machine has the capability of varying the media flow rate and incident angle to provide a variety of testing conditions. The hopper is transparent which will allow 10 operators to indicate the remaining amount of material at any given point of testing. The viewing area encloses the testing and is also transparent to allow John Deere to video record the interaction between the media and the test sample. The machine also features a load cell of our selection for measuring the force exerted on the test sample by the impinging media. A fiberglass grating and a waste container are used for media removal. The final assembly does not incorporate a corrosive fluid delivery system as initially stated in the project guidelines. This was determined to be an add -on feature and will be addressed by the sponsor at a later time. Our original design was to have a translucent hopper with a ball joint valve and a less precision load cells. This original design was selected so as to remain within budget. After receiving more funding from our sponsor, we were able to modify our design and purchase a custom made transparent hopper and a high precision load cell. These contributing factors allowed us to further meet project goals in a professional and timely manner.

Amar Patnaik [4], This report (with and without particulate fillers) has led to the conclusions like Successful fabrication of multi-component hybrid glass-polyester composites with reinforcement of ceramic fillers such as Al 2O3 and SiC is possible. Industrial wastes like fly ash and cement by-pass dust (CBPD) can also be gainfully utilized as fillers. Incorporation of these fillers modifies the tensile, flexural, impact and inter-laminar shear strengths of the glass polyester composites. The micro-hardness and density of the composites are also greatly influenced by the type and content of fillers. Hence, while fabricating a composite of specific requirements, there is a need for the choice of appropriate filler material and for optimizing its content in the composite system. A theoretical model based on conservation of particle kinetic energy during multiple impact erosion process has been developed. To overcome the shortcomings of the existing theoretical models, an "erosion efficiency" term has been introduced. It is demonstrated that if supported by an appropriate magnitude of erosion efficiency, the model can perform well for polymer based hybrid composites for normal as well as oblique impacts.

Raja Kumar S., Vijayaraghavan L., Mayuram M.M. [5], this paper concludes that the effects of velocity, angle of impact and grit size are experimentally investigated. As 11 the experimental results show, velocity and grit size has a significant effect on the erosion rate and the angle of impact has less significant. An optimum parameter combination for high erosion resistance are the medium velocity (40m/s), minimum angle of impact (30^o) and higher grain size (230ìm) Similarly maximum velocity (50m/s), maximum angle of impact (90^o) and minimum grit size (120ìm) yields maximum erosion rate indicating low resistance. A multiple non-linear regression equation is found for the erosion rate of alumina-zirconia composite. The developed mathematical model based on the Air jet erosion test process facilitate the estimation of erosion rate and proper selection of the parameters for the evaluation of erosion rate characteristics under various factor combinations with a reasonable degree of accuracy.

3. PROPOSED METHODOLOGY

Based on the literature survey and information received from the various sources there are number of slurry erosion test rig. To overcome the some restrictions of that test rigs, our motto is to test the jet erosion tester to varying different parameters like velocity of fluid, impact angle, solid concentration, materials like brittle and particle size.

4. CONCLUSIONS

Arrangements in the Jet Erosion Tester have been made to evaluate the effect of impact angle, concentration, velocity, particle size etc. on erosion wear. This design of jet erosion tester is intend to conduct wear tests at moderate solid concentrations and actual flow of velocities to simulate the wear conditions for impellers, pump etc. and may provide more realistic results. Finally, the contributions of jet erosion wear is find out in the form weight loss for the series of different impact angles and also for the at the same conditions like 15^0 to 90^0angles , 10% and 30% solid concentration of sand for 60 minutes for Brittle materials.

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