Raw mill fan optimisation

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Following the results from a plant-wide energy audit, one North American cement works set about to explore options to improve the energy consumption of its raw mill fan. In a project that spanned almost two years, the cement producer saw a new raw mill fan rotor retrofitted to its original casing to increase the fan's efficiency.

The existing fan at the North American cement plant was pulling over 6500hp with a design static efficiency of around 70.6 per cent. A closer look determined that energy savings could be achieved by installing a new, higher-efficiency fan rotor in the existing casing.

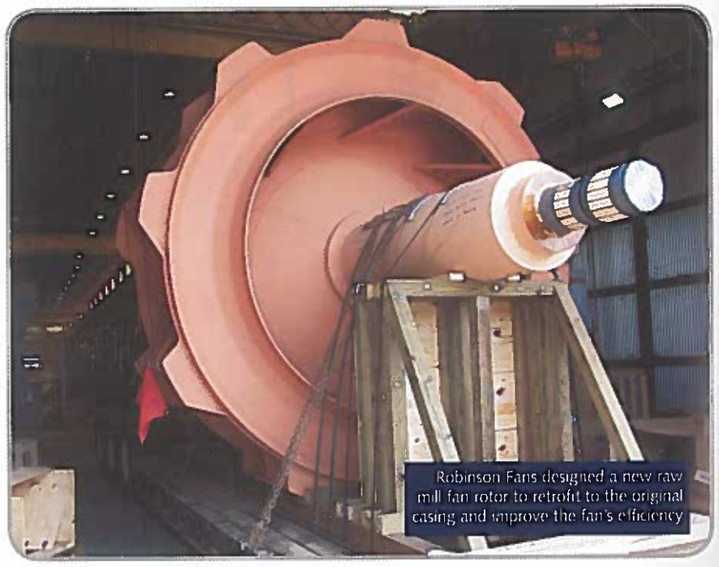
Project implementation

In the development phase of the new rotor, Robinson Fans was diligent in carrying out the necessary preparation and research to ensure a successful implementation. Completing a baseline test of the fan in the field was crucial to the success of the project. By conducting an AMCA 203-90 Field Performance Test, the fan specialist was able to understand how the fan was currently operating and focus the design to meet the customer's true needs. This provided an understanding of how the fan was actually performing as opposed to how it was thought to be performing.

Robinson opted to use a combination of historical data, computer modelling and working knowledge of its fan designs to engineer the retrofit. This approach allowed the design team to devise an acceptable solution, while avoiding physical model testing, ultimately saving time and money.

In a concerted effort to keep costs at a minimum in achieving the efficiency goal without jeopardising the quality of the project, Robinson adjusted the rotor design. The retrofitted rotor was designed to allow reuse of the original fan foundation, bearing pedestals, bearings and shaft.

The lifecycle of the entire project spanned nearly two years, with initial conversations taking place in July 2012. The first air performance test of the existing fan was completed in August 2012 and the design collaboration and iterations were completed by the end of December. The raw mill retrofit order was received in March 2013 and the fan shipped in August 2013. After installation, the final field air performance test was administered in January 2014.



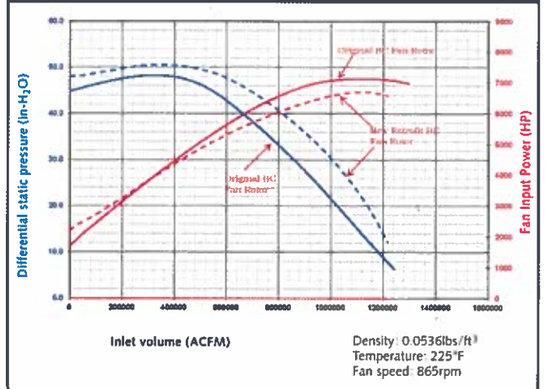
Robinson Fans designed a new raw mill fan rotor to retrofit to the original casing and improve the fan's efficiency

Increasing fan efficiency

The benefits of the rotor upgrade were apparent immediately after the installation of the new fan. Increased efficiency was recognised at a 9.7 percentage point improvement in fan efficiency (see Figure 1). The actual replacement rotor outperformed the projected system performance, causing the fan to operate in a dampered condition. This led to an in-place de-tipping of the fan rotor by Robinson, allowing for even more horsepower savings. Robinson Fans was able to lower the horsepower by around 300hp. At an estimated US$500/hp, this means a total annual saving of around US$150,000, according to the equipment manufacturer.

The new fan rotor ready for shipment

Figure 1: increasing fan efficiency to improve energy consumption of the raw mill fan



Lower throat velocity, less erosion

Optimising the energy output through the reduction of horsepower was the key goal of the project, Robinson was also able to minimise the throat velocity of the fan to help address erosion. Like most plants, the raw mill system had dust collection equipment installed upstream of the fan inlet boxes that filtered as much dust as possible prior to air entering the fan. However, the greater the amount of dust that infiltrates the airstream, the higher the erosion on the fan rotor.

In all raw mill systems, dust loading is always a significant concern in the design of the system. This concern is further complicated by the presence of quartz and the abrasiveness of other raw materials in the raw mill feed. In this aggressive area of the plant, it is common to wear out the protective fan wheel liners, and in some occasions, the base fan wheel material.

However, the amount and type of particulate is only part of the equation. The velocity of the particles as they enter the fan plays a considerable part in how fast the fan components wear. It was during the design phase that Robinson's engineering group paid special attention to throat velocity of the new rotor. This is the only part of the equation that they had control over. The final rotor design included a larger inlet throat diameter, resulting in a 35 per cent reduction in throat velocities.

Conclusion

While a lengthy and detail-oriented project, upgrading the raw mill fan with a new rotor was the appropriate solution for this cement plant. A final air performance test showed that the fan was performing better than expected and called for de-tipping to maximise the horsepower savings. The immediate result of the implementation proved that the goal of increased efficiency was met.