

CASE NOTE

# ACS1000 variable speed drive improves process efficiency and product quality at petrochemical factory



Daqing Petrochemical Plastic Factory in China manufactures petroleum-based plastics and synthetic materials.

To enhance the mixer's performance and improve productivity an ACS1000 variable speed drive was installed. Both product quality and process efficiency have vastly improved.

### Background

The Petrochemical Plastic Factory at Daqing, in northern China's Heilongjiang region, manufactures a range of petroleum-based plastics and synthetic materials. These include organic and inorganic industrial chemicals, chemicals for use in agriculture and other petroleum-based plastics and synthetic materials. Annual output from the plant is some 80,000 – 90,000 tons of materials.

### Challenge

Productivity at the Daqing Petrochemical Plastic Factory in China was below expectations because a 20-year old motor used to drive the Fuji-supplied continuous mixer was limited to two speeds. The mixer's 1,300 kW motor, a 6 and 8-pole, 6.0 kV machine, restricted the motor to two fixed operating speeds of 1,000 rpm and 750 rpm. These fixed speeds meant that the mixer could not operate at its optimal mixing point, and was not able to react to sudden load changes that resulted from the mixing of polyethylene. This led to poor product quality and frequent breakdown of the mixer, which subsequently reduced the amount of plastics being produced.

### Highlights

- Energy savings of 30%
- Increased production efficiency
- Improved production quality
- Reduced noise



ACS1000 variable speed drive controlling the mixer at the Daqing Petrochemical Plastic Factory in China.

## Solution

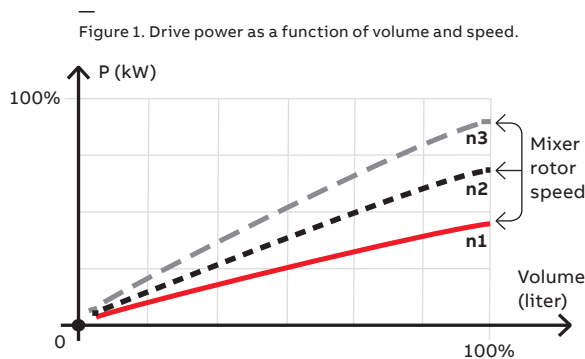
In August 1998 ABB was asked to investigate ways in which the mixer's performance could be enhanced so that productivity improved without any loss of consistency to the plastics being mixed. The answer was an ACS1000 medium voltage AC drive, together with a locally supplied input isolation transformer.

The ACS1000 has been designed as a standard product, using advanced, yet proven motor control technology – known as Direct Torque Control (DTC) – and advanced power semiconductor technology which increases reliability and helps minimize the drives footprint.

One of the most important developments is the use of a sine filter that eliminates harmonics to the motor which means the existing motor can be used without derating. The use of the AC drive means that the motor is no longer restricted to two speeds but can be varied, at will, from 500 rpm through to 1000 rpm.

As a result, the mixer is working at its optimal operating point with the added advantages of smooth starting and rapid reaction to sudden load changes. Both product quality and process efficiency have vastly improved.

In addition, the ACS1000 is a 12-pulse drive, eliminating the harmonics that might cause problems on the site's electrical supply. Because of this, a three winding input isolation transformer was supplied as part of the overall project, but without major space implications: the small footprint of the ACS1000 allowed both the drive and the transformer to be housed within the existing switch room.



## Benefits

The drive power required for a mixer is proportional to the volume of mix and generally also to the rotor speed as is shown in Figure 1.


At Daqing mixer loads can vary widely, across a range from below six tons of mix materials to loads approaching ten tons.

With a 9.5 ton load, the motor was using 1,215 kW; following the ABB drive implementation, the same mixer load required only 1,150 kW of motor power as the speed of the motor can now be varied to precisely match demand, rather than operating at constant speed, as previously.


As a result, Daqing Petrochemical Plastic Factory estimates that the drive has reduced energy consumption by 30 percent. Pay back period for the complete system has been proven to be as little as two years. Because the drive is of standard design, it can be easily retrofitted to existing motors. For Daqing Petrochemical Plastic Factory, this meant that the drive could be connected to the existing motor by simply changing the motor connection from star to delta.

### Other benefits include:


#### Reduced noise

 The use of DTC and the sine filter, has reduced the drive system noise level to 75 dBA.

#### Fast commissioning and start-up

 Total system commissioning was completed within 3 days, including complete electrical circuit redesign and motor reconnection.

#### Highly reliable operation

 Since the installation in 1999, the ACS 1000 AC drive has operated smoothly without any production interruptions.

#### ACS1000 key data

Inverter type	Three-level Voltage Source Inverter (VSI)
Power range	Air-cooled: 315 kW-2 MW Water-cooled: 1.8 MW-5 MW
Output voltage	2.3 kV, 3.3 kV, 4.0 kV, 4.16 kV
Maximum output frequency	0 to 82.5 Hz (higher on request)
Converter efficiency	>98%, external transformer >96%, integrated transformer
Type of motor	Induction motor

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