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Experimental Investigation and Analysis of ProductQuality to reduce Maintenance time using NDT

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Abstract:-In hydro generator breakage of pressing finger is major problem generally occurs due to surface crack on pressing fingers. Surface crack propagation leads break down of hydro generator. Break down of hydro generator increase maintenance cost and time. It also leads replacement of existing generator. Replacement of hydro generator is so costly because cost of one generator is approximately one cror rupees.it also disrupts production of electricity. Now days Dye Penetration Testing (DPT)apply for testing surface crack which was the root cause of breakdown of hydro generator. This Non Destructive Testing (NDT) detect surface crack of pressing fingers. After applying DPT on pressing fingers apply statistical analysis of samples of its and then control chart also applies on fingers which give result in terms of acceptance or rejection of its.Acceptence sample goes forward in operation and other samples reject.

Keywords:- flaw detection, product quality, DPT and control chart.

I. INTRODUCTION

Electricity production in India is 245.34GW in April 2014.Hydroelctricity production is 17% out of total production of electricity which is about 41GW[1].To maintain this electricity continuously provide maintenance of hydro generatorregularly but maintenance cost increases due to it. Functionof hydro generator is to convert mechanical energy into electrical energy [2].Cost of energy uses to evaluate the financial feasibility of power conversion [3]. Over all maintenance occurs due to maintenance of sub component of hydro generator. In sub component of hydro generator pressing fingers fails regularly so testing of pressing fingers is needed to reduce break down of hydro generator.so we apply Non Destructive Testing for investigation of these fingers. Non-destructive testing (NDT) is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage [4, 5]. Common NDT method includes ultrasonic, radiography, dye penetration, magnetic particle inspection and x-ray technique [4]. Dye Penetration Testing is cheapest process among all NDT techniques so it uses for detection surface crack on these fingers. Liquid penetrant examination is one of the most popular Non-destructive testing (NDT) methods in the industry. It is economical, versatile, and requires minimal training when compared to other NDTmethods [5]. Liquid penetrant exams check for material flaws open to the surface by flowing very thin liquid into the flaw and then drawing the liquid out with a chalk-like developer. Welds are the most common item inspected, but plate, bars, pipes, castings, and forgings are also commonly inspected using liquid penetrant examination. This method is frequently used for the detection of surface breaking flaws. This technique applies on samples of pressing fingers. After applying DPT quality measures by p-chart and to see whether sample is rejected or accepted. Rejected sample is out of control and accepted is under control process p-chart prefer only in this technique because it is based on yes or no.after applying quality control on pressing fingers reduction in break down time is performed.

II. EXPERIMENTAL DETAIL

In hydro generator many sub-component are assembled stator and rotor. Stator assembly(as shown in figure1)include pressing plate, pressing fingers, laminar sheets, ventilation space and casing etc. From fig. it is clear that function of pressing fingers is to maintain the levelling of ventilation sheet at their specific position if pressing fingers contains crack on surface then crack propagation takes place. Surface crack propagation leads breakage of pressing fingers. Due to this maintenance of generator take place which consume time or replacement of generator take place which consume more cost.

TEST SPECIMEN-Stainless steel 304 L (Medium carbon austenitic stainless steel, for high temperature application) Type 304L is an extra low-carbon variation of Type 304 with a 0.03% maximum carbon content that eliminates carbide precipitation due to welding.

Table1.Chemical composition of test specimen (%)

C	M	Si	P	S	Ch	Ni
.25	2	1.5	.045	.030	24-26	19-22

SAMPLE-Sample of 20 pressing fingers is selected out of lot. Simple random sampling applies in it because sample size is remaining same in all samples. Now number of defective determine of of these samples.

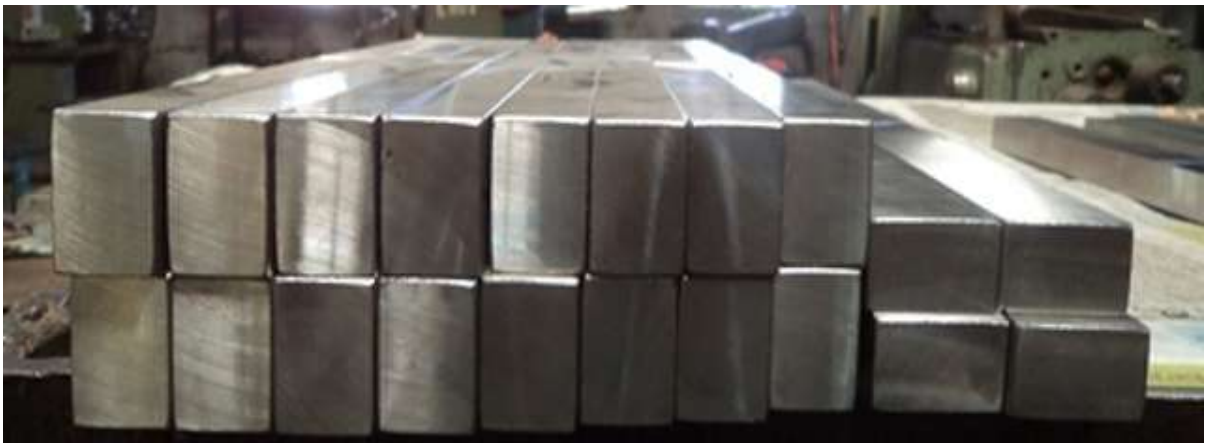


Fig1. Sample

2.1 EQUIPMENT USES IN EXPERIMENT

I. PENETRANT-Penetrants are carefully formulated to produce the level of sensitivity desired by the inspector. While visible dye penetrants still have many uses, fluorescent penetrants are used when a high level of sensitivity is required.

Penetrant detail-PMC flaw check,PP-31, IS 3658-1981

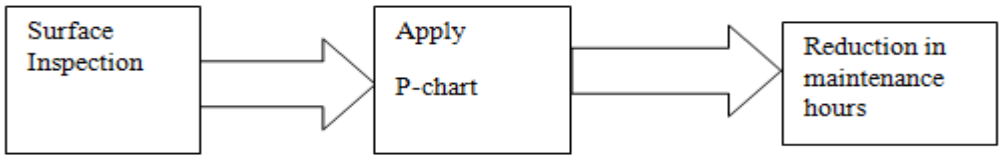
Fig2. Penetrant

2. DEVELOPER-The role of the developer is to pull the trapped penetrant material out of defects and to spread the penetrant out on the surface of the part so an inspector can see it. The fine developer particles also reflect and refract the incident ultraviolet light, allowing more of it to interact with the penetrant, causing more efficient fluorescence.

Developer detail-PMC flawcheck,PP-15,IS 3658-1981.

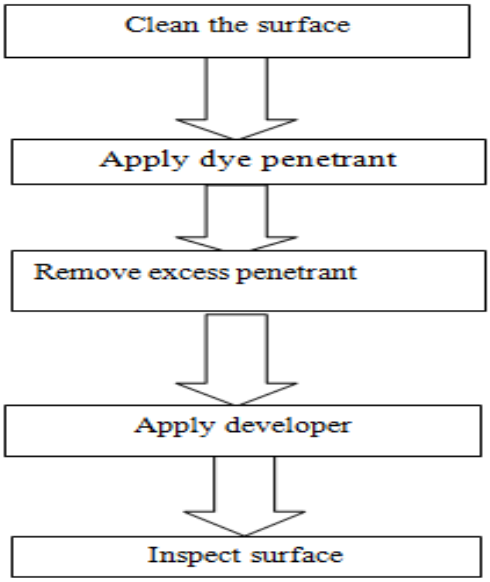
Fig3.Developer

III. METHODOLOGY



Flow diagram

SURFACE INSPECTION



Flow diagram for DPT

1. CLEAN THE SURFACE-Surface is to be cleaned for successful DPT inspection.it is necessary to remove contamination to avoid confusing result because containment may absorb penetrant and developer. Contamination such as scale, dust and dirt need stainless steel wire brush to remove these contaminant.
2. APPLY PENETRANT-This is done by spraying penetrant from can.Penetrant enters into crack or flaw by capillarity action. Capillarity actions enable penetrant to enter in crack. Dwell time for penetrant is about 15-20 minute. Dwell time is time for penetrant to entry in crack throughout the surface.
3. REMOVE EXCESS PENETRANT-Penetrant should remove from surface with clean and dry rags. Component should be rubbed until penetrant is not visible on surface. Penetrant remains in crack only.
4. APPLY DEVELOPER-Thin and light coating of developer apply on surface is being check. Developer absorb by penetrant in flaw by capillarity action. Adhesive force between developer and penetrant acts more than cohesive force between developer's molecules.
5. INSPECT SURFACE-As soon as developer dried indications appears on surface. Red line on surface shows crack, inclusion on surface. Tight crack appears as dots on surface. Size, location and type of indication as well as parts eventual use and work load willinfluence the rejection criteria.

Table-2Data collection by applying DPT on sample

Sample(20)	Number of defective fingers
1.	13
2.	5
3.	6
4.	8
5.	2
6.	10
7.	15
8.	17
9.	9
10.	10

3apply P-Chart

After performing DPT on 10 sample of fingers and found out no.of defective out of them. Now p-chart applies for determining which sample is out of control and which is in control process.

P-chart: P-chart is type of control chart used to monitor non confirming units [7].It indicates the magnitude of the quality problem and highlight the area of weakness. Quality improvement can result only if follow up action is taken to rectify shortcoming indicated by control chart [6]

Construction of p-chart:

Centre line=μ

Upper control limit=$\mu+3\sqrt{\frac{\mu(100-\mu)}{N}}$……..[6, 8]

Lower control limit=$\mu-3\sqrt{\frac{\mu(100-\mu)}{N}}$……[6, 8]

P-chart applies using Minitab software which is given in following

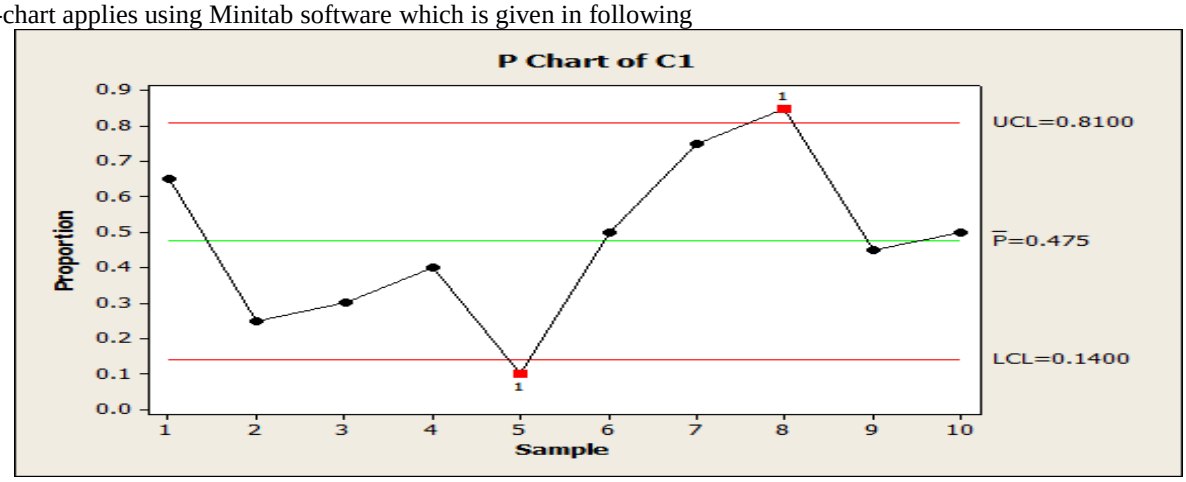


Fig4.P-Chart

Obtain the quality within the control limits. It is clear that sample 5 & 8 are running out of control limit. These samples out of quality limit should be rejected .sample 5 shows lesser rejection of fingers which is result of poor inspection so this sample need effective inspection. Sample 8 is showing excessive rejection which is result of manufacturing defect.Corrective action provide on these samples to remove defect at major scale during operation which disrupts the operation. Remaining samples should move in operation in hydro generator have better quality that is able to perform their intended functions?

Using quality control tool samples will use inhydro generator which are in control limit. These samples that are using in generator reduce break down time in operation because these are in control limit and their quality is quite good.

Total inspected fingers=200

Total defective fingers=95

Probability of defective finger=$\frac{95}{200}$

=.475

Probability for defective fingers was =.475 this should decrease inupcoming lot. We will suggest manufacturer to improve manufacturing process at earlier stage.

3.3 REDUCTION IN MAINTENANCE HOURS

Table-3Maintenance data of last 5 year

Years	Total % of defect in pressing fingers during 1st half year	Maintenance hours in 1st half year(% of maintenance hrs due to surface crack)	Total % of defect in pressing fingers during 2nd half year	Maintenance hours in 2nd half year(% of maintenance hrs due to surface crack)
2013-12	15%	290(10%)	16%	240(10%)
2012-11	17%	320(11%)	13%	250(9%)
2011-10	14%	150(9%)	18%	280(13%)
20100-09	16%	330(11%)	19%	400(13%)
2009-08	12%	280(8%)	15%	180(10%)

Table-4Summarised maintenance data of last 5 years

Year	Total Maintenance hours	Maintenance hours in pressing fingers due to surface crack	% of maintenance hours yearly basis due to failure of pressing fingers by surface crack
2013-12	530	53.0	10.00%
2012-11	570	57.7	10.12%
2011-10	430	49.9	11.60%
2010-09	730	88.3	12.09%
2009-08	460	40.4	8.78%

In last 5 year maintenance data we find
Total Maintenance time of hydro generator =2720hrs
Total Maintenance time of hydro generator due to failure of pressing fingers =289.30hrs
Percentage Maintenance time of hydro generator due to breakage of pressing fingers by surface crack
$=\frac{289.3}{2720}\times 100$ =10.63%
10.63% Maintenance time of hydro generator occurs only due to failure of pressing fingers. So Dye Penetration Test was performed on pressing fingers for saving breakdown time.

IV. CONCLUSION

P-chart analysis shows that which sample is to be rejected or accepted. Reduction in frequency of surface defect in sub component of hydro generator. By applying p-chart we suggest to improve manufacturing parameters on manufacturing stage and to motivate for effective inspection after manufacturing stage. Saving of MaintenanceTime by applying DPT on pressing fingers is 10.63% of total break Maintenance time.

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