INFLUENCE OF THE WEAR OF THE TIRES, SUPPORT ROLLERS AND THE GEAR OF ROTARY KILNS ON THE WORK OF THE EQUIPMENT

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A rotary kiln is a very large and heavy piece of equipment and each deviation from the perfect alignment of the various elements causes expedited wear. This wear has significant influence on the operation of the entire equipment. The integrity of the surfaces is compromised, working temperatures and power consumption rise, breaking or shifting of the undertire plates and supports, ovality of the shell, fatigue effect of the weld seams of the undertire plates, etc. can be observed.

Key words: rotary kiln, wear.

TASK FORMULATION

A rotary kiln is a very large and heavy piece of equipment (fig.1). In the course of operation of a rotary kiln, the individual elements wear out. This changes their sizes, and therefore the alignment of the mounted equipment. The changed sizes have a great impact on the operation of the kiln. It is necessary to identify the types of wear and determine the impact that each type has on the equipment operation.

Fig.1

OUTLINE

The perfect alignment of a rotary kiln involves a number of components, of which the following will be examined:

- parallelness of the drum axes and the support rollers (fig. 2);
Influence of the wear of the tires, support rollers and the gear of rotary kilns on the work of the equipment

- perpendicularly of the axis of the axial roller to the drum axis (fig. 3);
- the vertical plane of the band tire must be perpendicular to the drum axis, i.e. no thrust load of the band tire (fig. 3).

In the course of the operation of the kiln, the above alignment is disrupted which results in wearing out of the elements, which in turn impacts the overall behavior of the equipment.

Concave and convex wearing out of the tires and support rollers (fig. 4).

When the tires and support rollers wear out along the contact surfaces, the original alignment is disrupted, and so is the parallelness of the axes. It becomes necessary to rotate the support rollers to regulate the axial motion of the kiln. As a result of the rotation of the rollers, there will be higher concentrations of the load on the edges of the tires on both sides of the frontal surface.
After the kiln has been operating for some time under such conditions, the band tire will quickly wear out along the edges and becomes convex in shape. Since the support rollers are wider than the band tire, the surface of the roller will wear out in concave shape.

The wearing out of the tires and support rollers will continue to require constant aligning of the rollers for the purpose of compensating for the material lost as a result of the wear and tear. Increasing the angle of rotation of the rollers will expedite the wearing out of the tires and support rollers and lead to the following mechanical complications:

- As the wear and tear continues, the contact surfaces of the tires and support rollers will decrease. As a result of that, the accumulating rotations of the bearing will increase proportionately to maintain the necessary motion of the kiln against the motion of the rollers;
- With the rotation of the kiln, the contact between the band tire and the roller hardens the thin metal layer of the contact surfaces. Since the roller rotates approximately three times for each turn of the band tire, the surface of the roller becomes harder than that of the band tire. The ratio between the hardness of the band tire and the roller is important because the strain in the metal along the edges of the tires and rollers will cause cracking and splitting of the surface. The situation is complicated by the kiln’s upward and downward motion under weather conditions such as temperature changes, rain, snow or dust. When the kiln moves up and down, the band tire enters into counter-action with the edges of the support rollers, increasing their load and leading to broken edges of the band tire and the support rollers (fig. 5);
- Another major problem with the wearing out is the possibility for high temperatures of the bearing and resulting problems. In the event that the surfaces of the band tire and the rollers wear to a degree when the band tire can no longer move freely up and down along the surface of the support rollers, band tire will make the rollers move in the direction of the axial motion of the kiln. The axis of the roller will counteract to the stop collar of the block bearing or the thrust plate of the block bearing and will result in high temperatures. If the staff do not react sufficiently quickly and do not align the motion of the kiln, the roller will overheat and malfunction;
- The wear of the surfaces of the tires and the support rollers will cause dragging (slowing of the motion), which will increase significantly the electrical power used (in Amperes). When evaluating the operation of the kiln over the years, a trend can be observed of disregarding the quantity of power used in the industry. This is a mistake because power consumption is directly linked with the efficiency of the kiln. The excessive wear of the tires and rollers will reduce the operational efficiency proportionately, which will again increase the power consumption. Kilns using 25% to 50% more power due to wearing of the tires and rollers are a common phenomenon. Moreover, the dragging caused by worn tires and rollers will cause wearing of the gear which will escalate the problems with the gear components.
Conical wear of tires and support rollers (fig. 6)

![Fig.6](image)

The conical wear of tires and support rollers occurs when the axes of the support rollers are not parallel to the columns. This leads to slanting of the axes of the rollers in the vertical plane and conical wear. Conical wear can cause:

- Since the diameter of the tire is smaller on one side, the load is not distributed regularly along the surface. As a result of this, the axis of the tire leans to the side with the bigger load. The support rollers and undertire plates counteract to the leaning of the tire. This counteraction increases their load and can lead to breaking or shifting of the undertire plates and supports;
- In case of loading on the tire on the one side of the surface as a result of the conical wear, the internal diameter of the tire will create a high load on the external diameter of the supports. This will cause great wear of the tires and supports and the opening between them will widen. With its widening the upper part of the shell will become increasingly flatter which will lead to ovality of the shell. This ovality is a critical moment of the maintenance due to its relation to the untimely malfunction of the fireproof materials or bricks. This opening is directly connected to the deformation of the tire. When the opening widens, the tire will shift the undertire plates and when the opening closes, the tire will free the undertire plates creating changeable pressure leading to fatigue effect of the weld seams of the undertire plates;
- The diameter of the contact surface between the tire and support rollers will vary by sizes due to the conical wear. The dragging caused will create areas of great pressure on the surface. Excessive dragging can cause cracking and splitting of the surface, as well as increased power consumption.

Scars resembling stripes (fig.7).

![Fig.7](image)
Sometimes scars resembling stripes can be observed along the surface of the rolling planes. They result from poor alignment of the gear ring and pinion gear. This leads to *increased vibrations* whereby the cycles escalate and reflect on the other support stations. The resulting impacts lead to mechanical malfunctions.

*Breaking bits (fig. 8).*

Bits can break off when the contact between the rolling surfaces is reduced to a point and the contact pressure exceeds the limit of the material’s elasticity. The material begins to peel off in small pieces or it hardens, cracks and separates into bigger bits.

**CONCLUSION**

It can be concluded from all of the above that the staff responsible for kiln maintenance should strictly ensure that the original alignment of the equipment is observed, because all changes in the alignment can lead to expedited wear of the elements and poor operation.

**BIBLIOGRAPHY**