Variable Speed Applications
Mining, cement and aggregates processes

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Introduction

From surface and/or underground mining to processing/refining of any mineral, there are several motor-driven applications that can benefit from the speed and/or torque control offered by variable-speed drives.
General Variable Speed Benefits on MCA applications

- High uptime
- Unrivaled energy efficiency (less CO2 Emissions)
- Extended machinery lifetime
- Lower investment, installation, operational and maintenance costs
- Improved safety and comfortable working environment
- Robust and reliable
- Versatile control and integration
- Innovative and modern
- Possibility of fully redundant control
Mining/Minerals Process Overview

Variable Speed Applications
Fans – Blowers

Machines whose primary function is to provide a large flow of air or gas to various processes. This is achieved by rotating a number of blades, connected to a hub and shaft, and driven by a motor.

Benefits:
- Energy savings and improved process control
- Increase productivity (better system availability)
- Reduction of maintenance costs
- Reduce motor noise and vibration
- High starting torque at low speed
Pumps

A device that raises, transfers, delivers, or compresses fluids or that attenuates gases especially by suction or pressure, or both.

Benefits:
- Energy savings and increment pump lifecycle
- Increase productivity (better system availability)
- Reduction of maintenance costs, motor noise and vibration
- Soft starting eliminates abrupt pressure changes – smooth operation, less mechanical wearing
- Ability to control multiple pumps with only one Drive

Slurry pumps:
- With VFDs slurry pumps are operated at the most efficient rate, reducing energy and maintenance costs considerably
Crushers

Machines which reduce the size of the ore to a specified size for further grinding in ball/rod mills. Types include jaw, gyratory, vertical/horizontal impact or, hydraulic hammer and cone.

Benefits:

- Reduced mechanical stress, less disturbances – reverse operation (blocked crusher)
- Less maintenance and lower costs, prolonged drill lifetime
- Maximize uptime controlling speed and torque – consistent production
- Substantial energy savings – high power factor
- High starting torque at low speed – flexibility, better uptime
Mills – Grinders

Equipment to reduce the size of the ore to a powder. Types include ball mills, rod mills, autogenous (AG) mills, semiautogenous (SAG) mills, pebble mills, grinding rolls, etc.

Benefits:
- Optimized plant production – easily adapt/react to process changes (ore characteristics and throughput)
- Accurate and coordinated load sharing (two pinion mills) Master/Follower(s) capability
- Smooth ramp up – less stress in the electrical and mechanical train, low starting current with high starting torque (even fully loaded)
- Energy savings – big motors possible big savings, improved power factor
- Reduce maintenance requirements – lower mechanical stress, possibility of creep speed
- Increases output and performance of SAG mill – improved process control and longer lifetime of equipment (more flexibility)
- Better quality product – vertical mills (usually on cement industry)
- High starting torque at low speed – maintenance positioning
Classifier – Separator

An apparatus for separating mixtures of mineral particles into fractions according to size, shape, or density. Depending upon the medium in which separation of the materials occurs, classifiers are divided into hydraulic and pneumatic. Depending upon the force used, there are gravity classifiers, centrifugal classifiers, and high-tension separators.

Benefits:
- Increase separation efficiency
- Energy consumption significantly reduced
- Convenient adjustment and extensive adjusting range, better quality-precision
- Reduce maintenance requirements
- Possibility to increase production using higher speed (above nominal values)
Conveyors – Feeders

Equipment which moves material from one point to another continuously by means of an endless (looped) procession of hooks, buckets, wide rubber belt, chain, etc.

Benefits:
- Extended lifetime and increased availability
- More accurate and fast load sharing - Master/Follower(s) capability
- Regenerative braking of downhill conveyors saves energy
- Improves process control – enables collection of measurements and supervision information (continuous control)
- Reduce downtime and increase conveying capacity
- Smooth acceleration/deceleration – less mechanical wear
- Safer and more comfortable operation
Mine hoists, cranes, winches, draglines and shovels

Large surface mining equipment used to remove overburden above a deposit. Has a long boom and large bucket which is thrown outwards, then dragged back towards the machine.

Benefits:
- Safe and reliable operation
- Greater equipment control - easy and more accurate maneuverability (reverse operation, desired positioning)
- Remote monitoring and diagnostics
- Half speed, full load redundancy
- Master/Follower(s) capability
- Extended lifetime
- Lower energy consumption – regenerative braking energy is fed back into the plant electrical network, lowering the energy consumption
Drills

A machine that drills holes by rotating a rigid, tubular procession of drill rods to which is attached a bit.

Benefits:
- The varying soil quality requires a drill motor that is able to adjust its speed continuously
- Ensuring the correct drilling impact is achieved
- Energy use is considerably reduced
- Lower environmental impact – no hydraulic liquids or compressed air
- Considerable maintenance savings and increased productivity
- Prolonged drill lifetime - less maintenance and lower costs, reverse operation
- Safer and more comfortable operation
Compressors

A device that converts power (usually from an electric motor) into kinetic energy by compressing and pressurizing air. Compressed air is used in the mining industry as the major source of motive energy (tools, etc.).

Benefits:
- Energy-efficient solution to maintain constant air pressure – energy reduced, high power factor
- PID control included with communication capabilities - elimination of costs for additional components
- Reduced mechanical stress
- Less maintenance and lower costs, prolonged drill lifetime
Excavators

A machine designed to dig solid, soft rock or earth or fragmented hard rock. It could also be used to load the material into the hauling units (trucks) or deposit in spoil banks (stockpile).

Benefits:
- Optimized production – easily adapt and react to the varying conditions
- Reduce energy use/consumption and less wear and tear – lower maintenance costs, prolonged lifetime
- High uptime
- Better throughput
Stacker – reclaimers and spreaders

A stacker is a large machine used in bulk material handling. Its function is to pile bulk material such as limestone, ores and cereals on to a stockpile. A reclaimer can be used to recover the material. A Spreader is used to act as a continuous spreading machine in large-scale open pit mining operations.

Benefits:
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Trucks and loaders

The loader is a machine used for loading useful minerals and rock onto materials-transport units, the trucks haul useful minerals and rock to the crusher.

Benefits:
- Reduced fuel consumption and higher production efficiency
- Faster driving speed
- Minimized need for maintenance
- Reduced noise and emissions
- Improve the manoeuvrability – reverse operation
- Diesel generator fed
Rotary dryer – Kiln

A cylindrical furnace, oven or heated enclosure slightly inclined to the horizontal and rotated on suitable bearings; moisture is removed (dried) by rising hot gases.

Benefits:
- Optimization and easily adapt/react to the quality/volume of the sludge or slurry
- Reduce energy and maintenance costs
- Reduce mechanical stress – less disturbances, prolonged lifetime
- Better operation/control efficiency
- Smooth operation – better fuel consumption
- Load sharing possibility – Master/Follower torque sharing
- High Starting Torque at low speed
**Flotation cells**

Milling process that uses bubbles to capture valuable minerals particles that float to the surface, thereby separating them from waste which sinks to the bottom.

**Benefits:**
- Optimization of the slurry agitation and aeration almost without any sedimentation
- Reduce energy and maintenance costs
- Better operation efficiency
- Better mineral concentration
Belt press filters, disc filters and pressure filters

A device whose primary function is the retention by a porous media of insoluble contaminants from a fluid.

Benefits:
- Optimization and easily adapt/react to the quality/volume of the sludge or slurry
- Reduce energy and maintenance costs
- Reduce mechanical stress – less disturbances, prolonged lifetime
- Better operation/control efficiency – enhanced solid separation
- Reduced noise – smooth operation
Agitators – Clarifiers and thickeners

Mineral processing machines which separates minerals according to size and density, usually to separate solids from liquids. Fluid overflows from the tank and rock particles sink to the bottom.

Benefits:
- Torque control and feedback – less instruments better performance
- Reduce energy and maintenance costs
- Forward/reverse control
- Safer and more comfortable operation
- Better overall efficiency
Cement Process Overview

Dry Process
1. Quarries (limestone, clay)
2. Drill
3. Dumper
4. Crushing
5. Prehomogenization
6. Grinding
7. Filter
8. Preheating
9. Rotary Kiln
10. Cooler
11. Clinker storage
12. Additions
13. Cement grinding
14. Cement silos, dispatching

Wet Process
15. Wet grinding
16. Homogenization
17. Filter
18. Rotary Kiln

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