

Application note

AC drives prolong crusher lifetime and optimize electricity use



Motor control method A applied to a jaw crusher. Motor control method B applied to a hammer crusher.

Application description

In mineral processing and cement making, consistent raw material quality and continuous material flow are essential. To obtain the correct particle size of ore, limestone or other raw material, various types of crushers are available, the selection of which depends on the material quality and the quantity of material demanded. However, hammer and jaw crushers are commonly used.

Raw material quality is determined by its hardness, stickiness and water content. As such, quality variations can be wide and the crusher, therefore, needs to be able to adapt its speed accordingly, while providing accurate crushing to ensure correct particle size.

As crusher motors are typically rated at hundreds of kilowatts, starting needs to be smooth to minimize mechanical stresses and eliminate high starting currents.

The electricity used to power the crusher motor will vary depending on the required particle size: the smaller the particle the more electricity is used in crushing it.

Using AC drives for crusher motor speed control provides an effective way to meet the smooth starting and crusher motor speed variations.

Individual drive for each crusher motor

Crusher control is best carried out by controlling each crusher motor separately using an AC drive (see A and B in drawing above). The operation of the AC drive(s) is controlled by the operator according to the crushing requirements.

Typically, various conveyor motors are equipped with AC drives as well. Examples of control methods are shown on the drawing.

Hammer crushers – improved lifetime and maintenance

If crusher motors run at constant speed, the particle size cannot be controlled, resulting in particles that are consistently too small or too large. If the particles are too small then too much energy is being used during crushing, whereas too large particles will often mean extra crushing is needed at the cement or minerals processing plant.

Variable speed control of the crusher motors using AC drives ensures the correct particle size. With AC drives, the amount of energy used for crushing can be easily optimized. Increasing the motor speed raises the crushing energy providing the ability to create smaller particle sizes.

Crushing raw material causes the hammers to wear. This reduces the crushing effect such that small particle sizes are difficult to obtain, compared to the sizes possible with new hammers. Increasing the crusher motor's rotating speed compensates for this weaker crushing effect, thereby extending the lifetime of the hammers and prolonging the maintenance interval of the crusher.

Jaw crushers – increased crushing power

Unlike hammer crushers, variable speed control of jaw crusher motors does not affect the particle size. This is due to the different mechanical structure of the two crusher types. The energy needed in crushing depends on the raw material quality - variable speed control of the crusher motor enables increased crushing power whenever needed and constant throughput of crushed material.

Soft starting and reversing minimizes stresses

Many crushers are located in remote areas, where electricity transmission lines are long and the network is weak. With such supply networks it is important to avoid high current peaks caused by starting motors as this can create major voltage fluctuations that can trip electrical equipment.

With AC drives, motor starting is smooth, resulting in minimal mechanical stresses and elimination of high starting currents. The power factor of an AC drive is close to unity, meaning that only active power is drawn from the mains, so reactive power compensation equipment is not needed.

Should the crusher jam, an AC drive allows the direction of motor rotation to be smoothly changed to unblock the crusher. Change of rotational direction is only possible with rotor equipped crushers, like hammer crushers.

Synchronized motor speed balances loading

With double motor crushers, using AC drives in master-follower mode ensures that the speeds of both motors are identical and that the load is equally divided between the motors. Master-follower also eliminates undesirable dynamic effects, prolonging the maintenance intervals.



Large motors, used in the crushing of raw material, can benefit from AC drives.

Benefits

AC drives provide many benefits such as:

- Reduced electricity use
- Reduced maintenance costs and prolonged crusher lifetime through smooth starting
- Ability to increase the crushing power to compensate for weakened crushing effect due to hammer wear
- No reactive power consumption or compensation equipment due to ABB AC drives' unity power factor
- Accurate speed and dynamic torque regulation via ABB's motor control platform DTC (direct torque control)
- Less wear and tear through equal distribution of load between two motors and elimination of undesirable dynamic effects
- Easy change of motor rotational direction to unblock jammed crusher
- Enables the use of totally enclosed AC induction motors designed for harsh environments, i.e. dust and vibration

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