ABB drives in cement
Medium voltage drives for reduced energy consumption and optimized process control
Challenges
Increasing product quality and reducing operation costs

To be profitable cement producers need to:

- Reduce energy consumption per ton of produced cement
- Increase availability of equipment and reduce shutdown period
- Reduce maintenance costs

Variable speed drives (VSDs) optimize process control and save energy. VSDs are used in a wide range of applications.
Variable speed drives for cement applications

Quarry and conveying
- Conveyors
- Crushers

Raw mill and separation
- Fans
- Filters
- Mills

Kiln and clinker cooling
- Rotary kiln
- Fans
- Conveyors
- Filters

Fuel handling
- Mills
- Conveyors
- Fans
- Filters

Cement grinding
- Roller presses
- Mills
- Filters
Benefits of variable speed drives

Controlling processes with VSDs has a direct impact on a company’s operating costs.

- Lower energy consumption and CO$_2$ emissions
- Minimized mechanical wear of equipment
- Higher process quality and efficiency
- Increased productivity and throughput
- Less investment in electrical network compensation devices such as filters
Benefits of variable speed drives
Fixed versus variable speed control

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- Mechanical fixed-speed solutions
  - Flow is adjusted by a mechanical device, e.g. fan inlet vanes, dampers, resulting in:
    - Waste of energy
    - Wear out of equipment

- Electric variable speed drives
  - Change in production volume achieved by adjusting the speed and/torque of the motor
  - Equipment will be operated at Best Efficiency Point (BEP), resulting in:
    - Energy savings
    - Decreased CO$_2$ emissions
    - Minimized operating costs
Benefits of variable speed drives
Energy savings and reduced emissions

- Fans typically run at partial load
- Huge energy savings can be achieved by controlling their speed with variable speed drives
- A fan running at half speed consumes as little as one eighth of the energy compared to one running at full speed
- Energy consumption can be reduced by as much as 60% with variable speed drives
- Variable speed drives help to reduce CO₂ emissions
Benefits of variable speed drives
Reduced maintenance costs, longer equipment lifetime

- A direct-on-line started electric motor can cause starting currents of up to 6 - 7 times the nominal current
  - Voltage drops can disturb processes especially in weak networks
- Benefits of soft-starting electric motors with variable speed drives:
  - No process disturbance due to voltage drops; no trips of other electrical devices connected to same bus
  - No excessive thermal or mechanical stress on the motor; longer lifetime of the motor
  - Controlled and smooth start-up
Applications

Fans

- Changing the operating point with a damper alters the system characteristic, increasing system losses
- Increasing or decreasing the fan speed with a variable speed drive changes the fan characteristic
  - No additional losses
  - Significant energy savings as lower pressure is needed for the same air flow
Benefits of variable speed drives:

- Optimized plant production
  - More efficient use of grinding power - speed of the mill is tuned for optimal grinding and maximum throughput
  - Mill can be operated at partial load; no process stop required
  - VSDs adjust the speed according to charge volume
- Less wear and higher reliability
  - Direct-on-line start of the mill stresses the mechanical equipment, shortening its lifetime
  - VSDs help optimize the mill speed to match the material flow, minimizing the wear of the mill
Applications
Mills

- Energy savings
  - Grinding mills can consume more than 60% of a plant’s total electrical energy
  - Controlling them with VSDs results in significant energy savings
- Smooth ramp up
  - Low starting currents and high starting torque enable a smooth start-up of the mill, even when fully loaded
  - Reduced stress on network and mechanical equipment
Benefits of variable speed drives:

- Extended lifetime and increased availability
- Accurate and fast load sharing
- Power factor compensation
- Regenerative braking of downhill conveyors saves energy
Conveyors
Benefits of variable speed drives

- Extended lifetime and increased availability
  - Accurate torque and speed control reduces stress on mechanical equipment
  - Speed of the conveyor can be adjusted to production capacity reducing wear and saving energy
- Accurate and fast load sharing between several drives
  - All motors are loaded as needed if several motors operate on the same conveyor belt
- Power factor compensation
  - With ABB drives power factor is greater 0.95
  - No need for additional power factor compensation
  - Less losses on electrical network
- No inrush currents when conveyors are started
- Regenerative braking of downhill conveyors saves energy
  - The braking energy can be fed into the plant’s electrical network, thereby generating electricity
Applications
Kilns

Special requirements of kiln drives:

- High reliability – a kiln needs to operate 24 hours a day
- A wide range of speed control – a kiln’s most suitable speed is determined by material combinations and combustion even when load variations occur
- High control accuracy for an accurate load sharing if several motors are used
- High starting torque – the kiln must be driven with low speed until the temperature becomes sufficiently high
Components of variable speed drives

ABB can offer the complete variable speed drive system or assist in selecting components that match the process requirements.

A variable speed drive system consists of:

- Input transformer
- Frequency converter
- Electric motor
Medium voltage variable speed drives

- Power range: 250 kW – more than 100 MW
- Voltage range: 2.1 kV – 10 kV
- Products available for operation with external transformer, integrated transformer or for direct-to-line connection (transformerless)
Technology highlights

- Direct Torque Control (DTC)
  - For highest torque and speed performance
- Power loss ride through
  - The drive system is able to withstand power supply disturbances
- Low parts count
  - ABB uses high power semiconductor switching devices and a topology that minimizes the parts count
- DriveMonitor™ (option)
  - Remote and real-time monitoring and diagnostics of ABB drives from any location in the world
Direct Torque Control (DTC)

- Provides fast, accurate and stepless control from zero to full speed
- Full torque with optimal speed accuracy over the whole speed range
- Negligibly low torque ripple
- Minimal inverter switching losses at maximal control performance
- High accuracy even without speed encoders
DriveMonitor™
Intelligent monitoring and control

DriveMonitor™ is an intelligent diagnostic system consisting of
- Hardware module (installed in- or outside of drive)
- Software layer (collecting and analyzing selected drive signals and parameters)

Functions
- Monitoring of drive’s performance, and, if required, other shaft line components (main circuit breaker, transformer, motor)
- Fast fault finding process
High voltage motors

- Induction motors
  - Available up to 25 MW
  - Induction motors are usually the first choice for applications up to 10 MW

- Synchronous motors
  - Typically considered for higher power ratings (e.g. above 8 MW to more than 100 MW)
Input isolation transformers

- Input transformers have several functions, such as:
  - To adjust the network supply voltage to match the converter
  - To provide galvanic isolation between drive and supply network
- ABB transformers are available for all ratings and primary voltages, oil or dry type
Testing

ABB is committed to ensuring the reliability of every drive we deliver.

- Every component of a drive is subjected to thorough testing in ABB’s modern test facilities
- Routine tests, functional tests
  - Integral part of the scope of supply
  - Performed in accordance with international standards and ABB quality assurance procedures
- Combined tests
  - Tests with the complete drive system including transformer, converter and motor – can be performed
Worldwide service and support

- Worldwide service network
- 24 x 365 support line
- Local support
- Supervision of installation and commissioning
- System upgrades for optimized operation & migration
- Life cycle management
- Remote diagnostics
- Customized maintenance contracts
- Spare parts and logistics network
- Training
Case example
Jura Cement, Switzerland

- Jura Cement replaced a cascade converter, which controlled the clinker cooler exhaust fan, with an ACS 2000 (550 kW)

- Benefits
  - Higher availability
  - Reduced maintenance costs
  - Fast installation and commissioning
  - Reduced energy consumption (estimated about 20%)
  - Wider range of speed control (from 0 to 1000 rpm)
Case example
Cementir, Italy

- An ACS 2000 variable speed drive replaced the damper control on a fan at Cementir Italia’s Spoleto plant

- Benefits
  - Energy savings of 21%
  - Higher productivity and uptime
  - Less wear on mechanical equipment
  - Optimization of grinding process
Case example
Chettinad Cement Corporation, India

- Chettinad installed ACS 1000 variable speed drives for speed and torque control of bag house fan, raw mill fan, cement mill fan and preheater fan

- Benefits
  - High reliability and availability
  - Reduced maintenance costs
  - High efficiency
  - Wider range of speed control (from 0 to 1000 rpm)
  - Network power factor >0.95
Case example
Cementos Cruz Azul, Mexico

- Cementos Cruz Azul replaced the damper fan control of two 735 kW fixed speed ID fans with ACS 1000 variable speed drives

- Benefits
  - Revenue up - USD 900,000 through increased productivity
  - Energy savings USD 260,000
  - Maintenance reduced by 97%
  - Reduced motor noise and elimination of fan vibration
  - Payback on investment period: 6 months
Case example
Siam City, Thailand

Four ACS 5000 variable speed drives have replaced cascade converters controlling the flow rate of induced draft fans at Siam City Cement in Thailand.

Benefits

- Wide speed control range
- Energy savings $250,000 per year
- Reduction of CO2 emissions
- Reduced maintenance costs
- Ride through of power supply disturbances
Power and productivity for a better world™