INTERPRETATION OF THE DEGRADATION MECHANISMS IN SUPPORT MANAGEMENT LIFETIME OF THE CRYSTALLIZER

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Abstract

This paper is focused on degradation mechanisms acting on crystallizer and their interpretation in modeling the crystallizer lifetime by support lifetime management of crystallizer using Weibull distribution. For more accurate modeling of various degradation mechanisms scope of the crystallizer and the effective management of the lifetime of the crystallizer the crystallizer were did division into three regions, where each of them were defined its weight by different ways of the degradation mechanisms and refined by the action of various degradation mechanisms on the lifetime of the crystallizer as a whole. On the basis of this information was then carried out an effective assessment of the residual lifetime of the board's crystallizer. Such an assessment can then be used to support production scheduling and maintenance. In the field of production scheduling interpretation of degradation mechanisms are used in the compilation of sequences and the number of fusions of sequences so as to maintain the required production quality. The maintenance has to minimize effect of surface defects on the crystallizer's plates on continuously cast slab and to optimize the exchange of plates.

Keywords: control, lifetime, crystallizer, defect, degradation mechanism

1. INTRODUCTION

Degradation mechanisms in the crystallizer, which in this case we are interested in are those processes which have an impact on its lifetime. Their identification and, if possible, the most accurate interpretation in the lifetime model of the crystallizer we are able to achieve better results in the management of lifetime the crystallizer.

2. DEGRADATION MECHANISMS

Firstly, was made identifying degradation mechanisms involved in the crystallizer. Based on this identification was further analyzed the significance of the various degradation mechanisms exposure. Example output action degradation mechanisms shown in **Fig. 1**. Based on the significance of this effect were various degradation mechanisms associated coefficients. These coefficients are then used in modeling the life of the mold plates using the Weibull distribution. Due to the accurate output crystallizer was subsequently divided into three areas in which they have been reviewed and subsequently changed the coefficients of the individual degradation mechanisms so that the resulting lifetime model better match the reality. The distribution of crystallizer on three areas in the development of the lifetime model led us mainly because the effects of individual degradation mechanisms in the casting direction changes. [1, 2, 3]

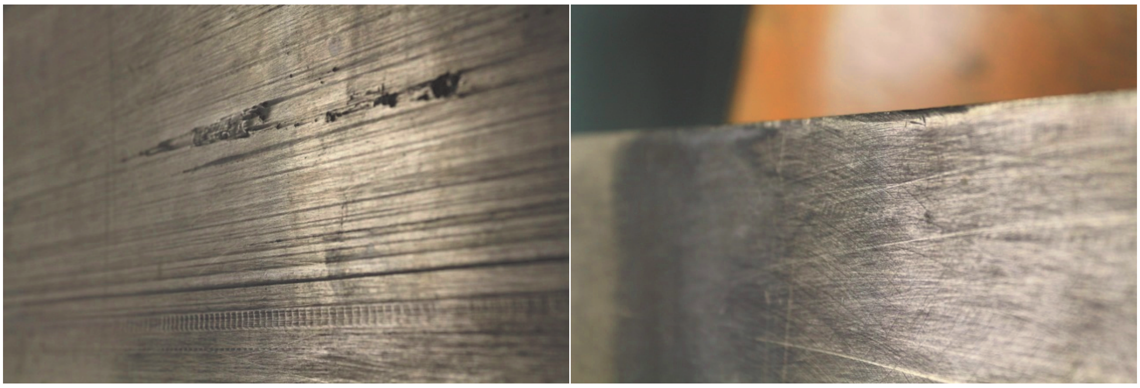

Fig. 1 Output of action degradation mechanisms

As an idea, select two degradation mechanisms and thermal gradient and the mechanical wear and find that the temperature gradient is highly dominant in the first and gradually the weight greatly reduced because, at the outlet from the crystallizer, the temperature gradient is lower by 40%. Contrary to mechanical wear is the lowest in the first and third highest in not only through the solidified casting crust but also due to the fact that in preparing the casting before the commencement of the crystallizer should be sealed so called and wherein also subject to mechanical damage to the plates crystallizer. Distribution crystallizer at each area in which the coefficients are recalculated Weibull distribution is shown in **Fig. 2**. [5, 6, 7, 8]

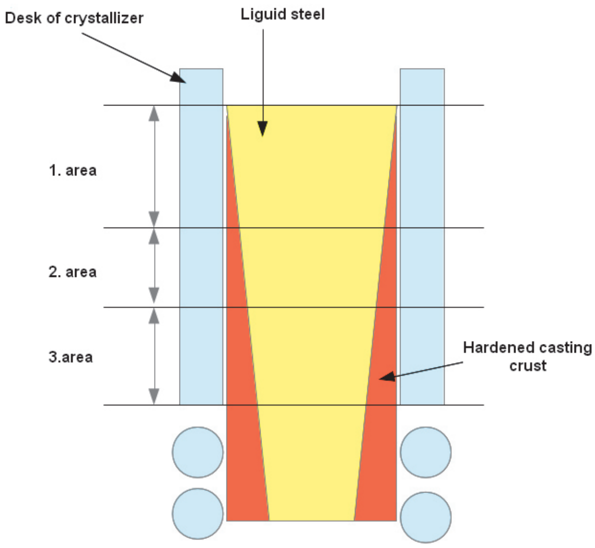

Fig. 2 Division of the crystallizer in terms of creating a lifetime model

The size of each area was determined based on the analysis provided data on the performance degradation mechanisms plate crystallizer. Specific values are not listed due to the ongoing optimization of these parameters.

3. MODEL OF RELIABILITY

Within the reliability of the model is created, which is identical to already published a reliability model with the only difference that is recalculated in different parts of the crystallizer according to various parameters, and the resulting the crystallizer is a minimum service life of the resulting values. Assuming it in shape [4, 11, 12]

$$F(t) = 1 - e^{-\lambda \cdot t^{\beta}} \tag{1}$$

Where *F*(*t*) is probability of reaching the limiting state when presumption, that random quantity *t* expressing time to limiting state will has a Weibull probability distribution; β is shape parameter, and λ is scale parameter.

Parameterization of that model then means numeration of shape parameter β and value of scale parameter λ.

Expression of the shape parameter is based on processing input data about degraded mechanisms. Which cause reaching of limiting state of the object:

- If is defined one dominant degraded mechanism, which cause limiting state on the object, then the shape parameter is the value, which is attached to given degraded mechanism.
- If there are two mechanisms, respectively three of them, which has the share on limiting state occurring, then the shape parameter will be defined according formula:

$$\beta = \sum_{\forall i} w_i \cdot m_i \tag{2}$$

Where β is resulting shape parameter, m_i is shape parameter for given degraded mechanism, which has share on limiting state occurring, and w_i is weight determining the mean of given degraded mechanism on limiting state reaching. This value is from interval (0; 1) and is given like expert estimation for given object.

Solution of determination of resulting shape parameter in this situation comes from analogy of artificial neuron (see **Fig. 1**), when each input has assigned the weight, which carried information either amplify or reduce. It means that resulting information can be obtained from the expression (2).

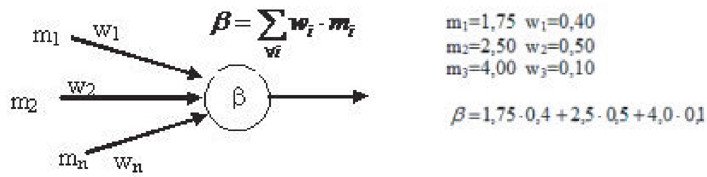

Fig. 3 Determination of shape parameter of Weibull probability distribution by neuron analogy

The third situation describe the state, when are defined more than three degraded mechanisms, from which one of them is dominant. After that, the shape parameter will obtain value 1.1 and Weibull probability distribution proceeds to exponential distribution. Scale parameter is then calculated according following formula

$$\lambda = -\frac{1}{t^{\beta}} \cdot \ln(1 - F) \tag{3}$$

Where β is resulting shape parameter, *F*.is a value of probability of reaching limiting state in the time of last known technical object state, and *t* is instant of time of last known technical object's state, expressed in form of number of operation hours from the beginning of object running or from the last repair, when the value of probability was lowered.

Consequently is able to numbering reaching probability of limiting state on the reliable model bases in each defined time moments, respectively to predicate according to defined operational hours value [9,10].

CONCLUSION

The aim was to clarify and better characterize degradation mechanisms operating in the crystallizer. Based on this model to refine the life of the crystallizer due to its division into several areas in which we approach life calculation crystallizer based on different interpretations of the significance of the various degradation mechanisms and overall life finally gives us the minimum of these calculated values.

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