ASPECTS CONCERNING THE SOFTWARE APPLICATIONS IN ORDER TO DETERMINE THE TECHNOLOGICAL SYSTEMS RELIABILITY

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Abstract: Within the paper there are presented the reliability problems specific to the technological systems, a programme that allows making certain applications simplifying the traditional mathematics device and getting closer quickly to solution taking into consideration its economic aspect in the working conditions. There are presented some general considerations regarding the method followed by an example regarding the estimation of the drilling bit reliability modeled like a serial technological system.

Key words: reliability, software application, technological system, drilling bits, data processing.

1. INTRODUCTION

Following carefully the statistics and also from case studies solution on drilling bits used in exploitation, there was realized a centralization of the number of used equipments depending on their dimension. The data were collected in an interval of seven years and they are the object of a data base concerning the use of the tricone drilling bits during the hydrocarbon drilling process in the country and abroad and they were interpreted and centralized having as a direct result the graphic from the fig. 1.

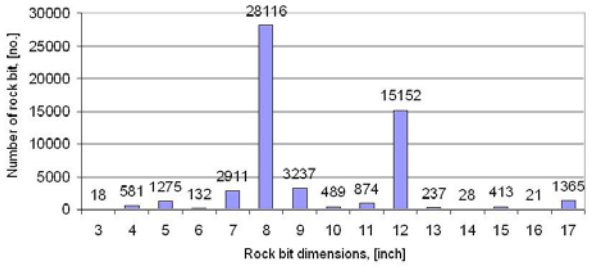


Fig. 1. Number of drilling bits used in production depending on their dimension

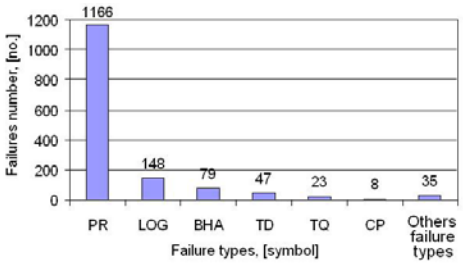


Fig. 2. Types of failures presented in the drilling pipes out of production

Also, from a study made to the extraction of the drilling bits used in the production process, there were been established the main ways of their failure and there were presented synthetically with the help of the figure 2.
The main cause of drilling bits failure is the decreasing of the advance speed because of the tooth and bearing wear. Further there was presented in percents the packing and tooth degree of the used drilling bits which are the object of the study.

The packing degree of the bearings for the used studied drilling bits (see figure 3): a. E - presents the packing; b. H - the packing can not be appreciated; c. F - missed sealing up gasket. The tooth degree for the used studied drilling bits (see figure 4): 1. A - bearings wear over 80%; 2. B - bearings wear between 50-80%; 3. C - bearings wear between 20-50%; 4. D - bearings wear under 20%.

Taking into account the influence of the damage ways of the studied drilling bits found out to their extraction from the drilling process, there was been conceived a serial reliability simple model (fig. 5), built from blocks for which the will be presented a special software conceived for the study of the industrial equipments (systems).

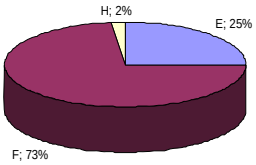


Fig. 3. Bearings degree to the drilling bits out of use

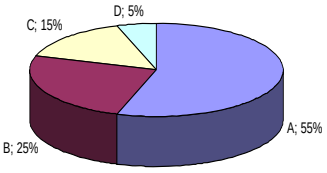


Fig. 4. Tooth degree to the drilling bits out of use

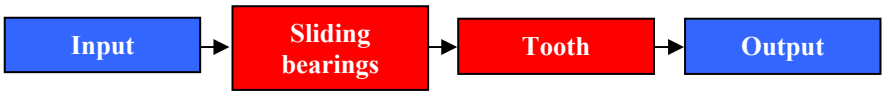


Fig.5. Serial reliability model realized in blocks

2. PRESENTATION OF THE SYSTEMS RELIABILITY SOFTWARE APPLICATION V 1.0

The application window, the interface (see figure 6) is composed of 5 work zones thus:
1. Work left zone for realizing the model composed of equipments' subsystems (blocks of reliability characterized by a certain level) and the connection between them;
2. Right up zone for the allocation of the reliability block label and of the value corresponding to the reliability level;
3. Right down zone for defining the ways (connections) between the reliability blocks and the display of the value corresponding to the respective way;
4. The display zone of the subsystems coordinates that compose the reliability way on two directions x and y;
5. The display zone of the final result - the reliability level of the subsystem the most pessimistic way that takes into consideration the connection between the system elements (serial system, parallel system and mixed system).

Also, the application zone contains the buttons associated to the commands ″Next step″ and ″Initialization″. The first command is necessary to cover the steps necessary for the application and the second for resetting an application that rules and the initiation of a new one. For understanding the soft there was exemplified by solving the model afferent to the figure 5.

The user as we mentioned has the model composed of blocks established with the each characteristic reliability values (calculated with the help of any reliability law presented in this chapter without any restrictions or recommendations on its use especially of any of these), for the system to which it is calculated the total reliability value. There has to be mentioned that it is also applied a calculus algorithm to the reliability systems composed of blocks that are found in different relations (besides the presented serial type relation) thus the reliability systems with elements (blocks): in parallel, serial and mixed.

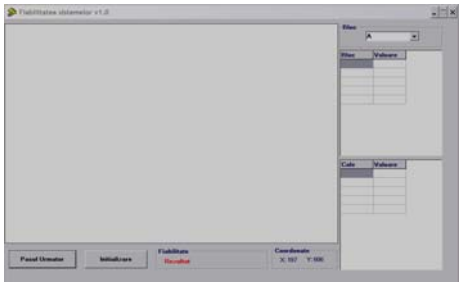


Fig. 6. Graphic interface of the programme SYSTEMS RELIABILITY v1.0

For solving the model there is preceded the following step succession:
Step 1. After the ″v1.0 SYSTEMS RELIABILITY″ application initialization by ruling the folder ″Systems reliability.exe″, the user meets the interface (window) afferent to it (see figure 6) that was presented upper.

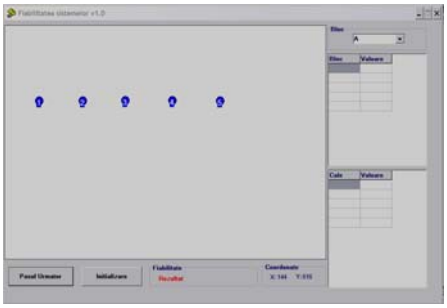
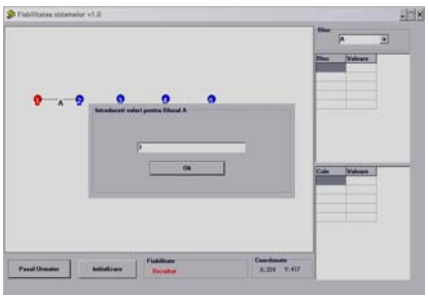


Fig. 7. Step 2: creation of the nodes that define the reliability blocks

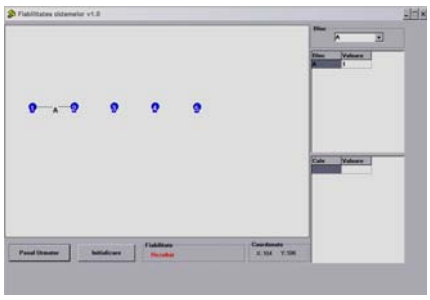
Step 2. To this step there are located in the work zone the nodes that define the reliability blocks (see figure 7), by a single click on the left button of the mouse. The connection between the blocks is realized with the help of the nodes (the node from the last created block is practically the first node that is created). After the nodes' creation it is pushed the button ″Next step″ for passing to the next step.

Step 3. Within the step 3 there are realized the connections between the created nodes (see figure 8), these connections having the blocks' signification from which it is composed the studied system, there are assigned labels, capital letters form the Latin alphabet (there has to mentioned that there must not use the same letter for defining two or more reliability blocks) and the reliability values characteristic to each element (see figure 8.a). The blocks' labels are selected form the ″Block″ zone of each main window by through the mouse from the selection element type combo-box. After realizing the connections and the assignation of the reliability values (see figure 9.a) there is pushed the button ″Next step″ passing thus to the step 4.

Step 4. Visualization of the obtained result (fig. 9.b) in the zone 5 and of the reliability possible ways (connections) with values calculated in the step 4. Also it may be mentioned also the fact that for the reliability blocks that are practically functional (the reliability function having value 1) in the selection element type combo-box there is the option 1 and instead the label with capital letter it will appear the number ″1″ specific to the reliability value.

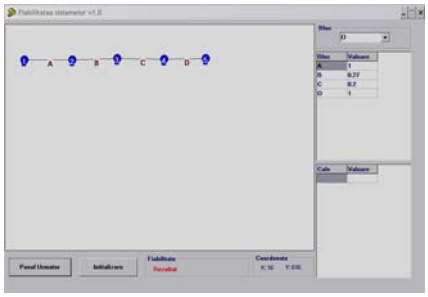


a.

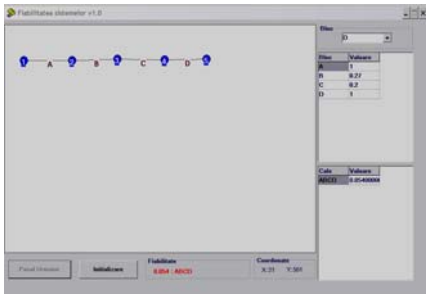


b.

Fig. 8. Step 3: realization of the connections (reliability blocks) with assignation of characteristic labels and characteristic reliability values



a.



b.

Fig. 9. Step 4: visualization of the model and of the result made by the application

The result is verified applying the reliability formula for the serial systems presented in the next paragraphs. In this case, the functioning of the entire system is based on the functioning of its every component elements.

The reliability is given by the expression:

$$R_s = P\left(X_1 \cap X_2 \cap ... \cap X_n\right) = P\left(X_1\right) P\left(X_1 \middle| X_2\right) P\left(X_3 \middle| X_1 X_2\right) ... P\left(X_n \middle| X_1 X_2 ... X_{n-1}\right) \quad (1)$$

where: R_s is the system reliability; X_i the event as the element be operational;
$P(X_i)$ probability as the element be operational.
For independent events the equation (1) becomes:

$$R_s(t) = \prod_{i=1}^{n} P\left(X_i\right) = \prod_{i=1}^{n} R_i(t) \quad (2)$$

where $R_i(t)$ is the reliability corresponding to the element i,
The function of non-reliability and the risk of failure are:

$$F_s(t) = 1 - \prod_{i=1}^{k} \left[1 - F_i(t)\right] \quad (3)$$

$$h_s(t) = \prod_{i=1}^{k} h_i(t)$$

The analogy with the serial circuits (electrical, mechanical etc.) is obvious. The system fails when there is no energy transfer; the components fail and/or work independently. The scheme from the figure 10 represents a system with five serial components replaced with an equivalent element.

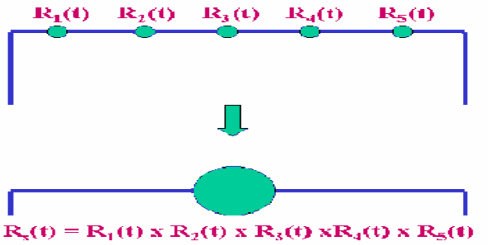


Fig. 10. Calculus of the reliability function for the serial systems

To the replacement of the reliabilities corresponding to the elements (blocks) of the considered technological system there has been obtained the same result 0,054 so it may be traced the conclusion that the software responds correctly to the data introduction.

3. CONCLUSIONS

There were identified the main causes of the rolling drilling bits failures generally and of those with sliding bearings packed especially by the analysis of an important lot of drilling bits used in exploitation. By an attentive evaluation of the wear of the drilling bit every elements there were emphasized that the main causes of the packed sliding bearings drilling bits out of order are the loss of the packing and the catastrophic wear of the tooth.

The presented software, conceived by the authors of the article is an independent instrument of the used operation system within reach of the engineers from the industry and not also what is useful by the help that provides the calculus of the systems' reliability with minimal hardware resources. The presented example is a simple one in order to make easier the application understanding but there may be solved the cases of certain complex mixed configuration systems.

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