SIPREC C
Control system for electrostatic precipitators

Environmental Product Declaration

Industry Solutions
“Our knowledge and our solutions are helping to create a better world. We have a responsibility to the wider community and we are committed to environmental protection.

In our global operations, featuring a great diversity of processes, products and services, our company is concerned with sustaining the natural resources essential to life. We view the economy, environmental protection and social responsibility as three key factors carrying equal weight in a liberal world market. We support the dissemination of knowledge needed for sustainable development through the transfer of knowledge in the fields of management and technology, wherever we operate as a company.

For us, sustainable development in environmental protection means careful use of natural resources, which is why we assess possible environmental impacts in the early stages of product and process development. It is our aim to avoid pollution altogether or to reduce it to a minimum, above and beyond statutory requirements.”

Design for environment

Ecological design is nothing new at Siemens. The company published its in-house standard SN 36350 on environmentally compatible product design in 1993, and since then this standard has been an integral part of our product planning and development process. Among other things, it calls for use of separate and distinct material fractions, ease of disassembly, a reduction in the number of components per product, durability, low energy requirements during manufacture and day-to-day use, and the avoidance of hazardous substances. It also lists minimum requirements regarding the parameters to be described in environmental declarations.

This standard and our system of environmental management enable us to take a holistic and all-encompassing approach to environmental protection spanning the entire product life cycle from product planning to end-of-life recycling and disposal. We also work with product-specific guidelines that refine the requirements outlined in SN 36350.
Substantial potential for saving energy

Improved electrostatic precipitator performance thanks to IGBT converter technology

Electrostatic precipitator expert system with comprehensive remote-controlled functionality for optimization and diagnosis

Energy management for minimum energy consumption at optimum collecting performance
Higher collecting efficiency and lower energy consumption

Advantages for the environment

- Higher electrostatic precipitator (ESP) efficiency
- Substantial energy savings

The challenge

Electrostatic precipitators (ESPs) have proved themselves capable of cleaning large volumes of gas for many decades in different industrial plants. The waste gas is cleaned by passing it through the electrical field between the arrangement of discharge and collecting electrodes. The optimized control of the DC high voltage supplied to the discharge electrodes in order to increase the ESP collecting efficiency and to reduce the energy consumption is a challenge for the environmental policy.

The solution

Siemens has taken up this challenge, and developed SIPREC I, SIPREC T and SIPREC ODS: new converter systems and controls for electrostatic precipitators. The switching concept of SIPREC I inverter systems verifiably increases the DC power (corona power) supplied to the electrical field and, in turn, the collecting efficiency of existing and new ESPs. The inverter is most efficient when installed at the gas inlet fields where the maximum possible corona power is typically limited by a high number of discharges due to the high dust load and space charge. However, SIPREC I inverters also achieve a significantly higher collecting efficiency of fine particulates in the last ESP zones. Modernization costs with installation of SIPREC I inverters are considerably lower than those for the mechanical expansion of an ESP. As SIPREC I and SIPREC T use the same control components, mixed systems are the optimum solution for maximum collecting efficiency with the lowest power consumption. According to the current emission value and the desired emission limit, SIPREC ODS, the expert software, coordinates the recording of measurements and the determination of target values of the individual SIPREC controllers connected by PROFIBUS to minimize energy consumption. SIPREC I, SIPREC T and SIPREC ODS use fuzzy logic for the dynamic optimization tasks, which determines the best possible operating point – especially during extreme process fluctuations (e.g. frequent discharge sparks, flashovers, lad changes, start-up and shutdown processes) – without intervention of the operating personnel.

Many years of practical experience with the installation of IGBT-based power supplies have shown remarkable increases of the collecting efficiency. Depending on the ESP design and operating conditions emission values have been decreased by up to 50%.

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Power plant capacity</th>
<th>Control unit</th>
<th>Installed power [kVA]</th>
<th>Power consumption w/o EMIN [kW]</th>
<th>Power consumption with EMIN [kW]</th>
<th>Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard coal</td>
<td>2 x 750 MW</td>
<td>2 x 20</td>
<td>4,320</td>
<td>2,560</td>
<td>760</td>
<td>70%</td>
</tr>
<tr>
<td>Hard coal</td>
<td>1 x 400 MW/1 x 350 MW</td>
<td>1 x 18/1 x 15</td>
<td>5,450</td>
<td>2,210</td>
<td>750</td>
<td>66%</td>
</tr>
<tr>
<td>Hard coal</td>
<td>2 x 230 MW</td>
<td>2 x 5</td>
<td>2,140</td>
<td>780</td>
<td>660</td>
<td>15%</td>
</tr>
<tr>
<td>Hard coal</td>
<td>3 x 300 MW</td>
<td>3 x 18</td>
<td>3,618</td>
<td>1,650</td>
<td>1,300</td>
<td>21%</td>
</tr>
<tr>
<td>Hard coal</td>
<td>2 x 60 MW</td>
<td>2 x 6</td>
<td>672</td>
<td>240</td>
<td>70</td>
<td>71%</td>
</tr>
</tbody>
</table>

In some cases, substantial energy savings were also achieved with electrostatic precipitators in industrial plants, such as cement works. A side effect of the energy saved is the non-emission of several thousand tons of the greenhouse gas CO₂. That is not only a worthwhile contribution to the environment but also an incentive to continue optimizing developments to maximize the utilization of the available energy.

The potential for increasing collecting efficiency and saving energy depends on the number of installed HV transformer rectifier sets, the installed power and the configuration/operating mode of the electrostatic precipitator. It can be estimated for installed systems in advance, and quantified by trial operation.
The average reduction of power consumption achieved per SIPREC C installed in combination with SIPREC ODS was determined on the basis of the examples previously described and assumptions about two further applications at a coal-fired power plant and at an industry plant. This gave an average annual energy saving to be expected from the modernization of 23 T/R set controllers with an installed power of 2.1 MW:

<table>
<thead>
<tr>
<th>Number of controllers</th>
<th>Energy saving/ controller</th>
<th>Total saving</th>
<th>Energy saving (ESP)/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>30</td>
<td>690</td>
<td>5,465</td>
</tr>
</tbody>
</table>

The actually achievable savings depend on the configuration and operating mode of the ESP and process, and can be estimated in advance by means of pre-tests with simulation calculation and/or trial operation. The energy is saved in the first instance by replacing the existing thyristor controller by SIPREC C upgrade sets with implementation of the SIPREC ODS optimization.

**Greenhouse gas savings**

The absolute savings of greenhouse gas equivalents vary from region to region. The savings potential can be as high as 33 percent, depending on the configuration and operating mode.

**Eco-Care Matrix (ECM)**

In comparison to conventional solutions, SIPREC C controllers combined with SIPREC ODS achieve a 33 percent lower environmental impact by reducing energy consumption. At the same time, system costs are around 29 percent lower than in the reference solution.
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