From the diary of a bag filter

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The soil on the island Gotland in Sweden is very calcareous. This relates to the geological conditions of the island as it is a large limestone plateau. Since before the 11th century, limestone mining was common – both for domestic house building as well as for exports across the Baltic Sea. Since nature provided the material, industrial mining had begun before the late 1870s. The base for the local cement operator Cementa AB, part of the HeidelbergCement group, was laid by Skanska Cement. Today, the Slite cement plant on Gotland, which produces about 2Mta of cement, is one of the most modern and energy-efficient plants in Europe.

April 4, 1919 was an important day for cement production on the island of Gotland, Sweden as it saw the launch of the first rotary kiln at the Slite cement works. The plant has always been considered highly modern as the company has continuously worked towards reducing its environmental impact in terms of dust, noise and vibration.

November 3, 2009, was also a special day for the Slite factory, Cementa AB and the HeidelbergCement group. A new bag filter designed for a volume flow of more than 1,200,000m³/h was inaugurated in the presence of Dr Bernd Scheifele, CEO of HeidelbergCement. The background to this investment is in accordance with the company's local and global responsibility to reduce the impact of its cement production on the environment. Replacing fossil fuels with alternative fuels represents a significant contribution in this regard, reducing CO_2 emissions in particular. By 2010, the group aims to lower specific dust emissions by 15 per cent. As only filtering separators are able to comply in these cases with the legal and internal emission limits under all conditions, the operator decided to opt for modern bag filter technology.

In September 2008, Intensiv-Filter was awarded the contract for the dedusting of kiln Line 8 at the Slite plant. The turnkey project included a ProJet mega® bag filter, process fan, ducts and dust discharge system as well as transportation, installation and commissioning.

Project plan

Odysseus was able to navigate the world's oceans without a map and compass. After 10 long years at sea, he had the appropriate knowledge and necessary practical experience to more or less sail well. However, where he arrived was often not predictable and the trip not on schedule. Carrying out a project in this manner bears many risks and shipwrecking is inevitable.

Intensiv-Filter is awarded the contract at the Slite cement plant, Sweden for the dedusting of kiln line 8. At the heart of the turnkey project is a ProJet mega® bag filter

The contract for the new bag filter was logically edited by Intensiv-Filter with an appropriate "plan and compass." Also in the early stages of the project there was close cooperation between the respective engineers of the customer and Intensiv-Filter to develop a tailored solution.

After signing the contract in September 2008, further details were specified and determined. Not only did the technical characteristics of the production process have to be discussed and planned in detail, but also the entire settlement of the project. The design and manufacturing of the individual components were defined with a meticulous schedule in co-operation with the logistics and assembly department. A team of engineers and technicians accompanied the entire project carrying out continuous quality and manufacturing controls.

The finally implemented variant (Figure 2) clearly shows what significant flow optimisations can be achieved by constructional changes. Baffles were constructed accordingly and placed at the optimal position after the evaluation and determination of the CFD data. Thus the recirculation zone and the flow field were homogenised in the main ductwork. The execution of the raw gas duct also was improved on the basis of the flow optimised parameters. Due to the homogeneous inflow a much lower pressure drop could be realised, which leads to a lower energy consumption in the future.

Optimisation of volume flows

Numerical fluid mechanics, which is used with the help of CFD-programs (computational fluid dynamics) for the solution of procedural tasks to an increasing extent, was also applied for

Figure 1: initial situation and alternatives of the inlet stream

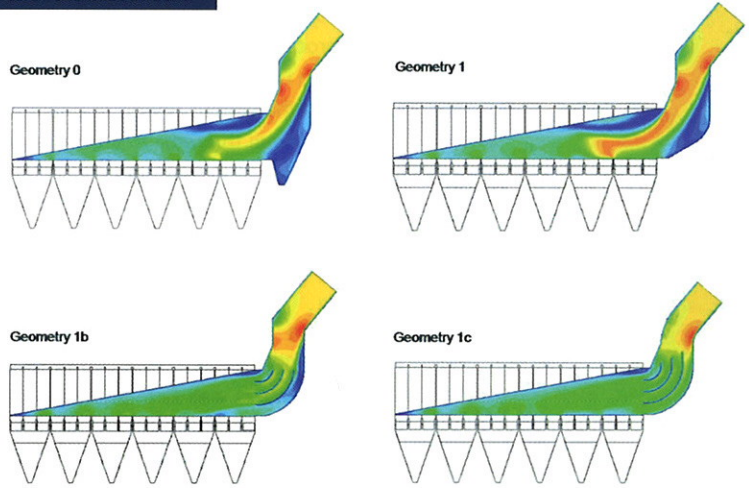
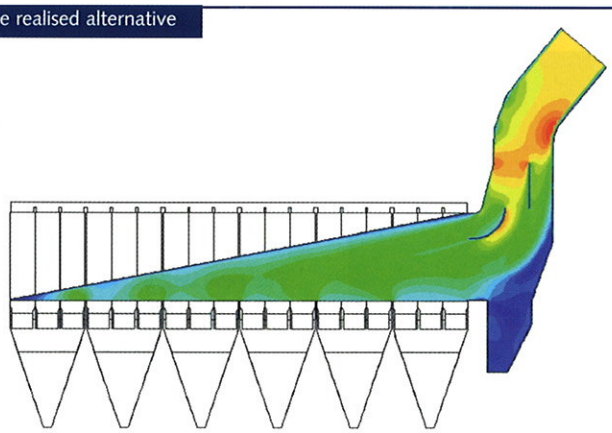


Figure 2: the realised alternative



this commission. In total, Intensiv-Filter carried out five different flow calculations in the area of the filter inlet to determine the flow distribution into the filter. Figure 1 shows the initial situation (Geometry 0) of the filtering installation on the example of the inflow area and three other variants (Geometry 1, 1b and 1c) with or without baffles respectively pre-separator.

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Transport

Over 800t of material had to reach the installation site on Gotland by September 2009. With the cement plant being located directly at the port, this provided the ideal conditions to handle most of the journey by ship. With dimensions including diameters of 4.5m for the ducts, transfer from Germany to Sweden completely by water was the best option. Only approved and escorted heavy and specialised transport was able to convey the cargo overland. This was even necessary during transfer to the port of embarkation.

Installation and commissioning

Before the bag filter (with dimensions of 33m length, 15m width and 22m length) was put into operation in November, essential construction and installation work was necessary. In April 2009 the site could be established and assembly work officially began in May 2009.

The foundations had been erected previously, and were directly next to the old electrostatic precipitator (ESP) which was no longer able to meet the current requirements for air pollution control. Approximately 160t of steel were assembled as a support structure, maintenance platforms and railings and around 180t of ducts with a diameter of 3m and 4.5m were installed.

A particular challenge for the construction team were the poor weather conditions on the island. High winds and snowload had to be taken into account in the static and dynamic loading of the components. The assembly team experienced such conditions several times. Some of the work of the 500t crane, which had been especially transferred from the mainland, had to be put down due to high winds of 50km/h.

The time-critical phase was reached in

Figure 3: embarkation in Leer


Figure 4: state of installation, July 2009

Table 1: design data of the bag filter

	Dust removal kiln/raw mill line 8
Needed time for erection	24 weeks
Gas volume	<1.223.500m³/h
Temperature	Maximum 220°C peak
Raw gas dust content	Maximum 900g/m³ n.c.
Residual dust content	<10mg/m³ n.c.
Cleaning mode	offline
Maintenance	online
Cleaning pressure	0.3-0.6MPa
Compressed air consumption	<310m³/h n.c.
Filter surface area	20.289m²
Length filter bag	8000mm
Filter material	glass fibre with PTFE membrane

October 2009. Until that point, regular production ran alongside the installation of the new filter system. After shutdown and stopping of the kiln on October 2 2009, the switch-over of the ducts from the raw mill and the rotary kiln to the new bag filter was carried out. The required period for the switch-over still was less than scheduled. In only 17 days, the old ductwork was dismantled where necessary and the new ducts including support structures were assembled. The old fan was separated from the existing ducts, the housing, impeller, shaft and bearings including drive were mounted anew and realigned.

Immediately after completion of the switch-over final quality and safety testing began. After a successful black-light test and completed cold commissioning, the precoating of the installed filter media followed as well as the subsequent admission of the filter media with the process gas. The kiln was heated step-by-step until the temperature was reached and the various modes of operation could be driven through. To ensure an optimal and energy-saving function of the filtering installation, the cleaning of the filter media is observed and optimised on a first operational phase of time.

The result

The Slite cement works ranks, both in the past as well as today, among the most modern and energy-efficient plants in Europe. The investment of SEK120m (approx. €11.77m) in the bag filter replaces the ESP from 1979, which was not able to adhere to required emission limits under all conditions.

With residual dust content of 50mg/m³ to last 30mg/m³ – after many upgrades – the company decided to opt for modern bag filter technology which easily falls below the legally prescribed residual dust limits.

The new bag filter of the ProJet mega generation reduces dust emissions – <10mg/m³ is guaranteed. It also has a direct share in environmental protection. Indirectly, because of its high energy efficiency, the filter also contributes to the reduction of CO_2 emissions. Compared to conventional filter designs, the ProJet mega in offline operation achieves energy savings of up to 30 per cent.


Figure 5: the commissioned bag filter