Key challenges for cement fans

Industrial fans in cement plants play a key role in the cement production process and hold huge opportunities in reducing the overall energy consumption of the whole plant. Fan specialists Pollrich discuss the main challenges and potential for industrial fans, particularly in the crude gas areas.

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Typically, cement is primarily made from limestone, shale or clay and a few other ingredients. Processing cement from raw mill to clinker production and then further to storage and dispatch facilities is a very demanding process for all equipment components, particularly for industrial fans and blowers. Furthermore, rising output of new and finer cement types, and production process enhancements leads to increasing wear.

The harsh environment presents a constant strain on all components of the industrial fan, especially in the crude gas area. Therefore, the focus in these cases lies on wear protection and prevention of caking. Meanwhile, in clean gas areas, various other fans are used, such as induced-draught (ID) fans, secondary air fans or fans for dedusting and cooling. These have different requirements, including temperature resistance, explosion protection and a gas-proof design.

Main fans in cement production

Raw material is dried in the raw mill using kiln exhaust air. To preheat the material, hot air (~450 °C/842 °F) is supplied by kiln exhaust fans from the kiln to the raw mill area. These fans have to withstand high temperatures and various gas mixtures. Raw mill fans then transport the raw meal to the filter and homogenisation systems. Here, the key is the prevention of build-ups due to the sticky media but also on wear protection. Following preheating, the meal enters the kiln, where the gas temperature rises up to 1093 °C (2000 °F). The hot air is supplied as preheated secondary air from the clinker cooler. When the raw meal leaves the kiln as clinker, cooling fans have to deal with the highly-abrasive clinker material in different particle sizes and hence, wear projection is important. Downstream of the cooling section, the clinker temperature drops to 27-93 °C (80-200 °F).
After the milling process, sifter fans transport the finished cement to storage and dispatch. Filter fans, exhaust fans and dedusting fans transport the dust-laden air from filter to stack or to downstream exhaust air cleaning systems. In all of these processes, there is a constant strain on all fan components, as a result of build-ups and/or wear from media. Due to the high demands placed on all components, but especially on the impellers, these fans have to be expertly designed for the specific process to ensure longevity and reliability.

In addition, their energy consumption plays an important role in fan construction. Heavy-duty solids handling High dust loads and dry, sticky media are the main challenges for raw mill fans. Many operational issues are caused by imbalances due to stickiness or wear from dust (see Figure 2). The result is bearing failure on fans and drives as well as severe vibration, which can lead to weaknesses in the entire construction, including the foundation. A further outcome can be a decline in performance or major damage and sometimes, even a total shutdown is inevitable. Therefore, it is advisable to have a knowledgeable partner with longstanding experience in fan construction, especially for the high demands of the cement production process.

To meet these requirements, German fan specialists Pollrich focus not only on wear protection but also on torsion-resistant substructures. Only a well-synchronised system of rotor, bearing and substructure minimises the vibrations of all parts.

Wear protection

As clinker is highly abrasive, cooler fans need specific wear protection and the provision of such protection is a key requirement. The round, sharp-edged clinker particles in different sizes can cause considerable abrasive damage on the rotor blades and other components of the fan (see Figure 3) and this must be avoided at all times.

This issue is addressed in a number of ways, including by optimising the fan’s suction speed. “Generally speaking, low suction speeds imply a low wear for both rotor and casing,” explains Axel Jahn, Pollrich’s managing director. “Speeds of around 25m/s would be ideal but are rarely practicable. To ensure maximum speed at minimal wear and a continuously-high efficiency, our control units, for example, can cause undefined zones of build-up or wearing on the rotor, even though they are still used in countries with limited electronic service abilities for high-end frequency converter systems. Other benefits of variable speed drives are energy savings of up to 70 per cent and a significantly-lower noise emission at reduced operation speeds.

In addition, design, geometry and angular position of the rotor blades also contribute to the longevity of the fans. It is important to consider the repose angle of the conveyed solids or gas mixtures. For an optimum operation, the blade angles should always be designed in ideal proportion to the repose angles of the respective dusts. Long-term experience over hundreds of installations and special in-house research is mandatory to select the right parameters.
engineers have developed special anti-wear solutions that permit suction speeds up to 50m/s. As every fan is individually designed, the wear protection is adapted to the respective process.

Hereby, the grain composition, grain geometry and the relative load are important factors to consider. Furthermore, high operating temperatures and the heterogeneous compositions of the dust-gas mixtures place a constant strain on the fans and are a challenge for the fan construction. Specific wear protection is ensured by a special tungsten-carbide coating. Tungsten carbide is a very hard, abrasion-resistant metal compound and offers optimum abrasion resistant properties. Its tensile strength lies over 3500MPa, with pressure resistance of up to 6000MPa and a Mohs hardness of 9.5. Thus, for wear protection in heavy-duty installations, tungsten carbide is the state-of-the-art solution (see Figure 4).

Pollrich ensures that this type of coating is designed to suit the individual application, leading to a long service life and equipment that is economical in its design. With new, sophisticated wear protection, adapted to the particular process requirements, impeller lifetimes can be increased significantly. This means at least a triple or quadruple service life and return on investment in less than one year.

Moreover, an increase in performance of over 10 per cent is a further benefit of this new kind of wear protection, which has been implemented in 2017 by Pollrich in close cooperation with one of the best-known suppliers of carbide coating systems.

Energy efficiency
Being a very energy-intensive industry, energy efficiency is always an important topic in the cement industry. Industrial fans, as high energy consumers, can cause high energy costs. They are an important cost factor in the production process. If designed energy-efficiently, fans present a huge opportunity in terms of lowering the overall energy consumption of the whole plant, particularly when variable-speed drives are used. A tailored fan design, individually adapted to the particular process requirements and optimised duct design are other ways of reducing energy costs.

To lower the energy consumption of industrial fans, frequency inverters are one method of choice. But other factors are also important, such as sophisticated wear protection and a special blade design.

A knowledgeable partner and expert in fan construction are considered the safest option for both plant operators and manufacturers. Pollrich engineers have a longstanding experience in industrial fans for heavy-duty applications. With over 112 years of expert knowledge, they work closely with plant operators and manufacturers in various industries all over the world.

Figure 4: a special tungsten-carbide coating of the impeller ensures high wear protection