Kiln Shell Ovality Measurement

Ovality is the measurement of shell deformation during the course of kiln rotation. Ovality readings are taken at each pier with an ovality meter. The device consists of a 40” beam with magnetic legs at both ends. It is attached to the shell near the tires. There is a spring-loaded pin in the center of the beam. This pin touches the shell and moves as the shell bends between the two rigid magnetic legs. The movement of the pin is amplified and recorded on a circular chart (see sample chart). The difference between the maximum and minimum pin positions in the course of a kiln rotation is a measure of the shell ovality. If the ovality at any pier exceeds empirically determined limits, corrective action is required. Shell ovality measurement is the only accurate predictor of refractory life.

Ovality measurements make it possible to change the pier load distribution in a manner that minimizes shell flexing at each pier. If the ovality at one pier is higher than at the adjacent piers, the support rollers can be moved to shift load to the low ovality piers. This is typically necessary near the burning zone, where the pier loading is high due to heavy coating and relative shell and tire thermal expansion. The shell is hot at the burning zone and is thus more likely to bend under a given load.

Ovality measurements indicate if one support roller on a pier is carrying a greater load than the other, in effect showing if the kiln has a lateral misalignment. The chart deflection corresponding to a roller carrying the higher load is greater than the deflection corresponding to the other roller. This is an important independent and qualitative verification of any misalignment found via laser survey procedures.

In addition, ovality measurements enable a kiln engineer to assess the effect of shell runout on dynamic pier loading. Damaged kiln shell affects measured shell ovality only if a dogleg spans three or more piers. A given dogleg condition will cause cyclic loading on the pier(s) within the span of a dogleg, which can easily be seen on an ovality chart.

One or more of five variables may cause high shell ovality.

1) The tire elevation may be too high, causing a high shear load on the shell where the shell is supported by the tire. The required action is lowering the tire by moving the support rollers away from the kiln axis.

2) The tire support pads may be worn. A loose tire cannot provide the structural support necessary to maintain a circular shell cross section. The required action is to replace or shim the tire support pads. On kilns without support pads, the shell will wear directly and consequently require replacement when tire clearance is excessive.

3) Heavy coating or high chain density may result in a higher than intended pier load. The shear load on the shell may thus be high, causing high ovality.

4) The tire may not be massive enough to provide the support necessary to maintain a circular shell cross section.

5) A shell dogleg spanning three or more piers will cause variable pier loading. Generally, dogleg conditions require repair only when they adversely affect ovality, tire/roller surfaces (wobble effects), radial gear alignment and hood seal performance.
Example Ovality Chart Analysis

PIER NO: 3 (UPHILL OF TIRE)
TIRE CREEP: 1-1/4"

DEFLECTION PERCENT OVALITY

<table>
<thead>
<tr>
<th>POSITION</th>
<th>DEFLECTION</th>
<th>PERCENT OVALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10.0 MM</td>
<td>0.54%</td>
</tr>
<tr>
<td>2</td>
<td>13.0 MM</td>
<td>0.71%</td>
</tr>
<tr>
<td>3</td>
<td>11.0 MM</td>
<td>0.60%</td>
</tr>
</tbody>
</table>

NOTE: 1. GRAPHS ARE NOT CONCENTRIC, INDICATING A LOAD VARIATION ON THE PIER AS THE KILN ROTATES. THE ROLLER SHAFT DEFLECTIONS NEED TO BE MEASURED.

2. FLAT LINES ON GRAPHS AT THE LEFT SUPPORT ROLLER POSITION OF GRAPHS 1 AND 2 INDICATE HIGH LOAD. BOTH ROLLERS NEED TO MOVE TO THE LEFT.

3. THE OVALITY IS EXCESSIVE BECAUSE OF HIGH TIRE CLEARANCE. THE SUPPORT PADS HAVE TO BE REPLACED.