Myths Concerning Shell Profile Analysis

NAK Instruction No 136
Revised December 2007

Numerous companies in the kiln repair industry charge a significant fee for Shell Profile Analysis reports, and use the reports to recommend the replacement of what is often perfectly good kiln shell. Such shell replacement recommendations are without technical merit. Shell profile analysis provides no useful information regarding the mechanical status of kilns because the theory behind it is fundamentally flawed. The procedure yields shell runout data, without quantifying the degree to which the runouts are dampened by often significant changes in shell stress distribution as a kiln rotates.

The load fluctuation on a dogleg affected pier often exceeds 500 tons. At the point of minimum pier load, gravity pulls the shell down and lowers the elevation to which the tire would otherwise rise. At the point of maximum pier load, vertical reaction from the pier keeps the tire from going as low as it otherwise would. Load variations on the support rollers likewise limit the lateral movement of the tire. The net effect of the high pier load variation is to dampen the radial shell runout that the Shell Profile Analysis mystic is measuring. Because of this dampening effect, radial runout measurements near a tire are always near zero. But a near zero measurement is not necessarily indicative of the absence of serious problems. Shell stress fluctuations caused by gravity and pier reaction mask what may otherwise be a very high runout.

Consider a perfect kiln perfectly installed. A shell profile analysis would indicate zero radial runout over the length of the kiln, and correctly conclude that the kiln is free of doglegs. If you cut such a kiln close to a tire and open that cut at the top of the shell, the tire will eventually come off the support rollers. Now close the cut until the tire touches the support rollers, but does not put any weight on them. The kiln would be mechanically unstable because of a substantial pier load distribution discrepancy; but a shell profile analysis would still indicate zero radial runout over the length of the kiln. The load distribution problem would be masked (as far as shell profile analysis is concerned) by significant shell stress fluctuations in the course of kiln rotation; but a major problem would definitely be there. (Note: zero tire clearance is assumed for the purpose of this thought experiment).

Next, consider a kiln having seriously deformed shell with high pier load variations. A shell profile analysis would produce a distinctive profile for the shell. If the pier load variations are then corrected with alignment cuts ***close to tires***, the effects of the doglegs would be eliminated, but the shell profile would not change. (This is because if a shell alignment cut is close to an effected tire, a significant pier load change can be achieved without radial movement of the shell at the cut). The shell would have identical radial runout profiles before and after the correction cuts are made, but the before and after shell stress distributions would be radically different.

Shell replacement is never necessary to correct doglegs. A dogleg is not caused by defective shell; it is caused by the misalignment (relative to the kiln rotating axis) of perfectly good shell. NAK has demonstrated at numerous plants that cutting the shell and realigning it eliminates dogleg conditions without the need to replace the shell.

Using correction cuts instead of shell replacement for the purpose of correcting doglegs offers significant cost benefits:

1. The cost of shell is eliminated.
2. Brick removal is limited to less than four feet per correction cut.
3. The cost of a crane is eliminated.
4. Because only one or two cuts are required for correction purposes, and each cut spans only 300 degrees of shell, downtime is cut by 75%.

The proper way to guarantee kiln shell stability is to measure and correct pier load variations in the course of kiln rotation, and not pay any attention to shell radial runout. If the load variations are eliminated with correction cuts, the kiln will be stable. Arguably, there may be a shell radial runout between piers, but this condition would not affect kiln stability. And if no one measures such a runout, nobody will know the runout is there because the kiln would run without adverse symptoms that would attract attention.

Incidentally, every time a shell section is replaced, the pier load variation has to be measured at the pier adjacent to the new shell. Adjustments have to be made until the pier load is constant as the kiln rotates. Centering shell joints is the commonly accepted means of aligning new shell sections prior to welding. This procedure is seriously flawed because it often causes a dogleg condition. When joints are adjusted to eliminate doglegs (or tire axial runouts for that matter), one of the consequences is shell radial runout at the joints. In other words, the joints need to be pulled off center to eliminate doglegs, contrary to the very common misconception that the joints should be centered. Radial runout at joints will not affect shell stability, whereas pier load variations will.

Proper kiln maintenance requires in depth knowledge of the variables affecting kiln stability. If the above information is something you have not seen before, your kiln service provider does not have the expertise you require. Contact NAK for state of the art solutions to all kiln related problems. NAK is your best source for technical information that makes sense.

Phone: (770) 831-8229 (800) 331-KILN Fax: (770) 831-3357