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Slurry Flow Erosion in Industrial Pipeline

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ABSTRACT

Erosion wear is intense issue in slurry pipe-tubes explicitly in nuclear energy stations. Wear of the pipelines brings about harm of capital cash because of disappointment & regular substitution of pipelines. As per FAU-20l2, 88 nuclear energy stations in Indialwith introduced limit of 80458MWl, devour l407.6l million ton of coal (lignite based) each year. Colossal measure of base debris is created each year in these nuclear energy stations & this is shipped to debris lakes principally through gentle steel funneling framework. Writing study of different scientists shows the great disintegration wear of gentle steellpipeline materiallwith base debris slurryl.

In the perspective on abovel, creator is propelled to concentrate on disintegration wear conduct of various broadly useful materials & coverings. Disintegration wear of WC-l2Co & Ni-20Cr2O3 covered & uncoated Gentle steel, SSl304 & SSl202 materialslis assessed by utilizing slurry pot analyzer with base debris slurry. High velocity oxy-fuel measure is utilized for the covering. Disintegration wearlat fourlunique velocities 500 rpm, 800rpm, ll00rpm & l400rpm is assessed at 25% & 45% slurry focuses with 90min & l80min trial study. Disintegration wear increments with expansion in slurry focus & velocity, it is seen that at low velocities (500rpm -800rpm) pace of disintegration wear is high when contrasted with higher velocity(ll00rpm to l400rpm). The velocity example & fixation type are additionally determined & are in acceptable concurrence with past research works, exploratory outcomes are likewise examined with taguchi approach to assess the impact of rapidity, focus & time boundaries on the disintegration wearlof the materials & it is discovered that impact (level) of velocity is additional on disintegration wear & is trailed by period & focus boundaries.

Keywords: Erosion wear, SEM, ANOVA.

INTRODUCTION

In the transport system for coal ash sludge, solid particles are one of the main causes of erosion in pipe-tube. Particles such as solid particles in the fly ash sludge collide with the inner surface of the pump, pipe walls, seals, valves & other system components, causing erosion & wear. This phenomenon can be very costly due to the frequent component changes & component letdown of the sludge conveyor arrangement.

INFLUENCE-OF0SLURRY EROSION ON. PIPELINE-SYSTEMS

In India, the dust sludge is transported in precise small concentrations & the solid deferments are diverse, as the impression of elements on the wall of the pipeline material reduces the service life of the pipeline system. Mud pipe erosion wear is recognized as a significant difficult in thermal power plants in-India.

Forecasts by the board as the Ministry of Energy until 203l-32 show that 2/3 of the age of the troops in the countryl would .depende on coal anyway (FAU – 20l3) & under are the current realities of the information from 88 (80 8) coal / lignite-based Nuclear power plants of many energy suppliers in the country in 20l0-20l2.

1. Coal consumption: 407.61 million tons
2. Total installed capacity: 80,458 MW

Conferring to technical-data from M.-P. Super lThermal Power lStation, Adhinicl power & natural resources limited, Padampurl, Jharkhand India. The predictable annual coall depletion aimed at a 540 MW construction facility is 2.75 million tons & the production of slag is 0.25 million tons. This means that the slag content is 9.091%, based on this total slag, which is produced in 88 factories, is 37.056 million. This amount of clinker is normally transported through a pipeline system for the production of manure. As the size of the boilers became larger than the amount of ash that could be handled manually, automatic devices for ash management appeared. Transport systems with pipes offered the greatest flexibility in transporting ash from the boiler area to an overseas disposal destination. The clinker particles erode heavily, so the pipes fail due to extreme erosion. Usually the pipeline material used to transport slurry is ductile in nature, & slurry flows in the pipes influence on the inner walls of the pipe, resulting in continuous erosion of the material of the pipe until the pipe system fails. The cost of repairing wear damage from erosion from the impact of eroded solid particles from the transport of ash sludge & other particle-loaded liquids in sludge lines can be exceptionally great. Therefore, continuous monitoring of the wall thickness of the sludge line & additional maintenance costs are essential for the longest possible service life of the pipelines.

The interest of the manure transport plan framework is a careful understanding of the disintegration tool in manure pipes. The reformist mass damage of conduit material from a surface, mostly due to decay & attrition, is known as wear & tear. In the case of the mud pipes, the consumption is a kind of marvel based mainly on the measurement of the dissolved oxygen in the suspension, then again two instruments are mainly responsible for the wear & tear from the disintegration of the pipes, in particular warping & cutting. The rate of wear & tear from consumption is far less than when it decays, so it requires more careful consideration of the pipeline planning framework. The loss of mass of the pipeline also affects the life expectancy of the pipeline structure & thus the underlying investments.

TESTING MATERIALS AND COATING

Furthermost coal-fired power plants yield fly slag & fly ash at a proportion of 20% fly slag to 80% fly ash, & maximum of them are characteristically inclined of by trucks & tubes. In pipe conveyance, water is usually diversified with residual ash to form sludge, & this sludge is transported due to the erosive action of the material of the mud pipe that wears out, so various types of sludge hardening methods are used to raise the rigidity of the pipe.

TESTING MATERIALS

There are the resources that normally come into question for the manufacture of pipes. In this study, three types of pipe constituents are particular, which are as follows.

3.2.1 Structural stee1:

Structural stee1, also recognized as ordinary carbon. stee1., is the most popular type as it covers 0.39% carbon., which makes it pliable & pliable. Its cost is extremely low, & there are material properties that are more suitable than iron for some reasons. Mild stee1 has a short lifespan, although it is modest & ductile.

3.2.2 Stainless. toughen 202:

The austenitic crystal structure of stainless stee1 in the 200 series is a face-centered cubic crysta1 structure. They are austenitic. 'Cr'.-'Ni'-manganese lalloys that preserve an austeniticlstructure from cryogenic heats to melting temperatures.

3.2.3 Stainless stee1 304:

Grade 300 stainless. stee1 contains approximately (but not accurately) 17% 'Cr'. & 7% 'Ni'. The most common stainless stee1 is 18/8 stee1, which is often referred to as 18/8 stee1. The most important non-ferrous components are metals. It is an austenite stee1. It is neither thermally nor magnetically conductive.

'Ni' is existent in huge quantities in entirely three layers with dissimilar carrier materials & a small quantity of 'Cr' carbidel is also experiential during the mineralogicall examination of the layers Fig. 3.10. If SS 202 'Ni' carbide & 'Cr' carbide are available versus other coated-materials, this may be accountable for a slight growth in coat rigidity.

3.1l SEM (SCANNING. ELECTRON-MICROSCOPY.)

An examining electron magnifying instrument is a kind of electron magnifying instrument that utilizes an engaged light emission to make photos of an example. The connection of electrons with the particles in the example produces dissimilar sorts of signs, which might be recognized & used to assemble data about the example's creation & geology.

EROSION & RESULTS

Suspended erosion. tests are done on mild stee1, 304 stainless stee1, & 202 stainless stee1 constituents, with & lacking coat, by a suspension pot tester under various test settings to evaluate various erosion phenomena & the wear & tear of every coated & .uncoated material.

4.1 SLURRY. POT.TESTER

For instance referenced in the main part, a slurry pot analyzer comprises of a round & hollow pot into which previously pre-arranged slurry is discharged, & this.pot is movable & can go all over with the assistance of an installation, while the testing example is secured to the turning shaft. The pivoting pace of the upward shaft can be modified with various qualities & at various velocities & diverse co-efficients.

Fig. 4.1: DUCOM slurry. pot tester

4.2 PORTIONS OF SLURRY.POT.TESTER

It contains of a modest tool as shown below.

- **Revolving shaft**: The electronic motor, which is placed on top of the machine & covered on all sides, rotates it. The spinning shaft can rotate at a maximum velocity of 1500 revolutions per minute.
- **Agitator**: The agitator has the task of distributing the prepared sludge evenly while the sludge pot tester is in operation. Usually it is quadrilateral in form.
- **Work piece**: This is.the tested substance & is attached to the spinning shaft with a bolt device & a stirrer.
- **Slurry pot**: The entire prepared slurry is discharged into a slurry pot, the extreme volume of the manure pot is 1.8 l & the pot can be detached from the tester for dust down.
- **Bracket**: The bracket consists of a movable jack that is responsible for moving the slurry tank up & down. After the liquid manure pot has been filled, the slurry tank cover is connected to the assembly in an articulated manner; The lamp is rotated by means of a rod in order to change the pot up to the greatest position of the revolving channel.

Fig. 4.2: Portions of SP

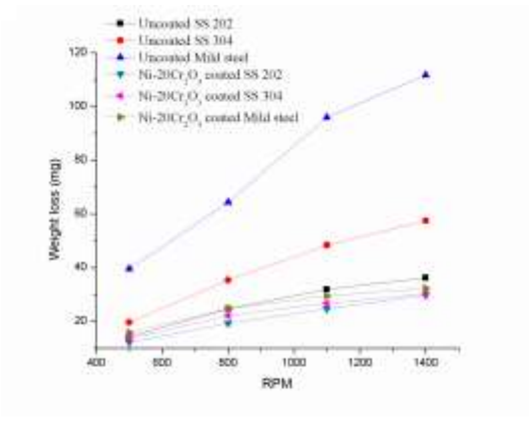


Fig. 4.ll: Erosion of Ni-Cr2O3 covered materials at 24% absorption & for 90lmin

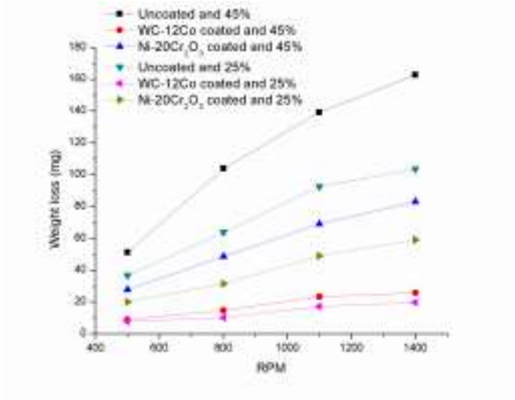
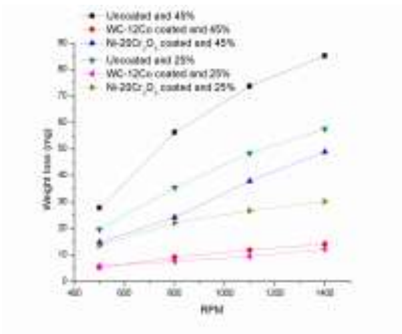


Fig. 4.l4: Comparative erosion of SSl304 for l80 min

Related to a 90 min test, or if there is a non-linear relationship among them, the last eroded particles will become dull in the early phases of the test & may too be due to metallurgica1 fluctuations in the belongings of the test materials as long as the test is running, the temperature of the suspension rises, which affects the erosion occurrence.



5.1 THENCIATION STUDIESlBY ANOVA (ANALYSISlOFlVARIANCE)

The outcomes acquired from Taguchi strategy for enhancement of linseed oil methyl ester creation were measurably checked by. ANOVA (investigation of change). The term change proportion, which is proportion of difference of feature to mistake fluctuation, recognizes the massive elements from fewer critical. In excess of 9 difference proportion for a influence addresses that the factor is having a disintegration of examples & tabletops underneath shows the examination of change utilizing S/N proportions of done tests for all boundaries. The dissimilar terms of .ANOVA that are utilized for the estimation are assumed underneath in the sequence of little conditions:re T is wholly weight reductions found, n is the entire no. of tests, is the amount of entirely proportions S / N below leve1 l with no limit, is the amount of analyzes with level l irrelevant which limit? , is the amount of all S / N shares below level 2 without import which limit, is the number of tests with level 2 no import which limit, is the amount of all S / N shares below level 3 of the source limit, is the number of the investigations with level 3 of the marginal source, is the marginal level of the opportunity & is the fault rate.

Feature	D.o.f	Sum of squaresl (S)	Variance. (V)	F-ratio (F)	Pure-sum (Sp)	(%)
S	3	226.56	71.85	317.14	241.14	54.14
C	l	52.45	54.52	229.00	54.25	12.97
T	l	135.78	125.80	489.92	125.54	28.23
Error	l0	2.54	0.245			00.8
Total	l5	414.62				100

Table 5.ll: .ANOVA table for uncoat MS

Feature	D.o.f	Sum of squares (S)	Variance (V)	F-ratio (F)	Pure-sum (S_p)	(%)
S	3	214.37	60.24	877.27	220.14	53.10
C	1	49.54	50.55	600.14	41.46	12.42
T	1	ll5.63	115.63	1348.43	ll5.54	20.l3
Error	10	0.886	0.087			00.38
Total	15	373.43l				l00

Table 5.l2: ANOVA table for uncoat SSl304

Factor	D.o.f	Sum of squares (S)	Variance (V)	F-ratio (F)	Pure-sum (S_p)	Percent (%)
S	3	160.53	56.24	342.3	161.15	51.49
C	l	28.00	28.00	176.41	28.83	9.26
T	l	104.13	103.13	650.30	105.96	31.36
Error	l0	1.57	0.183			0.7
Total	l5	308.89				99

Table 5.l3: .ANOVA table for uncoat SSl202

The study of the difference estimates the commitment rate of altogether limits of velocity, fixation of Lisier & time on the dissolution of the material input. Later the Taguchi, the test outcomes are additional confirmed with a survey on the fluctuations. The results show the coherence of the motif found in the two investigations, the influence of the velocity on the disintegration increases & is delayed by the time & the fixation in each case without detection, as indicated in Tables 5.l4, 5.l5 & 5.l6.

Feature	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	178.36	49.7	110.56	174.27	49.12
C	l	52.36	54.67	102.66	55.14	17.26
T	l	60.14	60.17	106.11	61.62	19.08
Error	10	5.21	0.51			01.59
Tota1	15	301.78				99.01

Table 5.l4: ANOVA. table for WC-l2Co coated MS

Feature	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	150.14	50.51	50.71	150.75	60.28
C	1	9.78	13.40	10.70	8.8	4.88
T	1	70.12	71.10	78.50	70.9	30.55
Error	10	8.96	0.8			06.22
Total	15	240.50				98

Table 5.l5: ANOVA table for WC-l2Co coated SS-304

Feature	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	160.55	55.40	138.25	167.96	52.19
C	1	42.3	48.28	100.84	44.96	15.34
T	1	72.3	70.27	155.18	71.85	21.37
Error	10	3.96	0.32			1.10
Total	15	290.63				90.00

Table 5.l6: ANOVA table for WC-l2Co coated SS-202

In addition, the analysis of the change results is listed separately in Tables 5.l7, 5.l8 & 5.l9 for the WC-l2Co lid & in Tables 5.20, 5.2l & 5.22 for the Ni-Cr2O3 lid. Agreement with the results of the Taguchi survey.

Feature	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	72.23	62.79	68.5	180.36	60.00
C	1	24.40	26.82	26.35	22.51	07.13
T	1	72.34	70.36	82.36	70.88	24.33
Error	10	6.71	0.9			03.54
Total	15	280.02				97

Table 5.l7: ANOVA table for Ni-20Cr_2O_3 covered Mild stee1

Feature	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	180.1	60.29	111.59	160.22	49.03
C	l	22.54	21.49	40.58	17.94	11.76
T	1	93.29	84.18	167.19	73.69	20.38
Error	10	5.80	1.50			12.83
Total	15	310.00				80.11

Table 5.l8: ANOVA table for Ni-20Cr_2O_3 covered SSl304

Factor	D.o.f	(S)	.(V)	(F)	(Sp)	(%)
S	3	180.13	61.47	100	170.44	62.92
C	1	32.17	36.12	54.22	32.44	10.22
T	1	70.68	63.51	111.12	53.11	14.44
Error	10	7.07	0.23			2.36
Total	15	286.19				101.11

Table 5.19: ANOVA table for Ni-20Cr_2O_3 covered SS-202

The effect of three dissimilar strictures on velocity, attentiveness & time for non-revitalized materials is exposed in Fig. 5.10, the fraction influence for all parameter shows the dominance of the features in erosion. With the non-renewable material SS 304, the influence of velocity is more important & with slow velocity the influence of velocity is less, which means that soft raw substantial is better suited for moving buildings to dissimilar velocity limits. Correspondingly, for SS 202 the outcome of transporting the Lisier is minimal & for Soft Duty it is maximal, which means that the SS 202 is more preferred than other materials for transporting Lisier to greater concentrations. In addition, the soft ground is preferred for a longer lifespan of the Tuyau, however, with this material, transport at a greater height is preferably not possible due to the greater influence of the concentration on the matter. Incorrect comment in the ANOVA consequences if it is not greater than 1% for non-renewable materials, this guarantees the accuracy of the analysis of the erosion results.

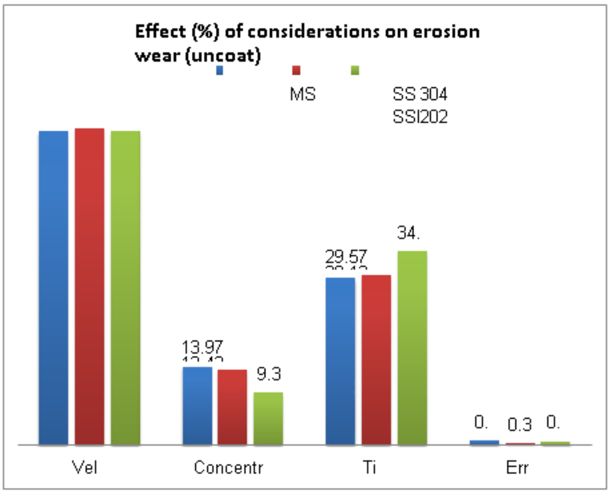


Fig. 5.10: Effect (%) of considerations on erosion wears (uncoated materials)

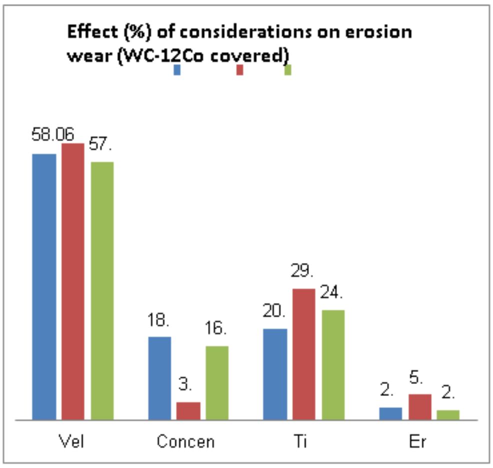


Fig. 5.11: Effect (%) of parameters on erosion wear (WC-12Co covered material)

CONCLUSION

1. The SS-202 displays improved erosion confrontation under all situations, shadowed through the erosion confrontation of the SS 304 & the double axel.
2. With toilet materials made of WC-12Co, an excellent improvement in durability is indicated compared to the materials made of Ni-20Cr2O3.
3. The WC-12Co display shows a significant development in the erosion confrontation of the three materials substrate SS-202, SS-304 & darker

stee1 at 2.29 0.24, 5.52 0.89

4. The velocity & concentration of exhibitor scores for altogether materials are in good arrangement by preceding investigation.

5. When adapting the Taguchi analysis, it was found that the influence of the velocity is additional on the destruction through erosion of all materials & estimates & monitoring by the period & attention parameters, the outcomes are valid compared to the method of the analysis of discrepancy.

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