ROTARY KILN ALIGNMANT IN DYNAMIC CONDITIONS

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ضبط الفرن الدوار أثناء التشغيل

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SUMMARY

The rotary kiln is the heart of every cement plant. Any failure of the kiln causes a standstill of the production process. Additionally, a kiln that was operated for years and had several repairs often behaves like a heart after an attack. It is therefore very essential for the kiln user to care about its mechanical and geometrical condition, which can be achieved by conscious and permanent diagnostics and by preventive measures.

الملخص

إن الفرن الدوار هو كالقلب بالنسبة لكل مصنع إسمنت ، وأي خلل في الفرن يسبب توقفاً لعملية الإنتاج . كما أن الفرن الذي يعمل لسنوات مع العديد من عمليات الإصلاح يعمل كالقلب بعد تعرضه لنوبة . لذلك فإنه من الضروري أن يهتم مستخدم الفرن بالحالة الميكانيكية والهندسية للفرن وذلك من خلال التحليل المستمر والواعي والإجراءات الوقائية . ومن المعروف لدى معظم مستخدمي الأفران أن الشرط الرئيسي للعمل الصحيح للفرن هو ضبطه والذي لا يعتبر إلا واحداً من المعايير الحساسة العديدة التي يجب مراقبتها . كما أن قياس ضبط الفرن بحد ذاته يمكن أن يتم بطرق مختلفة تقدمها عدة شركات التي يحدد اختيارها نوعية ومدى فعالية التحليل بالنسبة لمستخدم الفرن . يعتبر الرد على كيفية ضبط الفرن أثناء التشغيل دليلاً إلى ما يتوجب على مستخدم الفرن طلبه من الشركة المحللة بهدف ضمان أفضل موثوقية لعمل الفرن .

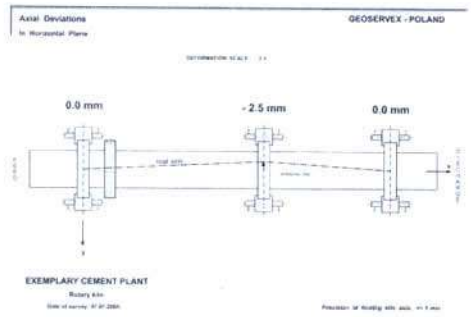
For the majority of kiln users it is obvious that the basic condition for the correct operation of a kiln is its alignment in support points. This is however only one from many critical parameters that should be monitored. Furthermore, the measurement of the kiln alignment itself may be carried out by different methods offered by various companies. The selection of the diagnostic company often decides the quality and complexity of the service, i.e. its usefulness for the kiln user. What does the term complex kiln alignment in dynamic conditions mean? The answer to that question is a simultaneous guidance for what the kiln user should demand from the diagnostic company for the purpose of assuring the highest reliability of its operation.

The issue of kiln alignment in dynamic conditions (during operation) was intensively discussed in magazines like ZKG, Rock Products and others some years ago and it is presently known that aligning a kiln during standstill does not give a true image of its geometry. The well-known method of measuring plastic shell de ections (SHELLTEST) does not provide sufficient information on the geometric condition of the kiln axis and does not make it possible to carry out efficient alignment. There are presently many known measurement methods that enable measuring a kiln

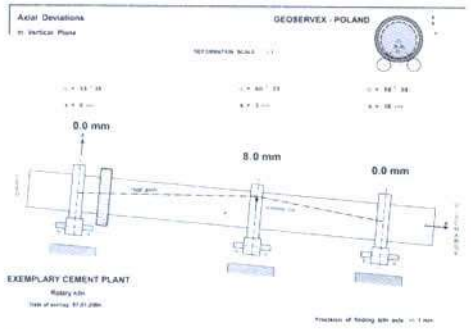
1. Measurement of kiln axis in horizontal plane

axis during its operation. These methods differ both in terms of methodology of measurements, as well as in terms of exactness and, most importantly, reliability of measurement (degree of confidence to the result). It is important for the kiln user that the measurement be performed in a complex manner, i.e. that it covers all geometric parameters having effect on the operation of the kiln, such as:

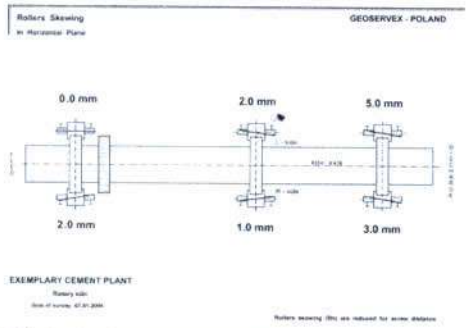
- kiln axis deviation in the horizontal and vertical plane;
- undertyre clearances
- operating angles
- kiln's slope



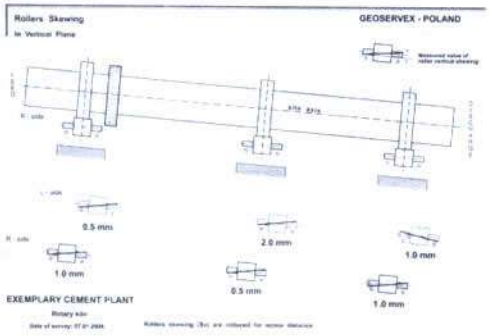
2. Kiln axis in horizontal plane (result)



3. Kiln axis in vertical plane (result)



4. Roller's skewing in horizontal plane



5. Roller's skewing in vertical plane (inclination deviation)

- roller's skewing in the horizontal plane
- roller's inclinations
- girth gear and pinion meshing
- tyre's and girth's gear wobbling
- roller shaft de ections

Furthermore, measurements should cover mechanical parameters, i.e. wear and tear of components, hydraulic system pressure, amperage of drive engines, analysis of vibrations as well as parameters connected with the production process, e.g. kiln shell temperature. All of the mentioned components apply only to classic kiln alignment and do not cover kiln shell deformation measurements that will be discussed in the next article.

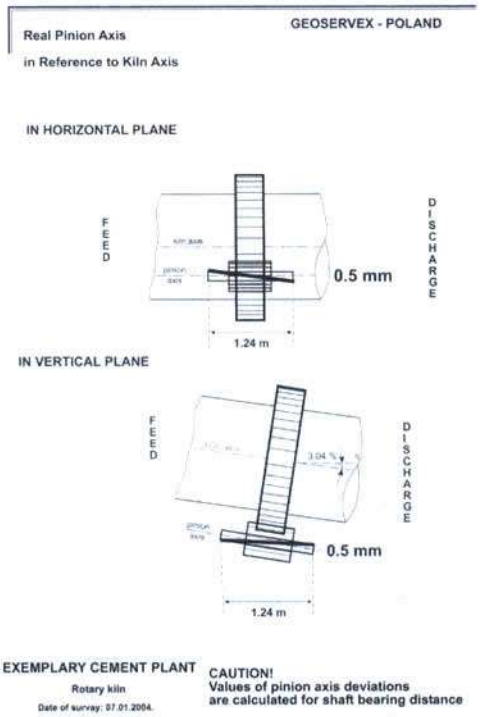
ACCURACY AND RELIABILITY

All measurements should be performed with utmost precision and the accuracy of measurement results should always be higher than the tolerance specified for the given parameter by the kiln's manufacturer. For example - kiln axis deviation, according to the guidelines of kiln manufacturers, should not exceed ±1.5mm, i.e. the accuracy of the measurement result should be of the order of 0.5mm – 1.0mm. One should note that in the case of measuring kiln axis deviation – the accuracy of the result is not the same as the accuracy of the reading on the measurement device or accuracy of setting the location of a single support point (axis point). The final accuracy of the result is determined by the precision of setting all intermediate axis points as well as by the precision of the measurement base alone. Some diagnostic companies suggest that the accuracy of determining kiln axis deviation is equivalent to the accuracy of setting a single axis point, which only reveals their lack of understanding the mechanism of measurement error transmission, which in consequence reduces the quality of their offered services.

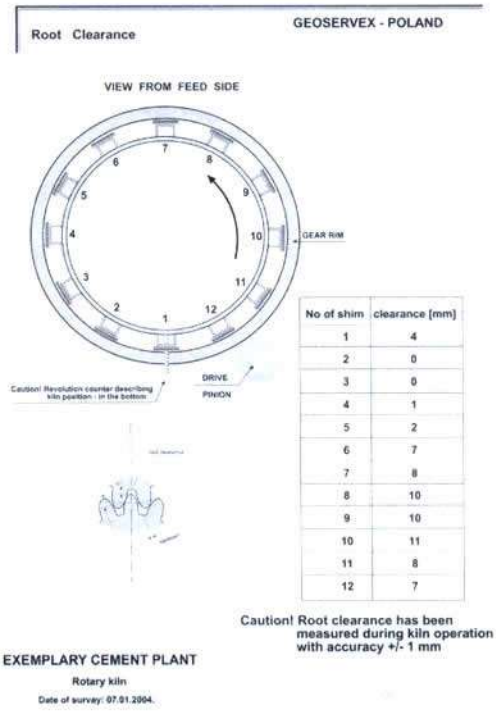
METHODOLOGY AND RELIABILITY

Measurement methodology has a significant impact on the reliability of measurement results. The majority of companies offering kiln alignment services carry out axis measurements by measuring the locations of its components, i.e. rollers and tyres or shell. In the opinion of the author, the most reliable methods are those examining mutual settings of tyres with simultaneously measuring undertyre clearances. A kiln axis measurement related directly to the shell near support points may provide satisfying results only in minor shell deformations.

There are, however, cases when shell deformations in the support zone reach a level of tens of millimetres (such cases are documented by the Research & Development Group of the company GEOSERVEX). In such case, achieving an accuracy of the order of



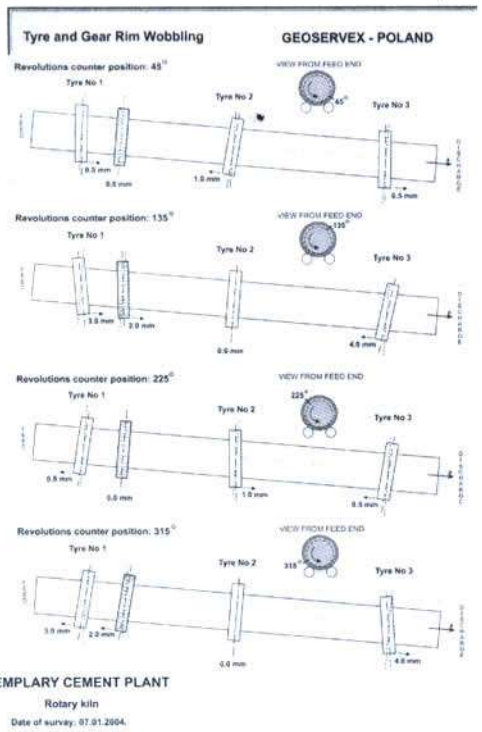
6. Drive pinion axis position



No of shim	clearance [mm]
1	4
2	0
3	0
4	1
5	2
6	7
7	8
8	10
9	10
10	11
11	8
12	7

8. Root clearance (meshing of a drive)

1.0 mm for the location of an axis intermediate point



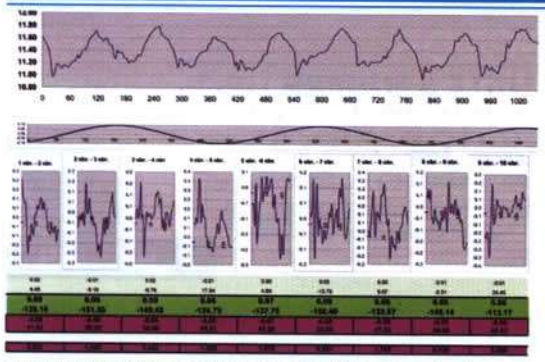
7. Tire and rear rim wobbling

seems impossible, even with applying sophisticated approximation methods. The reliability of these methods is for this reason significantly lower than in the case of the first mentioned group. Shell deformation measurements serve other purposes not directly connected with alignment. Furthermore, kiln axis adjustment is made on bearing (support) points and therefore the kiln axis measurement related to the kiln shell, remote from the support point, is a procedure evidently intermediate.

COMPLEXITY

The complexity of kiln alignment services is amongst others re ected by the scope of performed measurements. The author believes that the minimal, indispensable scope listed at the beginning of this publication is a certain standard that allows realizing the alignment process correctly. Measurements are only an information basis used for designing adjustment axes, the value and order of roller displacements as well as for adjusting the axial balance by the skilful adjustment of roller's skewing. Therefore, the term complex kiln alignment in dynamic conditions includes not only performing measurements, but also the capability to plan adjustments and supervision over their performance.

The kiln adjustment process for this machine is a substantial technological stress, which can manifest



9. Roller's shaft de ection (approximation procedure)

itself by the temperature rise of roller bearings, increase of drive amperage, etc.

It is very essential for the kiln user that these operations be carried out in the presence of specialists from a very experienced diagnostic company, who can provide their technical support when necessary.

However, this is not the point where the alignment process ends. After making the adjustment, the diagnostic company should control the parameters that were adjusted. This measure is on one hand a representation of the kiln's actual condition after adjustment, and, on the other hand, a quality verification of the service.

The control measurement will show if the design and realization of the adjustment have improved the kiln's geometric condition and in consequence, if an improvement in the operation of the machine can be expected. Therefore, in the opinion of the author – it is in the interest of the kiln user to request a complex service from the diagnostic company, taking into account the above mentioned comments.

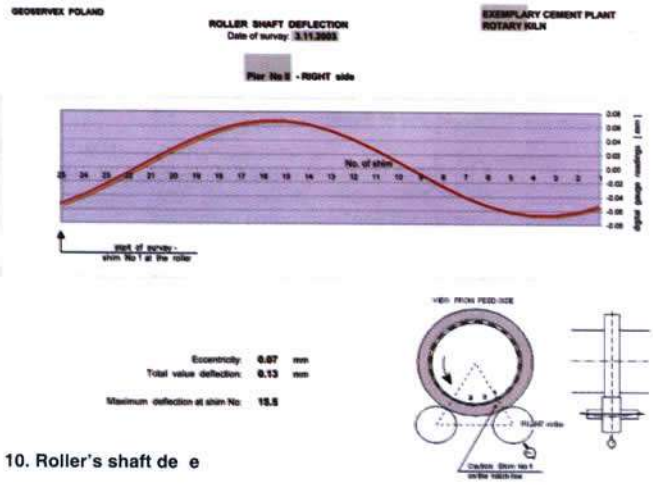
ADVANTAGES AND BENEFITS

The basic advantages of periodically carrying out kiln alignments in dynamic conditions are simply financial savings. Every standstill in the production process caused by the kiln's failure generates losses that are often several dozen-fold higher than the cost of complex alignment. If it is suspected that a failure standstill could be caused by irregularities in the kiln's geometric parameters, a complex alignment should be performed without delay. Through this operation it is possible to avoid the problem recurrence, increase the reliability of the machine's operation, and therewith reduce operating costs.

Over a longer period of time, savings are also achieved by slower wear and tear of kiln components, and sometimes allow preventing their devastation.

In many global cement concerns, the procedure of complex kiln alignment in dynamic conditions has been introduced as a compulsory standard for the purpose of reducing kiln maintenance costs. Also all kiln manufacturers recommend periodic geometric examinations. An additional advantage of carrying out complex kiln alignment is reducing stress of management responsible for kiln maintenance, when permanent, difficult to explain failures may be attributed to their reduced performance.

Besides measurements connected with alignment, shell deformation measurements are carried out for rotary kilns. These deformations exist between supports, not effecting the kiln alignment, but they may cause serious problems with its operation, including complete unfitness for production. The author will try to explain these problems and the way of solving them in the next issue of this quarterly magazine.



10. Roller's shaft de e