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RELIABILITY OF CLINCHER BURNERS FROM CEMENT INDUSTRY

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Abstract: The correct operation of clinker furnaces also involves understanding and mastering the appearance of their defects. This requires tracking the operation of these machines for as long as possible and recording the good operating times and stationary due to defects. In the present case, the follow-up was done daily for nine months. Good running times determine the level of reliability, and stops for restoration, maintainability. Only reliability is studied in this paper. It is important to determine the mathematical law of the proper functioning of the burner, ie reliability. Reliability analysis shows how maintenance has been done prior to the study and in which moment of life is the burner being studied. The information obtained allows a critical analysis of the decisions that need to be taken to improve reliability. Increasing the reliability of burners reduces the demand for corrective maintenance and consequently increases the production of cement.
Keywords: cement industry, clinker, oven, reliability

1. INTRODUCTION

Romania has a long history of cement production. In fact, the cement industry in Romania is more than 100 years old: the first cement plant came into operation in 1890 in Braila. Several other cement factories were built, and by 1950 their number had grown to 10. This situation remained unchanged until the end of 1989, when in Romania, within the Cement Company Bucharest, the following units operated: : C.L.A. Bicaz, C.L.A. Fieni, C.L.A. Medgidia, C.L.A. Tg. Jiu, C.L. Câmpulung, C.L.A. Aleşd, C.L. Deva, I.L. Hoghiz, C.L. Turda.
In 1990 the cement production was made with 38 ovens:

- 2 ovens of 300 t clinker / day, wet process (1951-1955);
- 3 ovens of 800 t clinker / day, wet process (1962-1964);
- 23 ovens of 800 t clinker / day on dry process with heat exchangers (1965-74);
- 9 ovens of 3000 t clinker / day on dry process with heat exchangers (1974-1986);
- 1 oven of 3000 t clinker / day on dry pre-calcification (1986).

After 1989, a slow transition period began, corresponding to a low economic progress for Romania. As regards the cement industry, at a capacity of approximate 17 million tons of production decreased drastically, the level in 2004 accounting for only 50% compared to the level of 1989. In fact, the cement industry has fallen from 12.2 million tones in 1989 to 6.3 million tones in 1992. Since then, total production has remained at the same level until 2003, with increased production being sustained beyond that date.
In 1995, the privatization process started in the cement industry. In a relatively short period, 1995-1999, the whole cement industry of Romania was fully privatized, being the first industry privatized by the participation of the most powerful industrial groups in this field in the world: LAFARGE (France), HOLCIM (Switzerland) and HEIDELBERG (Germany). The participation of these multinationals in the full privatization of this industry constituted an advantage compared to other industrial sectors, and through the technical, financial and managerial capacity, they secured the premises for an accelerated development of this industrial branch. Indeed, each cement company has applied on the local market all the knowledge and techniques available within the group to which it belongs. For this reason, a very high technological level has been achieved, so that in 2014, the cement industry in Romania has 9 dry-process ovens, of which 4 are pre-burner. Since 2008, the newest furnace has been put into operation, with the highest capacity and equipped with a 5-stage heat exchanger and pre-burner.
This brief introduction only shows that the appreciation of cement factories' production depends on the capacity offered by the combustion furnaces (clinker). That's why any study on them is suitable.

2. COLLECTION AND PROCESSING OF EXPERIMENTAL DATA

In order to accomplish the proposed goal, the operation / failure of a clinker firing furnace was monitored for nine months. Good running and maintenance times were recorded on special papers.
Because we concern only reliability, good running times have been considered and introduced into the Weibul ++ 9 specialized software. The good operating times entered in the program are shown in Figure 1.

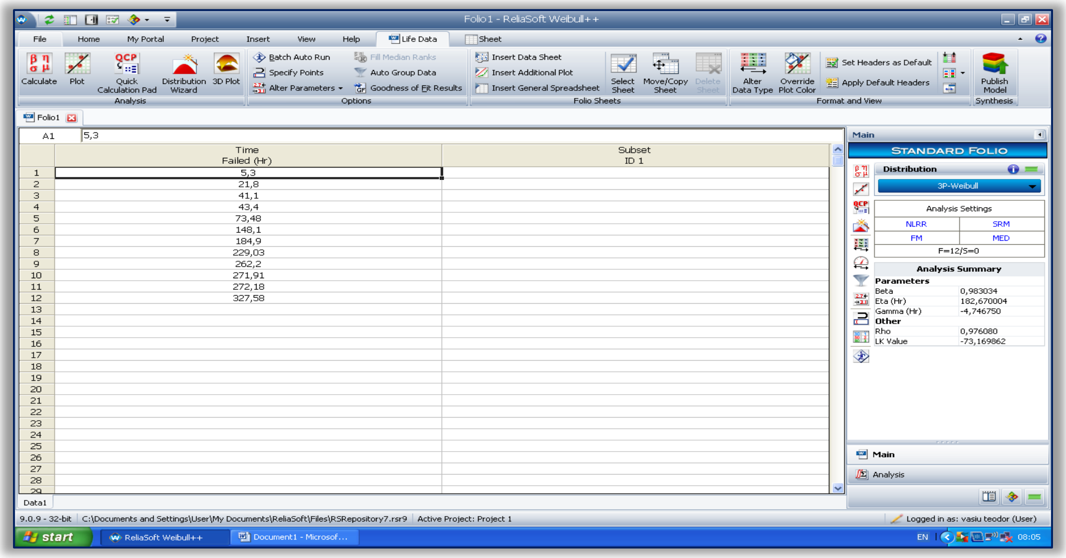

Figure 1. Good running times

The chosen software has the possibility of an analysis that provides the optimal distribution law for each case, ie the mathematical law with the maximum correlation coefficient between the experimental and the theoretical data.

For reliability R(t), run times t respect the Weibull law :

$$R(t)=e^{-\left(\frac{t-\gamma}{\eta}\right)^{\beta}} \tag{1}$$

with three parameters (Figure 2) with a correlation coefficient Rho = 0.976. The parameters of this law are: the shape parameter β = 0.983034, the scale parameter η = 182.67 hours and the initialization parameter γ = -4.74675 hours (Figure 1).

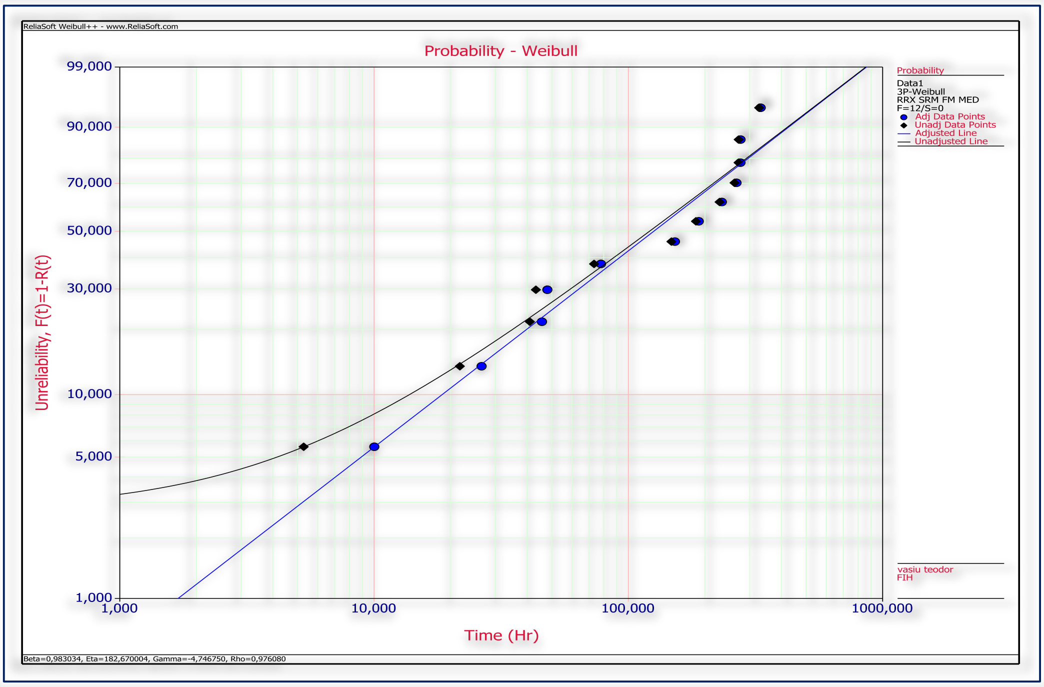

Figure 2. Probabilistic diagram of Weibull distribution

2. INTERPRETATION OF THE OBTAINED RESULTS

The value of β, about 1, shows that the machine under study is in its normal life (its maturity). The negative initialization parameter γ indicates a worrying fact that the burner defects occur before it is put into operation, meaning the maintenance is done imperfect. This is also evident from Figures 3 and 4, in which it is clear that the reliability (Figure 3) drops sharply from the zero point of operation and the non-reliability (Figure 4) increases rapidly.

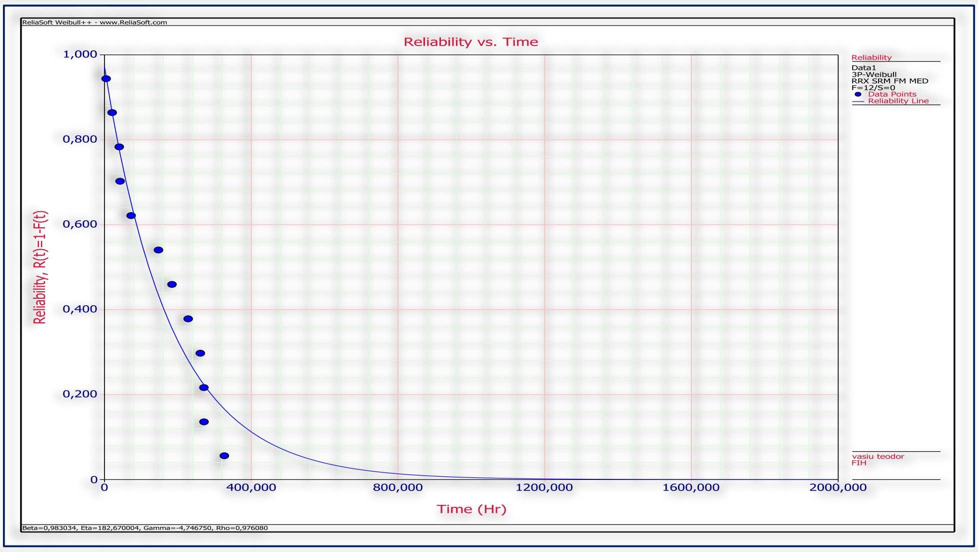

Figure 3. Burner reliability versus time

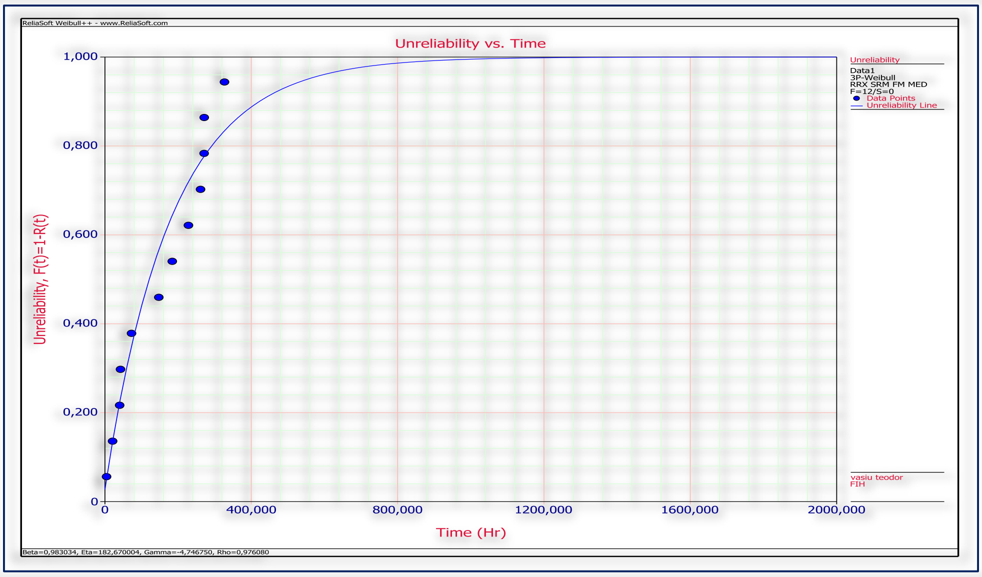

Figure 4. Non-reliability versus time

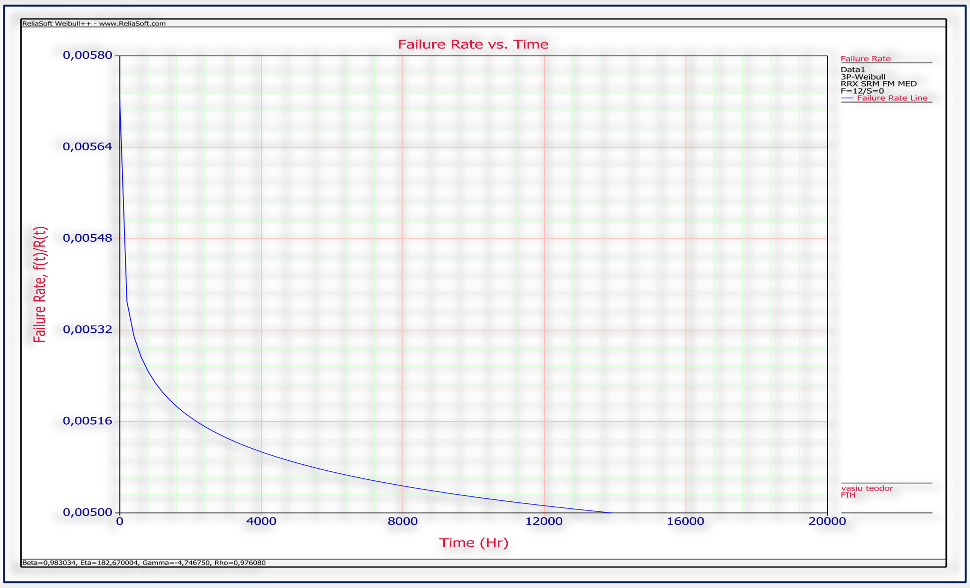

Figure 5. Failure rate versus time

At the same time, the failure rate has high values at the beginning of the operating period (Figure 5), then decreasing with time. Just the great initial values are in support of the previous statement that maintenance and repair operations are carried out with great deficiencies.

3. CONCLUSION

As a conclusion to those set out in this chapter, it is necessary to review all aspects related to the maintenance of the burner: procedures, infrastructure, adequate qualification of maintenance and exploitation personnel, etc. Otherwise, the problems of non-functioning will persist, worsen and the normal life will be significantly reduced, with direct implications for the costs of the economic agent.

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