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# Energy Retrofits and the Cement Industry

Change seems to always be a part of the modern day business lexicon. One thing that does not change is the desire to become more efficient in what we do. Plants have to do more with less, and management teams are always looking for ways to increase profitability by becoming more efficient. As demand for power and efficiency increases, existing cement facilities must continue to operate while being mindful of environmental and financial constraints. Existing plants have been operating at higher and higher capacity factors to facilitate this trend for years. In addition, many old kiln systems and fans are operating at conditions for which they were not originally designed. There are myriad technical, economic, political, and environmental issues that must be considered when retrofitting an existing fan.
A quick look into our energy expenditures reveals that fans constitute a significant portion of our energy bill.

Many plants have invested substantial capital to improve plant efficiency, lower emissions, increase output, switching to lower cost fuel, or increasing reliability and availability. Retrofitting fans for improved performance has been a recognized practice for decades. The fans must be studied to discover the potential retrofit solutions.

Many facilities are undergoing such a retrofit process. Some facilities are under legislative pressure by federal or state governments to reduce the amount of kilowatts consumed. Fans are the number two consumer of plant power, large inefficient fans are targeted as potential efficiency projects. Other plants are under pressure to reduce yearly maintenance cost. The number one issue during scheduled outages is the erosion on the impeller and in the housing. The yearly expenditures in power consumption, and yearly maintenance cost should prompt a business review and payback calculation for retrofit fan project.

According to the *U.S. Industrial Electric Motor Systems Market Opportunities Assessment*[1], the cement industry uses $2.2MM per plant in motor energy. That translates to 9.6% of the plant's operating budget. The existing energy retrofit potential is $219,000 per facility. Cement fans are notoriously inefficient. Most plants were built with older fan technology that employs less than optimal blade geometry.

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## Technical solutions – Kiln Induced Draft (ID) Fans

Kiln ID fans are typically inefficient, meaning they consume an unnecessary amount of energy for the work performed. They also require a disproportionate amount of annual maintenance. When retrofitting the existing fans, compromises are required between ideal designs and existing physical constraints. In a retrofit situation, the existing envelope limits the space available for new equipment.

Constraints:

- Bearing centers/size
- Centerline heights
- Fan housing cutoffs
- Inlet/outlet area duct sizing and configuration
- Motor rpm
- Motor $WR^2$

An important factor to ensure long term reliability of a retrofit fan impeller is to eliminate problem areas, while considering current and projected future operations. Fans should be designed to optimize both maintenance and operational issues.

Factors to optimize are:

- Air volume (acfm)
- Static Pressure
- Vibration
- Bearing life
- Blade erosion
- Fan system efficiency

## Retrofit Solutions

Many kiln ID fans are radial tipped (RT) designed that were engineered in the late 1970's. Lime particulate is normally abrasive and can sometimes adhere to the fan blades causing excessive vibration, and resulting in unplanned outages. Many installed rotors are oversized, and operate at a damper setting of 45% open. Normal operating conditions should range 70-90% open. The first step is to conduct an AMCA 203 field fan performance test to determine the actual operating conditions and to determine the efficiency of the system. Fan system/static efficiency is the ability of the fan to create volume and pressure for a given unit of energy. This is stated mathematically as:

$$Fan\ Static\ Efficiency = \frac{(ACFM\ x\ Static\ Pressure)}{(6263\ x\ horsepower)}$$

Kiln ID fans should average a static efficiency above 75% percent.

| Annual Energy Costs | Existing System | New System @ 75% Fan Efficiency |
|---|---|---|
| Hours in Operation: | 8,298 | 8,298 |
| Fan Energy Usage, Megawatt Hrs/Yr: | 23,787 | 16,512 |
| HP per inch of Pressure Loss: | 77.8 | 54.0 |
| Cost per Inch of Pressure Loss: | $25,469 | $17,679 |
| **Annual Operating Cost of Fan** | **$1,253,586** | **$870,202** |

**Reduced Megawatt Hrs/Yr = 7,275**

**Annual Energy Savings = $383,384**