Performance of Alumina based coatings for slurry erosion resistance

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Abstract

Slurry erosion of hydro-turbine parts in water driven power plants is an extreme issue everywhere. As the water stream from slopes, stone and sand particles are conveyed alongside it and there is unexpected increment in strong molecule fixation in water during the rainstorm season which can notwithstanding bring hydro power plants to stop, prompting huge financial misfortunes. Alumina coating was deposited by using flame spraying process. The behaviour of the coating was determined by conducting a slurry erosion testing. The weight reduction of the coatings was analysed and further failure modes were analysed using SEM-EDS. The alumina coatings showed a better performance in resisting the slurry erosion.

Keyword: Slurry erosion; Alumina; Thermal spray.

1. Introduction:

Erosion of turbine blades has a big problem in hydropower plants where rivers' and mountain's water carry small solid particles of rock, sand and many more, these particles erode the outer surface of blades. It increases the maintenance cost of plant and huge amount money is wasted by this erosion[1-3]. The slurry disintegration and stick on plate conduct of customary and nano (Cr_2O_3-3%TiO_2) coating kept on SS-304 substrate by using Plasma shower method. In like manner, considered the Impacts of slurry fixation from 10%, 20% and 30% of SiO2 at edge of 300 and 900 on slurry deteriorate performace of coatings. SEM/EDS, XRD alongside microhardness, porosity and mass misfortune were used to evaluate the metallurgical and minute properties of coating and substrate. The results showed that the nano secured surface has better disintegration opposition close by incredible grip properties and firmly pressed structure.

The slurry disintegration conduct of coating Ni-Cr-Si-B stored on mellow steel substrate by using fire splash procedure[4-6]. The erosive wear test was driven using 20 and 40 percent silica sand slurry at three rotational speeds (600, 800 and 1,000 rpm). SEM/EDS, XRD alongside microhardness and mass misfortune systems were used to assess the metallurgical and minute properties of coatings and substrate[7-8]. The results showed that augmentation in the rotational speed from 600 to 1,000 rpm constructs weight decrease in 20 percent silica sand slurry while because of 40 percent sand slurry weight decrease first additions with addition in rotational speed from 600 to 800 rpm sought after by negligible decrease in weight decrease with further augmentation in speed from 800 to 1,000 rpm. In the present work, the alumina was deposited by using flame spraying process [9-11].The various parameters affecting the slurry erosion are presented in Figure.1. The material deposited by using thermal spray provides good hardness, adhesion and mechanical properties [12-19].

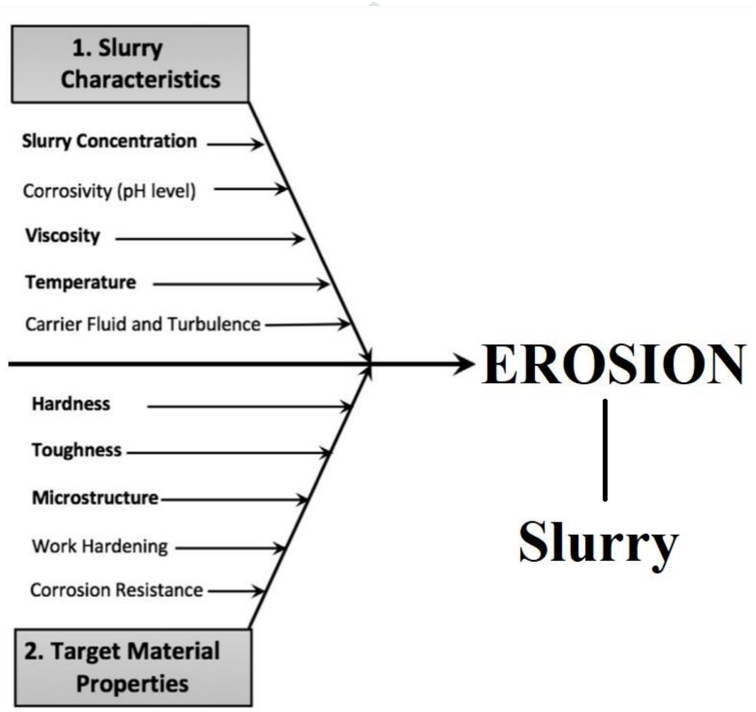

Fig.1. Factors affecting slurry erosion performace.

2. Experimental details

The ALUMINA used as coatings require to check that a ground-breaking evasion against synthetic and mechanical corruption and moreover have a mind boggling level of warm conductivity to give a decent administration reaction and making an arranged and needed result. There are a great deal of coating materials open in present time to shield the material from spoilings like oxidation, wear and consumption Al_2O_3 were chosen due to withstand their mechanical and electrochemical properties at high temperature as well. Before the coating of Al_2O_3 security layer of thickness 50μm was splashed by flame spray coating instrument on substrate for improving the attachment of coating. The powder was procured from SVX POWDER ltd. India, having normal atom size of 45µm with round morphology.

3. Results and discussion

The powder used for the coating and slurry is presented in Figure.2. The SEM micrograph represents a powder with sharp morphology and with 50 µm particle size as presented in fig.2a, whereas the morphology of the silica which is used as a slurry presents a angular morphology with same particle size as that of powder used for coating.

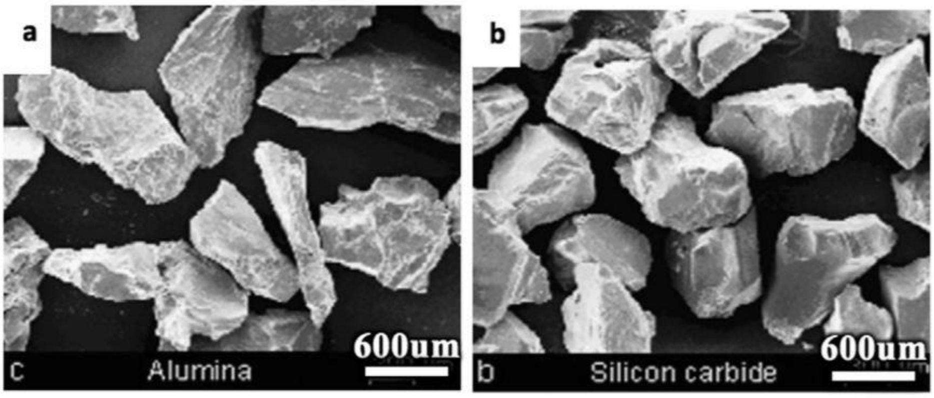

Fig.2. SEM micrograph of (a) alumina and, (b) silica.

The slurry disintegration testing of the example was finished with a rapid stream impingement slurry disintegration analyzer planned This setup was made to reticulate a similar slurry for the testing. The slurry disintegration analyzer comprises of a slurry tank in which slurry was contained, a spout through which the slurry was contained, a spout through which the slurry was made to encroach on the examples, example holder to hold the example inflexibly, a divergent siphon, an electric engine to drive the siphon, valves weight measure and pipes and so forth for consolidating every one of the parts. Slurry set up used with some focuses i.e 20000ppm and 25000ppm and was poured in the separating slurry tank for various tests as required. The slurry on being sucked from the slurry tank was siphoned by outward siphon to the spout. The stream control valves gave on the setup were utilized to control the stream and weight. The weight of the stream was observed by weight measure present on the setup. There is a set up for rearrange the stream was given in the setup by associating a by-pass pipe in the analyzer. The veering state of the tank did not enable the sand particles to settle down at base and guarantees the progression of slurry under gravity consequently permitting the re-course of slurry. Figure 3. shows the set up for slurry erosion testing.

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3. Results and discussion:

3.1 Porosity

The technique well-known as flame spray procedure was utilized for splashing the coatings on substrate material and the normal porosity for both the oxides coating was under 1%. Flame spray coating indicated less porosity as a result of high working temperature and constantly splash of molten state liquid droplets of powder shaped closely pressed splats. Also, the coating thickness testing check (Mitotoyo,minitest-600B-Japan) was utilized to gauge the thickness of both the coating specimens and it was establish to be in the extent of 200-250µm for both Al_2O_3 coating.

3.2 Micro-hardness of the coating

The hardness of the as-flame sprayed covered test was detected along the outer layer thickness was utilized. A flat out number of ten indents were interpreted over the cross-section of the coating at two random zones and out of these five indents were brought the layer thickness at each region. The SS-304 substrate demonstrates a micro- hardness around 230 $HV_{0.2}$. The coarseness impact of grit blast performed before the coatings join the impacts of grating unpleasant particles on mirror-cleaned substrate and the extended hardness at interface could be a direct result of work solidifying of substrate. Plus, Al_2O_3 coating exhibited a typical hardness around 815 $HV_{0.2}$. The microhardness testeer is shown in fig.4

Fig. 4. Vicker's Hardness test

3.3 Slurry erosion performance

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Table1. Slurry Erosion Testing Results

Specimens	SOD(mm)	Slurry (ppm)	Angle	Initial Weight(g)	Final Weight(g)	Erosion/ Weight Loss(g)
SS-304	20	20000	30	35.260	34.813	0.447
SS-304	20	25000	90	35.374	34.973	0.401

Al_2O_3	20	20000	30	36.415	35.768	0.647
Al_2O_3	20	25000	90	36.270	35.467	0.803

4. Conclusion

The coating Al_2O_3 by utilization of Flame spray coatings were successfully deposited on SS-304. Al_2O_3 coating provides erosion resistance in all different sets of testing parameters. The maximum erosion took place at 30^0 impact angle, 15mm SOD for Al_2O_3 coating due to less adhesion strength of bond. The most extreme disintegration occurred at slurry concentration of 15000ppm and impact angle of 30. SS-304 uncoated substrate is having less resistance of slurry erosion when compared with CrO3 coating yet at the same time it is superior to Al_2O_3 coating.

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