Meglouli H.

Bouali L.
University of Boumerdes, Boumerdes, Algeria

The probabilistic approach to the determination of consumption volumes and repairing the pieces of hydrocarbon's equipments

Keywords

probabilistic approach, planing repairing, reliability, evaluation pieces

Abstract

The system of hydrocarbon equipments maintenance includes a group of activities and organisational measures and techniques. The principal equipment that we meet in the hydrocarbon domain consists of three parts: mechanical, electric and electronic and we are interested in the mechanical part, which is related to the problems of planning of the repairing of the equipments constructive elements. This research paper is devoted to the development of accompany approach to the problem of estimation or evaluation of consumption volumes and of pieces repairing, and equipments in taking into consideration the possibilities of the repeated rinses of restored pieces and of samples heterogenrionsity of identical equipments at the time of repairing. We give at the end an application of the viewed approach to the case of installations of gas turbine.

1. Introduction

According to the composition of the carried out works in the enterprises of equipments maintenance we predict two types of reparations:
-The current reparations and big reparations [3], [5], the current reparation has an aim, it is to guarantee the good functioning of equipment in a certain interval of time which separates it from the planned reparation as follows. It replaces and retires certain pieces.
The big reparation's ain is to put in a state the equipment and to guarantee it's good functioning in an interval of time which separates it from the big reparation and it is for replacements or the restoration all the pieces together.
All the predicted reparations are followed in a well-determined order and form reiterative cycles, which can be achieved by big reparation. The duration of repairing cycle of the equipment is given by the number of hours of functioning during the ones in which all the predicted operations are done in [5] this cycle. And which are executed in a well-determined order in intervals of functioning time of the equipment called periods between reparations. During these reparations, the different constructive elements of the equipment are under control non-destructive of their state. The controlled pieces are sorted out into three groups:
-Good for the inside use, subject of repairing, and outside the state of serving which must be replaced.
The reparation system of hydrocarbon equipments consists of group of activities and of organizational and technical measures; among which we can cite the planification of volumes of repairing operations and of spare pieces's consumption, this latter needs correct methods of evaluation of consumption volumes and the repairing of constructive elements of equipments that are in question or matter, this is the subject of this work:

2. Probabilistic formulation of the considered problem

The probabilities of a piece of the given type are judged as good for the inside use (Pub) or subject to the repairing (Pr) are related to estimated greatnesses of its degradation (usury) they are probabilities of incompatible events and contrarily verified the relation.

$$p_b + p_r = 1 \quad (1)$$

The results of the non-destructive control of a piece of a sample can contain pieces, which represent usuries, or damages (break or rupture…etc) are one of the three flouring incompatible events. The piece is good for the inside use, the subject piece to the repairing of the piece scraped.
The probabilities correspond respectively to events. They are related by the relation.

$$p_b^* + p_{rr}^* + p_g = 1 \quad (2)$$

The scrap of pieces due to damages is judged as necessary by the non-destructive control in which the results are discrete and the series of proves of Bernoulli that attributed to their descriptions. To determine the probability of searing a piece or use the law of (Poisson.), this facilitates sensitively the calculation and give results close to those given by the law of binomial. The number of essays is important [1] taking into consideration the expressions (1), (2) and (3) and the fact that the probabilities P*r and P*b depend practically as follows.
Pr and Pb, we can showthat:

$$p_r^* = p_{r.}.p_i \text{ and } \quad p_b^* = p_b.p_i . \quad (3)$$

Knowing the values of Pr and Pb, we determine easily the probabilities of the heeds of the repeated reparation of the piece of the given type. In fact, lither K=Pr, the since the following reparation and K=Pb, the probability of the opposite event for a cycle of reparation of the given equipment.
The probabilities of the given type piece's repairing is determined by using the adding theorem of probabilities and the theorem of products of probabilities (3), (4), (6) knowing the values of these probabilities, we determine the medium volume of the scraped identical pieces by the expression:

$$Q = n\sum_{i=1}^{d} iP_{ri} \quad (4)$$

Or "n" is the quantity of identical pieces in the considered equipment "d" is the number of predicted reparations on the considered period.
Pri is the probability that a piece of the given type needs repairing to the i I reparation.
For a given period, the medium volume of scraped pieces by an equipment of given type and in which the repairing is repeated "h "times, it is evaluated by the expression:

$$q_{r,h,d} = n\sum_{i} {}_{i=h+1}(i-h).p_{r_i} . \quad (5)$$

And the quantity of pieces that need repairing is determined by the expression.

$$R_{h,d} = n\left[P_{r_1} + \sum_{i=2}^{d} hP_{r_{i.}}\right] \quad (6)$$

3. Application

We consider the installations of gas turbines, which are frequently used in production, and transportation of hydrocarbons. The reparations and their periodicities of considered machines are given in the *Table 1*.
The results of non-destructive controls of pieces are treated by the methods of descriptive statistics and of preliminary analysis of data's nature, the tests of hypothesis of homogeneity, the independence and the stationary of observations [1].
Once, the values of K and k are determined. We calculate the repeated repairing probabilities of the pieces by the given formula in the *Table 2*. The volumes of spare pieces needs and the repairing of the recuperated pieces are estimated by the expressions (5) and (6)
Finally the real annual needs are given in the *Table 3*

Table 1. Types of preparation of the considered gas turbine installation and their periodicity

Reparation type	Revisions of the combustion rooms	Revisions of parts at high temperatures	General revision
Periodicity in hours	8000	16000	32000

Table 2. Number of reparations and repairing

Number of reparations and repairing	Pr: Probabilities of repairing in the state of " r " times				
	p_0	p_1	p_2	p_3	p_4
Two reparations case	$\bar{A}_2$	2 $\bar{A}$ A	A^2	-	-
Three reparations case	$\bar{A}_3$	3A $\bar{A}_2$	3 A^2 $\bar{A}$	A^3	-
Four reparations case	$\bar{A}_4$	4 $\bar{A}$ A^3	$6A^2$ $\bar{A}^2$	$4A^3$ $\bar{A}$	A^4

Table 3 (a and b). The estimated annual needs and real of spare pieces by Gas turbine installation

Table 3. a)

Pieces	Waterproofness joints (oil-gas)	Tubes with flames	Disk of the T.H.P.
The predicted annual need	0,218	0,284	0,175
The annual real need	0,205	0,256	0,170

Table 3. b)

Axial compressions down	Mobile down of the T.H.P.	Directions down of the T.H. P	Down of the T. B. P.
0,073	0,210	0,061	0,063
0,069	0,202	0,065	0,059

4. Conclusion

The application of probabilistic approach to the considered problem requires an efficient organisation of the comeback of experience, and the domain of hydrocarbons are organised in this sens.
It brings advantages and improvements and it can be used directly by study offices.

References

[1] Aivazian, A. et autres. (1986). *Elements de modulation et traitement primaire des donnees.*Ed-Mir Moscou.
[2] Billingsley, P. (1995). *Probability Measure 3 rd.* New York: Wiley.
[3] Duncan, J. & Scholnick, L. S. (1973). Interrupt and opportunistic replacement strategies for systems of deterioration components, operational res. Quart, 24,N°2.
[4] Feller, W. (1968). *An Introduction to the theory of probability and its application.* Vol. 1,3. New York: Wiley.
[5] Jardine, A.K.S. (1973). *Maintenance, Replacement and Reliability.* Pitman, London/Halsted Press Wiley New York.
[6] Love, M. (1977). *Probability theory,4 th.ed*. New York: Springer- Verlag.