Journal of Demerits Method to Determine the Reliability for Thermoelectric Power Station Elements

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Abstract — **This industrial method is called demerits method (from French démérite = lack of merits). For each analyzed product a detected defects catalogue will be created and they will be grouped according to their importance, through arbitrary established categories (for example critical defect, principal defect, secondary defect, minor defect). The total number of defects for each category is recorded (N_c, N_p , N_s, N_m). Each defect group is arbitrary penalized with a certain penalty points, as shown in table I. Obviously other penalization systems can be chosen too. According to the considered factors there are two kind of demerit:**

- Specified demerit, where the weight is established according to the defect percent from each category

- Acceptance demerit, where the weight is established according to the acceptance probability by the beneficiary of damage.

The penalty points on the controlled unit are obtained by multiplying number of defect with the penalization weight, divided to the number of products controlled.

The quality of the products can be globally estimated through an indicator "the demerits indicator", determined by the "nonconformities" or by the observed defects in the final control.

Index Terms—**defect, demerit, admissible limits**

I. INTRODUCTION

Quality can be estimated in different ways. Measuring the characteristics of the product, comparing the quality indicators or determining the defect weight is some of these possibilities.

All the companies are preoccupied in present by the quality problem, because only qualitative products can satisfy the needs of the users.

The quality of the product is determined by the entire set of properties (characteristics) that can be seen, tried and measured or at least be compared with a standard.

The producer gives the usage values (utilization), while the quality denotes the degree of how the characteristics (proprieties) of the product, answer to the beneficiary needs, and the measure of a confident service.

Manuscript received March 16, 2010.

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II TEORETICAL CONSIDERATION

The methods to measure the quality level are:

1. Experimental method. It's used to estimate the products proprieties using essays or mechanical determination,
2. Physical and chemical proprieties. They are made the help different means and technical proceedings. Quality characteristics like strength, elongation, hardness are tested and the results are picking and worked.
3. Expertise method. It's used in addendum for experimental method for quality, a characteristics values evaluation when they can not measured. The exactitude of determination depends on specialist qualification, capacity and competence.
4. Sociological method. At the base of this method are the results that are obtained after the inquiry of the beneficiary.
5. Statistics method. It is the most laboriously and usable method.

At the base of demerits method are the probability and statistic mathematics theory. For inquiry analysis and decision a lot of primary information is used.

The paper presents a statistic method called "Journal of demerits". The method is applied on Economizer element from the thermoelectric power station. The principle of the demerits method is based on the qualitative level for product or production, but speaking about their defect and not about their features. The companies are preoccupied by the quality of the active elements from the thermoelectric power station and a monitoring test of them because gives important information for the remaining live time.

When we start to make the "Journal of demerits" for a product, for a component or for simple characteristics, there must be seen which kind of defect can appear in the pipes from a thermoelectric power station. The defects are divided in four: critical defect, principal defect, secondary defect and minor defect. The defect has a negative influential in the function of the equipments from the thermoelectric power station. Depending on their severity, the defects receive penalty points. The penalty points are given in table I.

Table I. Defect classification and the penalty points

Defect classification	symbol	Penalty points
critical	c	100
principal	p	50
secondary	s	10
minor	m	1

Critical defect gives the impossibility to work the product and there are important damages and accidents.

Principal defect gives the possibility to use the product but they are giving important losses to the producer.

Secondary defect doesn't affect very much the utilization of the product but is determinable to the user.

Minor defect doesn't reduce the utilization and the user doesn't determine them.

To concentrate the results that are obtained after we check the products we follow sequences steps:

1. product and controlled operation
2. the location where we have made the check
3. month
4. year
5. name of the check man
6. possible defect
7. day of the check
8. number of check products
9. number of defects (their frequency)
10. total number of defects
11. relative fervency of defects k/n
12. graphic representation of the relative frequency of defects
13. the penalty points on the checked unit
14. graphic representation of non price item defect histogram

$$D=\frac{N_c d_c + N_p d_p + N_s d_s + N_m d_m}{n}$$

where:

- D – demerits
- N_c - number of critical defects
- N_p - number of principal defects
- N_s - number of secondary defects
- N_m - number of minor defects
- d_c - critical defect penalization
- d_p - principal defect penalization
- d_s - secondary defect penalization
- d_m - minor defect penalization
- n – total number of defect

In case that the result of demerits is out of the admissible limits, we identify the defects that determine the overflow of admissible limits.

We establish the histogram scale different for each type of defects.

The scale is proportional with the penalty points. We take the scale at the critical defect as been direct proportional with the penalty point.

In the case of critical defect the scale is 1:1, at the principal defect the scale is 1:2, at the secondary defects the scale is 1:10 and for minimal defect the scale is 1:100.

The defect histogram is the second quality indicator; using the defect histogram we can at the first look to establish what kind of defect take the most important influence on the demerits.

The penalty points for the defect category are:

- Critical defect – 100 penalty points
  - A = crack in the pipe wall
  - B = crack in montage weld
  - C = crack in repair weld
- Principal defect – 50 penalty points
  - D = pore in the pipe wall
  - E = pore in montage weld
  - F = pore in repaired weld
- Secondary defect – 10 penalty points
  - G = through erosion
  - H = rolling defect
  - I = corrosion cavitations
- Minor defect – 1 penalty point
  - J = incomplete erosion
  - K = other kinds of defect

Table II, contains the number of defects which appear in active element as economizer from the thermoelectric power station.

Table II. Number of defect

Month	**DEFECTS**											**Nr. of check unit**	**Total defect**	**Unit defect [%]**	**demerit**
	Critic			principal			secondary			minor					
	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**				
January	2	1	-	1	-	-	-	-	-	-	-	56	4	0,07	6,25
February	-	-	-	-	-	-	1	-	-	-	-	56	1	0,018	0,17
March	-	-	1	1	-	1	-	-	-	-	-	56	3	0,054	3,57
April	-	-	-	-	-	-	2	-	-	-	1	56	3	0,054	0,37

ISBN: 978-988-18210-7-2
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

May	-	-	-	-	1	-	3	-	-	1	-	56	4	0,071	1,44
June	-	-	-	-	1	1	-	-	-	-	-	56	2	0,036	1,78
July	-	-	-	-	-	-	2	1	-	-	-	56	3	0,054	0,53
August	-	-	-	-	-	2	1	-	-	1	-	56	4	0,071	1,98
September	-	-	-	-	-	1	1	-	-	-	-	56	2	0,036	1,07
October	-	-	1	1	-	-	2	-	-	-	1	56	5	0,089	3,05
November	-	-	-	-	-	1	4	-	-	2	-	56	7	0,125	1,64
December	-	-	-	-	-	-	1	-	-	-	1	56	2	0,036	0,19
Total	**2**	**1**	**2**	**3**	**2**	**6**	**15**	**1**	**-**	**4**	**3**	**56**	**40**		

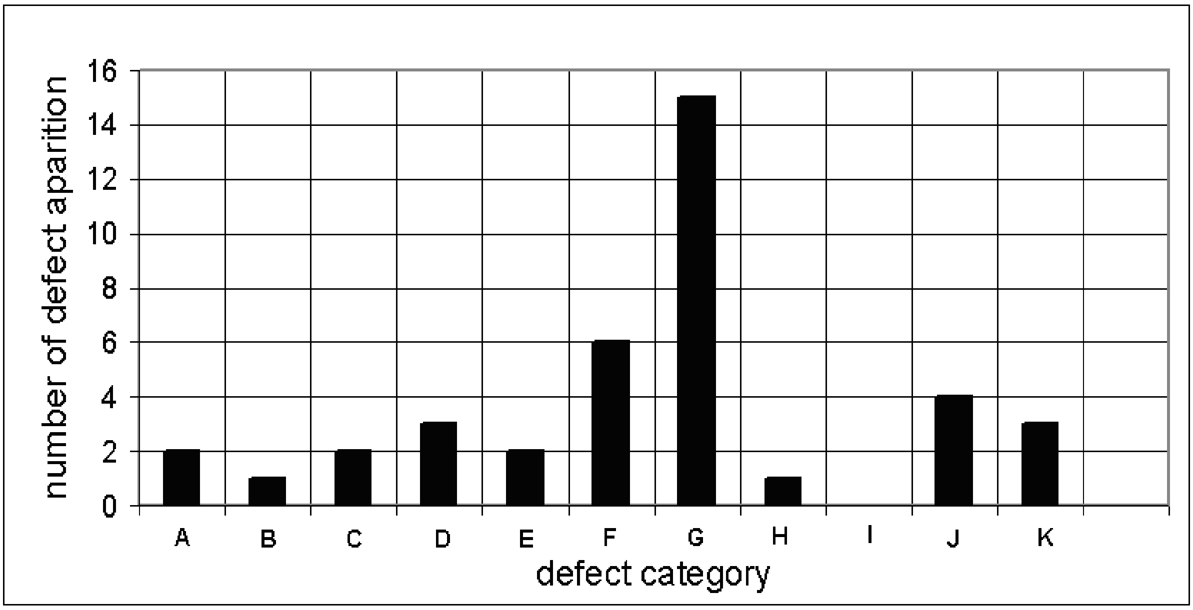

Fig.1. Defect histogram

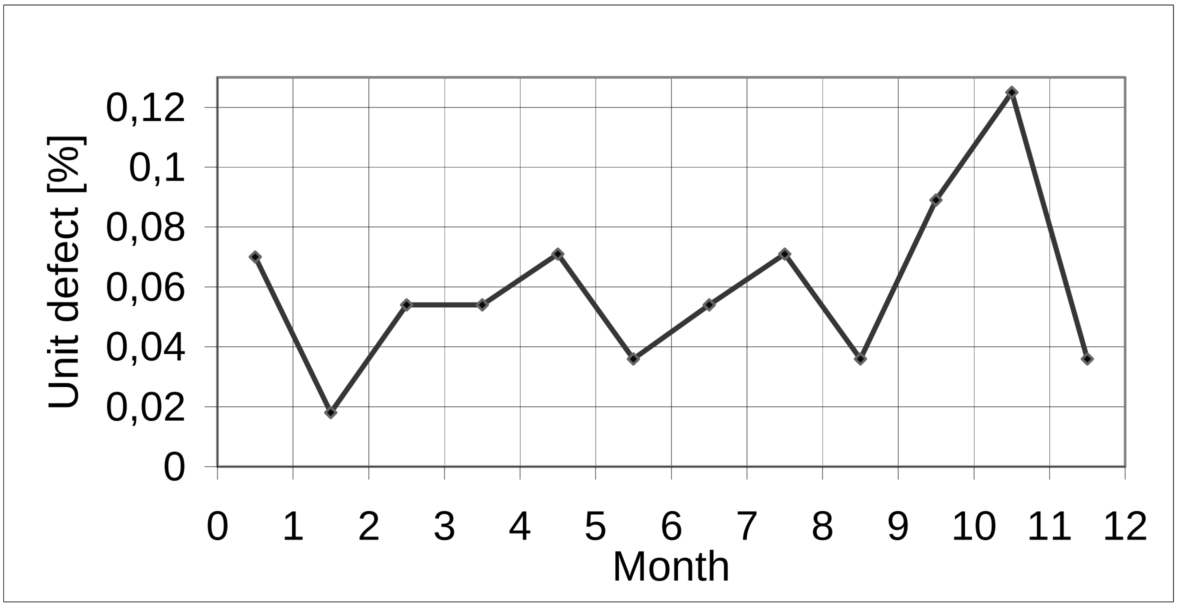

Fig.2. Unit defect graphics

ISBN: 978-988-18210-7-2
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)

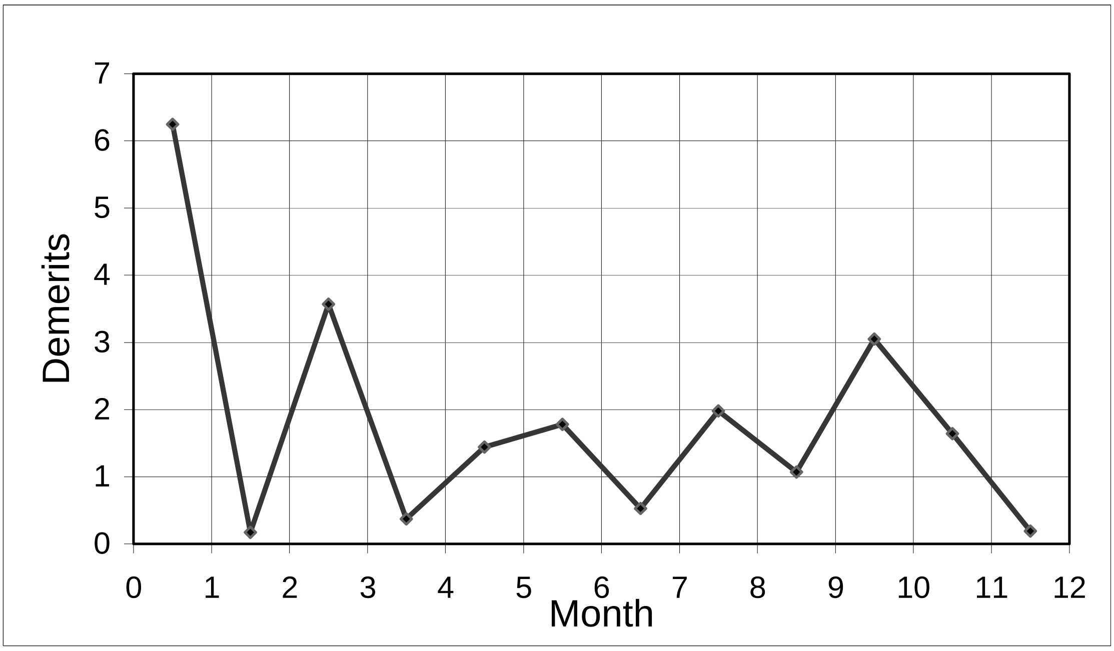

Fig.3. Demerits graphics

III. EXPERIMENTAL RESULTS

The study is made on the pipe from a thermoelectric power station with 420t/h capacity.

The pipes from the thermoelectric power station suffer in time dimensional damage because of the corrosion process and degradation.

Metallic material of the pipe in time suffers degradation, and this make a modification in the exploitation behavior.

The samples are marked and for each of them it is made analyses like:

- dimensional check
- microscopic aspect
- spectral identification
- metallographic analyses
- mechanical characteristics

The results are graphic presented in the paper for the time period.

The results of the analyses are presented in table II, which include number and type of defects that appear in every month from the year, the percent of the defect and the demerits indicator. With this element it is possible to make some graphics:

- defect histogram (fig.1)
- unit flow graphics (fig. 2)
- demerits graphics (fig. 3).

Defect histogram from fig.1, shows the frequent recurrence of particular defect.

Unit flow graphics from fig.2, presents the variation of the percent of the defects in a year.

Demerits graphics from the fig.3, shows that the dangerous period for the thermoelectric power station is in January.

The pipes from the thermoelectric power station work in high temperature and high pressure condition.

In the welded zone, the samples have a structure with bainitic aspect and we can see the microstructures at the root in the welding join.

In the sample was also found internal marginal corrosion.

IV. CONCLUSION

Minimal information that is necessary to diagnose the stage of the active elements from a thermal – electric power station is the intensity value of damage and number of repair.

The information that is in the table is picked in exploitation condition.

Damage intensity from table II, illustrate that there is a constant damage but the values of damage are small, so the thermoelectric power station can function.

Using the value from table I, table II and fig.3, it is possible to establish principal correction way to diminish the intensity of damages values.

It's possible to make correction at the external factors like welding reparation. It is possible not to be able to modify the external factors because we can't modify the nominal parameters of the thermoelectric power station function.

It's essential to have dates and information about the reliability of the components because so the enterprise can calculate the reliability of the installation.

REFERENCES

[1] T. Baron, et al. – Calitate si fiabilitate - Quality and reliability - Technical Publishing 1988 – Bucureşti
[2] Ryabinin, I. – Reliability of engineering systems; Principles and analysis – MIR Moscova 1976
[3] Eftimie, C., Soare D. – Fiabilitatea sistemelor de distribuţie electro - energetice industriale - Reliability of electric distribution systems - Industrial Energy – Technical Publishing 1979 – Bucureşti
[4] Aloman A. – Statistică şi probabilitate în experimentul ştiinţific- Statistics and probability in science experiment. Editor Matrix-Rom Bucureşti 1998
[5] Nichici A., Cicală E., - Prelucrarea datelor experimentale- Experimental data processing.- Universitatea „Politehnica" Timişoara 1996.
[6] Vodă V. – Planuri de eşantionare pentru verificarea fiabilităţii - Sampling plans for checking the reliability -.Tribuna calităţii nr.9/1997
[7] Truşculescu M., Fleser T. – The influence of structural states over the life – time of some active elements from electric power station vol. I - Welding Power Industry Belgrade 1995.

ISBN: 978-988-18210-7-2
ISSN: 2078-0958 (Print); ISSN: 2078-0966 (Online)