

Cost-Effective Motor Management in an Aeration Station with Critical Start-up and Operating Conditions



Waste Water Treatment Application Profile



The waste water treatment plant operated by the City of Chur in Switzerland is the largest in the region and one of the most modern in the country. An important part of the treatment of waste water is the “biological stage”. For the reliable and cost-effective operation of the fans that provide the aeration for this stage, the plant engineers chose motor management technology from Rockwell Automation.

Modern motor management systems of the 825 series equipped with electronic control and protection provide for gentle cascade starting and reliable operation of powerful fans physically arranged in series. The fans are the most important components in the aeration station of a waste water treatment plant for 90,000 people and are essential for the proper functioning of the “biological stage”.

It is a quarter of a century since the Swiss Cantons and communities became obliged by law to treat the waste water produced by households and industry. In the meantime, many waste water treatment plants have been built and the quality of the water in the lakes and rivers has steadily improved to the extent that today it can be generally described as good. One of the most advanced waste water treatment

plants is at Chur the capital of the Canton of Grisons, where receptive to innovation and new technologies it has been possible to devise a system that permits sewage sludge to be used as fertiliser in agriculture. The aerobic-thermal process that achieves the required degree of purification produces heat which together with the gas produced by the sewage covers the thermal energy requirement of the entire

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waste water treatment plant. The production of fertiliser is therefore also an economic proposition from the energy point of view.

Oxygen an essential ingredient of waste treatment

The search for and implementation of progressive low-cost solutions is a factor in all branches of industry. The performance demands on the individual industrial automation components are therefore correspondingly high. This was very much so in the case of the aeration equipment for the biological stage of the waste treatment plant and the engineers responsible were not prepared to compromise.

In the biological stage, the remaining suspended fine particles and dissolved matter are broken down and converted to a solid residue by micro-organisms that settles in the sedimentation tank. Oxygen is introduced into the aeration tank to maintain the culture of micro-organisms. To prevent the solid matter from settling, the pond also has to be continuously stirred. Both stirring and aeration are achieved by blowing air into the pond. “Three fans arranged in series, each with a rating of 75 kW and capable of circulating up to 160 m³ per second, are used for this purpose. We have duplicate sets and the fans are started in

cascade”, the Electrical Engineer Giatgen Battaglia explained.

High efficiency and full protection – even when conditions get difficult

The aeration plant had to be designed for extremely complex starting and operating conditions and the task of the control and protection system is to guarantee its reliable and cost-effective operation at all times. That is why the engineers seized the opportunity while other modifications were being made to the waste water treatment plant of optimising the control and protection system. “We set our-



View inside the switchgear cubicle at the waste water treatment plant: the Modular Control System (MSC) was the first choice for compact well designed power feeders.

selves quite ambitious targets. The system must be able to detect long starts and reliably recognise the various load conditions”, Mr. Battaglia said. A sales engineer at Rockwell Automation’s local agent worked out a solution based on the electronic control and protection system of the 825 series. Now after a considerable period in operation, the Engineer in Chur talks enthusiastically

of “clean” Y/delta starting in cascade and of peak currents that are no problem at all.

A thermal replica that really models the motor

To achieve efficient utilisation of plants with difficult starting and operating conditions, the 825 series of electronic control and protection systems forms a thermal image of the motor. This is the only way of effectively coping with:

- a frequently changing load
- short overloads
- heavy duty starting
- asymmetrical loads (NPS)

The thermal image simulates the temperature rise in the stator winding and in the iron mass of the motor (simulation of two masses). This permits correct modelling, for example, of both the initial fast temperature rise of the winding during heavy duty starting and the subsequent dissipation of the winding heat into the iron which warms up much slower.

Thermal image corresponds to the conditions of the motor

The temperature rise due to iron losses or an asymmetric load during operation is continuously fed into the image. Optionally, the ambient temperature of the motor can also be taken into account, which further enhances efficiency under conditions of widely varying ambient temperature. Two different time constants allow for the different cooling rates when self-cooled motors are running or are stationary. After a motor is switched off, the winding cools relatively quickly to the temperature of the iron, but from that point the motor as a whole cools



The three fans each with a rating of 75 kW are arranged physically in series and starting and operating them in cascade was critical. The problems were solved by installing the electronic control and protection system of the 825 series which achieves maximum utilisation without risk to the motor by forming a thermal image of the conditions in the motor.

slowly, and both these characteristics are precisely modelled. The thermal image in the electronic motor protection thus corresponds at all times to the conditions actually prevailing in the motor. Technical and cost optimisation Cost-effectiveness is the principal aim of Rockwell Automation’s motor management philosophy. All the solutions we offer therefore

enable the user to get the most out of his plant without neglecting the protection of his investment. These were the considerations that prompted the decision-makers at the largest waste water treatment plant in the Canton of Grisons to choose the electronic control and protections system of the 825 series to optimise the aeration plant both technically and economically.

In brief

Problem: Waste water treatment plants pump oxygen into the aeration tank of the biological treatment stage. For this purpose, the largest waste water treatment plant in the Swiss Canton of Grisons has aeration equipment comprising three fans arranged in series each with a rated power of 75 kW that are started in cascade by Y/delta starters. The design of the station, that has to run reliably and cost-effectively 24 hours a day year in year out, results in critical starting and operating conditions for the motors.



Solution: With its precise thermal image of the motor, the electronic control and protection system of the 825 series permits maximum utilisation and maximum protection of the motor even in cases of:

- a frequently changing load
- short overloads
- heavy duty starting
- asymmetrical loads (NPS)

The thermal image effectively simulates the temperature rise of the stator winding and the iron mass of the motor (simulation of two masses).



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