CASE NOTE

ABB drives reduce energy consumption of fans at waste-to-energy plant

Six ABB variable speed drives have replaced damper control on induced draft fans and secondary air fans at Valorsul's waste-to-energy plant in Portugal.

The result is an annual energy saving approaching € 240,000.

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Valorsul's waste-to-energy plant in S. João da Talha, Portugal

Valorsul

Valorsul is responsible for the recovery and treatment of solid waste throughout 19 municipalities of Lisbon and western region of Portugal. The company processes and recovers about one million tons of municipal solid waste each year.

Waste-to-energy (WtE) plant
Valorsul operates a waste-to-energy plant, located some six kilometers from Lisbon center, which converts waste into electricity. It has three blocks and a total capacity of 50 MW. The plant receives about 2,000 tons of waste per day and produces enough energy to supply a city of 150,000 inhabitants.

Highlights
Energy savings of € 240,000 per year
Reduction of CO_2 emissions
Accurate and reliable process control
Reduced maintenance costs
Return on investment period: three years

Emission control includes a bag house and semi-dry scrubber. It incorporates the SNCR (Selective Non-Catalytic Reduction) method for reducing nitrogen oxide emissions. An environmental monitoring program is implemented to evaluate the impact of the plant.

ABB drives for Valorsul, Portugal

Energy efficiency program
Looking for ways to reduce the energy consumption and CO_2 emissions of the plant, Valorsul identified six fans with a high energy savings potential: three induced draft (ID) fans and three secondary air fans.

Challenge

Energy efficient control of fans
The control method employed has a major effect on the running cost. Previously, the ID fans were controlled by dampers, which is the least energy efficient control method.

Fan characteristics
The performance of centrifugal fans is controlled by a set of rules known as the affinity laws, which state that:
- Flow is proportional to speed
- Pressure is proportional to the square of the speed
- Power is proportional to the cube of the speed

Figure 2 shows a typical fan characteristic which is a function of pressure and volume flow. Also shown is a typical system characteristic; the operating point of the system is at the intersection of those two curves. If the required volume of air is deviating from this point the fan or system characteristic needs to be changed.

Traditionally, the most common way of changing the operating point is by using a damper which alters the system characteristic (operating point moves from position 1 to 2, see Fig. 2) increasing the system losses.

However, increasing or decreasing the fan speed with variable speed drives will change the fan characteristic itself (point of operation moves from position 1 to 3, see Fig. 2) without adding additional losses. The energy consumption can be reduced significantly.

Solution
ABB supplied three ACS2000 medium voltage drives for direct-to-line connection; three ACS800 low voltage drives; and UniMix medium voltage switchgear for line supply connection and backup bypass for the variable speed drives.

The ACS2000 variable speed drives, rated at 700 kW, 6.4 kV, can be directly connected to the line supply, not requiring an input isolation transformer.

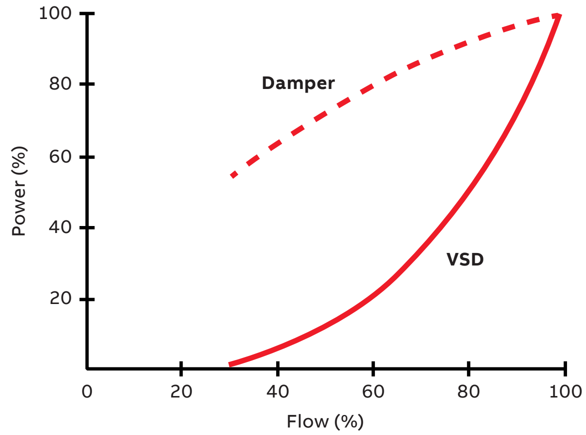

Fig. 1: Graph showing fan power requirements for damper and variable speed drive (VSD)

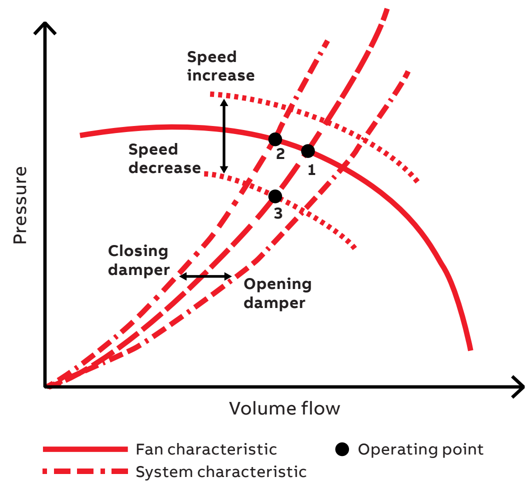

Fig. 2: Typical fan characteristic showing operating point

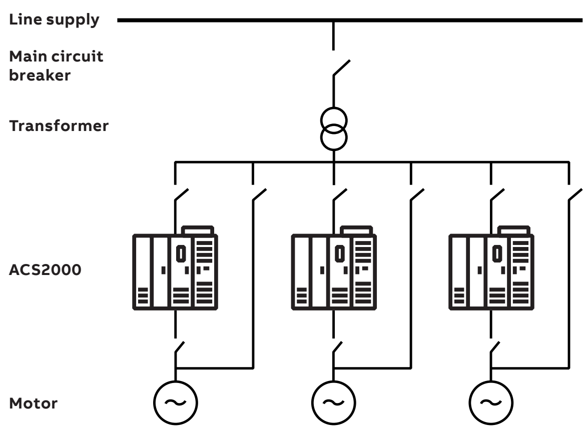

Fig. 3: The three ACS2000 direct-to-line variable speed drives are connected to the same network, requiring only one transformer.

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01 The three ID (induced draft) fans at Valorsul's WtE plant are now controlled by ABB's ACS2000 variable speed drives.

Benefits

Energy savings
The average daily energy consumption of the ID fans and secondary air fans with damper control was 153.6 MWh. After the upgrade with variable speed drives, the daily energy consumption was reduced by 9 MWh to 144 MWh. Multiplying it with the energy price of € 0.08 per kWh results in annual energy savings of about € 240,000.

Reduction of CO_2 emissions
The daily energy savings of 9 MWh reduce the CO_2 emissions by about 4.5 tons per day.

Accurate and reliable process control
With variable speed drives the flow can be controlled more accurately, faster and more reliably than with dampers.

With damper control there is a risk that the dampers get stuck if they are not frequently re-adjusted. If they are kept in the same position for too long it is no longer possible to accurately position them which might result in an unscheduled shut down of the process.

Lower investment costs
The ACS2000 direct-to-line variable speed drive does not require an input isolation transformer reducing capital expenditure.

The three ACS2000 drives were connected to one transformer via a common AC bus (see Fig. 3).

Lower maintenance costs
Variable speed drives act as soft starters, gradually bringing fan speed up to operating conditions. Starting current peaks are eliminated, reducing stress on the electrical equipment and lowering maintenance costs.

Saving valuable space
Due to the fact that the ACS2000 can be operated without a transformer, less space is required in the electrical room, freeing up valuable space.

Smooth integration in existing infrastructure
The smooth integration of the drive into the plant particularly pleased the customer along with the short commissioning period which minimized site disruption and expensive downtime.

Marpe

The Portuguese erection company Marpe was responsible for detailed engineering, sourcing and commissioning of the variable speed drives controlling the ID fans and the secondary air fans. It was also responsible for civil construction and the HVAC room at Valorsul's Boiler Treatment Center Solid Waste (CTRSU), which houses the variable speed drives controlling the ID fans.

Key data of ACS2000 product family	
Inverter type	Multilevel voltage source inverter (VSI)
Converter cooling	Air cooling
Power range	250 - 3680 kW
Output voltage	4.0 - 6.9 kV (higher on request)
Maximum output frequency	90 Hz
Converter efficiency	Up to 97.5%
Type of motor	Induction motor, PM synchronous motor
Special feature	Available for direct-to-line connection, for operation with external transformer or with integrated transformer

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02 Three ACS2000 direct-to-line variable speed drives, rated at 700 kW, control the ID fans at Valorsul's WtE plant.

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03 Control room with ACS2000 variable speed drives (left) and UniMix switchgear (right).

For more information please visit:

new.abb.com/drives
www.valorsul.pt

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