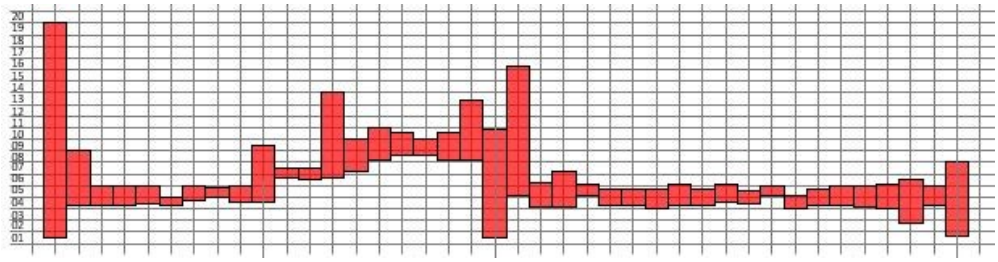

The Opportunities and Limitations of Predictive Maintenance

A breakthrough in the maintenance of thermal processing plants?

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5 Artikel

Anyone involved in maintenance has probably already wondered if Predictive Maintenance (PM) is the one and only preventive maintenance strategy of the future. Recent publications at least suggest a breakthrough.

But what exactly is meant by PM and what needs to be taken into consideration when thinking about the opportunities and limitations of PM for thermal processing plants?

Let's start from the beginning. All technical components have a finite remaining useful lifetime (RUL). They all eventually fail. The well-known failure rate curve shows us the failure behaviour of similar (mechanical) components per time interval. The curve is typically divided into three phases. In the first phase early failures occur, followed by a usually very long phase with a low number of so-called random failures, which is then sometimes followed by an increasing failure rate representing wear failures.

PM primarily focuses on random failures. A random failure (without big data consideration) is a failure without a recognizable systematic cause. Random failures, if we believe the statistics, are responsible for the vast majority of failures.

In practice the three phases occur in all possible variations, but usually without early failures and relatively rarely with wear failures. The three phases merge. Random failures predominate. If, for example, only a MTBF is specified for a machine component, then this refers to the random failures.

derived.

Since the failure rates for many components are unknown, maintenanc
this data. This however, is a serious problem for several reasons [1].

Preventive maintenance strategies

The goal of a preventive maintenance strategy is the replacement or re
components before a failure occurs. So far, this has been done either p
condition-based.

In **Periodic maintenance** the components are replaced periodically, regardless of the component condition, because the component condition is not inspectable or because the inspection effort is not worthwhile. Strictly speaking, periodic maintenance only makes sense in the wear phase, but in practice it is also used in the random failure phase.

Condition-based maintenance is based on the determination of wear conditions. These are assessed during an inspection and, if necessary, maintenance measures are initiated before any damage or failure occurs. One thing that should be emphasized at this point is that condition-based maintenance will be boosted by computer vision and machine learning, which alone will pay for the development effort.

Predictive Maintenance (PM) is an extension of the two aforementioned preventive maintenance strategies, in which probable failures are detected by condition monitoring sensors or / and by characteristic data patterns. PM in essence is data driven [2]. PM in combination with big data aims at random failures but looks at the wear failures as well. According to this claim, PM will integrate the two traditional maintenance strategies (I would not say replacement yet).

However, condition monitoring sensors cannot be used for of the fail-critical components inside thermal processing plants. We have to find indirect ways to collect condition data, such as Control Performance Monitoring. Otherwise we lack the basis.

What's new with PM: data and correlations

It is not without reason that the decisive difference is seen in the analysis of large amounts of data. PM is essentially about discovering data patterns and correlations we have not recognized so far (and therefore consider as coincidental).

But where does the data come from and what is the quality of the data for maintenance purposes? In the past, only production data was recorded. Production data however does not contain information about the wear status of components. The benefit of analysing production data for PM is therefore doubtful. It is therefore a question of which (possibly already existing) sensors, parameters and methods the wear conditions can be detected continuously. Without this data, PM is blind, so to speak.

analytics, machine learning and experienced data analysts need to build up big gains.

A critical success factor: Maintenance feedback

Last but not least, we have to correlate the data patterns with the real state of wear. We must also take into account the maintenance measures already carried out.

For both we need the feedback from the maintenance engineers. Computer vision, machine learning and system interfaces will help us with this. However, this feedback is and remains one of the very critical success factors.

So where do we stand?

PM presents us with a whole series of problems that can be summed up in an almost philosophical question: What cognitive possibilities are contained in the data? Or to put it more practically: Does the data collected allow reliable predictions of the remaining useful lifetime of critical components? For this, we must provide proof of the correlation between a data pattern and a state of wear. But this proof is far from existing.

Literature

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