Some questions and answers of CEMENT ROTARY KILN

1.What is the maximum continuous shell temperature a rotary kiln stands without permanent damage to the shell?

The maximum recommended rotary kiln shell temperature varies by plant, by country and by rotary kiln manufacturer, despite the fact that most rotary kiln shells are made of low alloy carbon steel. Age of the rotary kiln shell, distance between the tires, and structure of the shell are some important points should be considered before deciding what the maximum allowable temperature for a rotary kiln is. Let us explain these points briefly:

1. Age and condition of the rotary kiln shell: Old kilns shells have been exposed to creep for a long time and are more prone to develop fatigue cracks than newer shells.

2. Distance between tires: The longer the rotary kiln shell span, the less it will resist high temperatures without sagging. Therefore, longer spans have more tendencies to develop permanent deformation than shorter spans.

3. Kiln shell structure: Kiln shells are made with structural rolled steel plate, such as A.S.T.M. A36. The tensile strength of this type of steel at room temperature is 50,000 to 80,000 psi. As stated before shell strength is measured at a room temperature. Figure-1 is showing how shell strength drops considerably as its temperature is raised. It is interesting to notice that there is a gain in strength between room temperature and 200 °C, followed by a sharp loss in strength as the temperature goes up. At 430 °C the ultimate strength of the steel drops from 75,000 psi to 50,000 psi (a hefty 33%) loss. Some investigators report a 50% strength loss for the same temperature range.

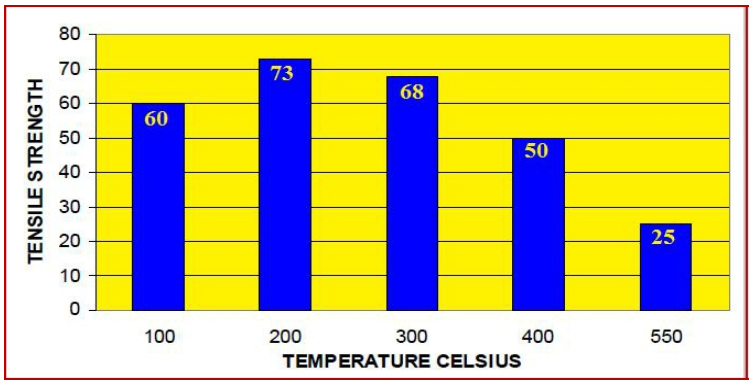

Figure-1: rotary Kiln shell strength as temperature raise

2: What is the difference between rotary kiln shell hot spot & red spot?

Hot spot is isolated area on the rotary kiln shell with abnormally high temperature. It is quickly detected by a shell scanner or with a portable infra-red pyrometer. It can't be seen during the day, and can hardly be seen at night (figure-2). Therefore, based on the visible radiation spectrum for hot surfaces, their maximum temperature must be below 550°C.

Red spot (figure-3) differ from hot spot in that it is visible at night. While a hot spot is just a warning, a red spot always demands some kind of action from the kiln operator.

Figure-2: Hot spot with a temperature of 570°C

Figure-3: Red spot with 830°C temperature

3: What is the maximum red spot temperature on the rotary kiln shell force kiln to stop?

The short answer is 550ºC if the spot is permanent and persistent. This is a short answer, but when we talk about red spot, damaging of shell, long kiln stoppage, and losing millions of Riyals or Dollars; this answer cannot be

acceptable. A number of factors are absolutely necessary to be considered in any red spot before taking the decision of kiln stoppage:

1. Proximity of the red spot to the tires or gear: Red spots near tires and bull gears require immediate action. These spots almost invariably force the kiln down. Shutdown procedure must start immediately to avoid damaging the kiln shell.
2. Extension of the red spot: The longer the circumferential extension of the red spot, the greater the risk of shell permanent deformation or collapse. If there is any persistent red spot covering more than 10% of the kiln circumference (figure-4); Kiln should stop immediately.
3. Kiln alignment conditions: Misaligned kilns induce localized stresses along the kiln length. If the red spot coincides with an area of stress concentration, the shell sometimes elongates or twists beyond recovery.
4. Whether the red spot is exposed or under roof: If the kiln shell is directly exposed to the elements and a heavy rainstorm hits the red spot, the shell may develop cracks under sudden quenching. Sometimes the brick results severely crushed in the red spot area.
5. The presence of shell cracks in the vicinity of the spot: The presence of cracks in the vicinity of the hot spot calls for an immediate kiln shutdown to avoid shell splitting.

Figure-4: Circumference red spot

4: What is "Oxygen Enrichment Technology"?

It is an oxygen injection system connects to kiln burner or precalciner burner to enhance the combustion of the fuel. In general, the use of oxygen enriched combustion air in the clinker burning process allows an increase of the energy efficiency, production capacity or substitution of fossil fuels by low calorific value or (secondary) fuels and that way the specific CO_2 emissions can be reduced.

By the use of additional oxygen the nitrogen fraction of the combustion gas is decreased, which has to be heated up in the case of combustion with ambient air. Therefore the adiabatic flame temperature rises and the flame becomes shorter and brighter. The measure is limited by increasing damages of the rotary kiln refractory and higher NO_X emissions due to increasing thermal NO_X formation in the sintering zone. In practice the application of the oxygen enrichment is still at an early stage, meaning that the technology contains potential for further optimization with respect to NOx emission reduction. Due to reduced secondary air flow the heat recuperation in the clinker cooler might be affected for example with a higher secondary air temperature as well.

The oxygen enrichment technology is established in some cement plants in order to improve production capacity. An increase of 25% to 50% (short term experiments) rotary kiln capacity by oxygen enrichment to 30-35 vol.% in the combustion air has been reported. Oxygen enrichment has not been applied to reduce CO_2 emissions so far. But the use of enriched combustion air may result in fuel savings and thereby avoids CO_2 production. The decision for a dedicated oxygen supply system (on-site/off-site) depends on the specific need of the cement plant. Oxygen production itself leads to comparatively high additional power consumption.

Surely; there are a number of plants using oxygen enrichment technique but still not commercially due to its high cost. If market demand exists with good prices for cement then oxygen enrichment can be a good option. Table-1 shows a number of rotary kilns in the USA using oxygen enrichment of either the main burner or the precalciner.

Company	Type	Base Production (tpd)	New Production (tpd)	% Increase
A	Precalciner	1,300	1,490	15
B	Precalciner	4,000	4,360	9
C	Wet	550	660	20
D	Wet	850	920	8
E	Precalciner	3,800	5,000	32
F	Precalciner	2,000	2,140	7

Table-1