DRY KILN VIBRATION PROBLEMS

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Four Main Causes and Their Detection Tips

We normally have two types of dry kiln blower systems.

1. Line shaft blowers, which have long drive shafts with fans attached that have couplings, drive sheaves, belts, and pillow block bearings throughout. These drive shaft systems reverse airflow by reversing the rotation of the fan assemblies, and typically rotate at 600 to 800 rpm.

2. Cross shaft or zone blowers have independent motor blowers driven by separate motors on each fan, and speed is controlled by a variable frequency drive (VFD).

The vibration analyst has to look for primary vibration problems at their source. Most problems in kilns are broken down to the following categories.

1. Unbalance
2. Misalignment
3. Mechanical looseness
4. Bearing failure - both sleeve and anti-friction bearings.

The problems vibration can cause, fall into four categories I have indexed above. All four are heavy contributors to the overall vibration in the kiln. Let's look at each problem.

Unbalance

Every rotating element has some unbalance, manufacturers set standards that are reasonable and economical to attain. The primary source of unbalance vibration is the fan assembly. Most manufacturers balance the hub assembly dynamically, that means balanced by spinning or running the assembly and correcting the imbalance by either taking weight off or adding weight to make the mass center rotate around its shaft center. The fan blades are then static balanced, which means they are typically weight matched, to a master blade. These blades are then assembled on the blower motor hub, on site in the kiln. There is some chance of misassembly, and faulty blade pitching at this stage. Most problems of this nature can be detected by a simple vibration meter or analyzer as to check for high imbalance. We recommend checking each bearing point for high vibration on install and several times throughout the year to insure dependability.

If a unit is retrofitted to your existing kiln, be aware of assembly faults, freight damage, and pay attention to manufacturer's instructions on blade angle, and position of the shaft to hub fits. These seem relatively unimportant in the assembly, but in reality are keys to your continued smooth operating efficiency.

Simple vibration meters can measure most vibration in kilns. A typical meter would read displacement (in mils) which is 0.001 inches peak to peak movement. Velocity, which is inches per second (IPS) and g's or bearing g's commonly known as spike energy.

A typical meter should cost less than $1,500.00 with some training included. Another way to keep vibration levels monitored would be with hard-wired vibration sensors mounted on your motors with a meter in the control room. You may then use set points to warn you, or shut down the system if high vibrations are present. These usually run approximately $150.00 per point with a brain box costing approximately $1,500.00. Remember there is more than one reason we have vibration. While the most prevalent problems in a kiln are balance problems, the other problems can and will damage your equipment. They are just as dangerous as high imbalance.

Alignment

This is particularly important on line shaft kiln systems as they have many bearings on a common shaft. On the original start up the contractor aligns all bearing to shaft fits. It's only after crashes, heat distortion, settling of the building, and normal wear and tear do we see alignment problems. We usually find them by checking the bearing housings taking an axial reading on the bearing. Finding the amplitude high or higher than the radial vibration is a cause for concern.

Mechanical Looseness

The mechanical looseness in the system is caused by heat deterioration of the sub structure, poor bearing fits, hub to shaft looseness, and the foundation deterioration of the primary base, the vibration may be caused by cracked, warped pedestals, holddown bolts gone, welds broken etc.

Your kiln was originally designed to hold 100's of horsepower to mother earth. If you put any looseness into the equation, you will not be happy with the results. We again find these problems by zoning your bearing housings and comparing the horizontal, vertical, and axial amplitudes. Your vibration levels are always higher perpendicular to its base, then second highest at the base direction, and at it's lowest level axial or parallel to the shaft. If these amplitudes are high, you are in for premature failure.

Bearings

Most systems use anti friction bearings. Years ago we used sleeve or brass bearings, but as the technology has reverted to ball bearings, our problem solving is indexed to the antifriction ball bearing. We definitely have to use an analyzer or spike energy type of vibration instrument for the following reasons: The ball bearing has several components, the balls (usually 10), an inner race, an outer race, and a cage, to contain the balls. As a bearing faults, we see a velocity level over .15 inches per second, which in itself is not a high vibration, but we also have to see a high frequency associated with it. Typically 10 times the rpm as a starter frequency with up to 30 times the primary rpm is a typical frequency. We would find the vibration over 6,000 to 10,000 cycles per minute as a problem. We can see this with a vibration analyzer that displays amplitude and frequency or a spike energy meter as it looks only at amplitudes above 10,000 cycles per minute. These instruments are readily available and inexpensive.

I have covered the most prevalent problems in the typical kiln. There are another nine possible vibration anomalies, they do occur, but at a very low occurrence level. I have given hand outs on vibration levels, and possible causes for excessive levels. All amplitudes are indexed by frequencies they occur at. Most vibration analysts can index these causes. Again vibration usually starts with imbalance, it then causes high wear of key components, which will cause catastrophic events to unfold.

An adage to remember, vibration is to equipment as blood pressure is to a human being. It may not get you today, but surely it will deteriorate components tomorrow.

TABLE 1. Vibration identification guide.

Cause	Relative Frequency to Machine RPM	Phase-Strobe Picture	Amplitude	Notes
Unbalance	1 x rpm	single, steady reference mark	radical steady proportional to unbalance	common cause of vibration
defective anti-friction bearing	10 to 100 x rpm	unstable	measure velocity 0.2 to 1.0 in/sec radial	velocity largest at defective bearing as failure approaches velocity signal will increase, frequency will decrease
sleeve bearing	1 x rpm	single reference mark	not large	shaft and bearing amplitude about the same
misalignment coupling or bearing	2 x rpm sometimes 1 or 3 rpm	usually 2 steady reference marks sometimes 1 or 3	high axial	axial vibration can be twice radial; use dial indicator as check
bent shaft	1 or 2 x rpm	1 or 2	high axial	
defective gears	high rpm x gear teeth	–	radial	use velocity measurement
mechanical looseness	1 or 2 x rpm	1 or 2	proportional to looseness	radial vibrational largest t in direction of looseness
defective belt	belt rpm x 1 or 2		erratic	strobe light will freeze belt
electrical	power line frequency x 1 or 2 (3600 or 7200 rpm)	1 or 2 rotating marks	usually low	vibration stops instantly when power is turned off
oil whip	less than rpm	unstable	radial-unsteady	frequency may be as low as half rpm
aerodynamic	1 x rpm or number of blades on fan x rpm	–	–	may cause trouble in case of resonance
best frequency	1 x rpm	rotates at best rate	variable at best rate`	caused by two machines running at close rpm
resonance	specific criticals	single reference mark	high	phase will change with speed; amplitude will decrease above and below resonant speed; resonance can be removed from operative range by stiffening.

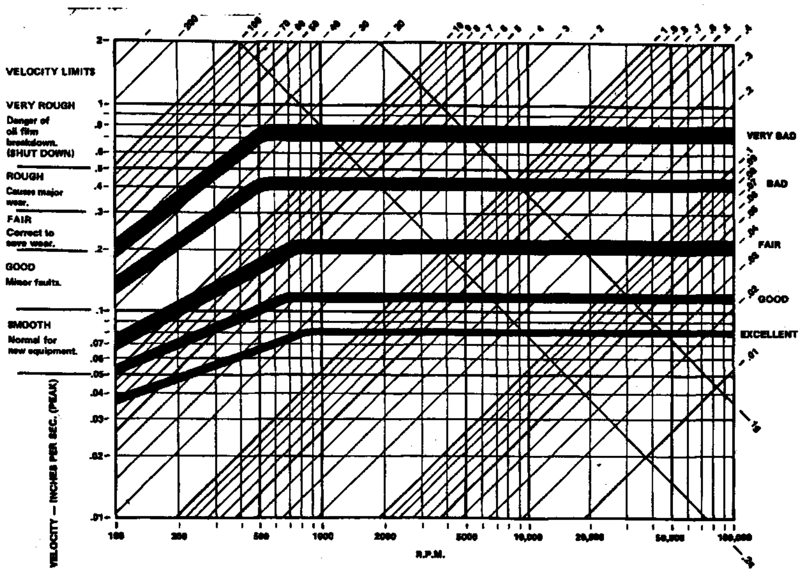

FIGURE 1. Chart showing severity of vibration