
Beating *Emissions Limits*



**HENRIK VITTRUP PEDERSEN,
FLSMIDTH'S GLOBAL FABRIC
FILTER MANAGER,** REPORTS ON
HOW THE COMPANY HAS HELPED
KEEP DUST EMISSIONS DOWN AT
THE STAR CEMENT PLANT IN RAS
AL-KHAIMAH.

Introduction

Over the past 15 years, the United Arab Emirates (UAE) has experienced one of the largest construction booms in history. As a result, the demand for building materials has skyrocketed – and to keep supply levels up, cement plants had to import large quantities of clinker. But always a step ahead, Star Cement, one of the leading cement manufacturers in the Middle East, decided to build its own clinker plant. The UAE has strict requirements on fugitive dust emissions, so Star Cement asked the Air Pollution Control unit of FLSmidth to take part in the bidding process for the fabric filter system.

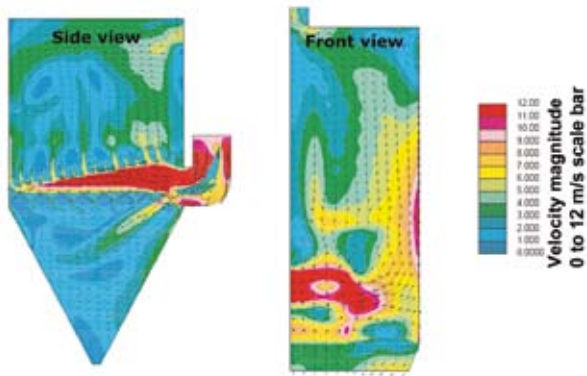


Figure 1. Gas distribution. Vertical mid-plane cross-sections (front and side views).

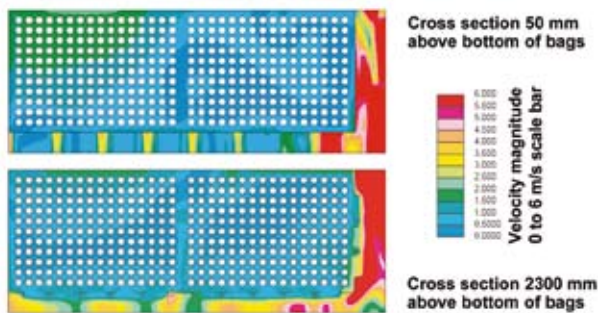


Figure 2. Gas distribution. Different horizontal cross-sections in the filter section.

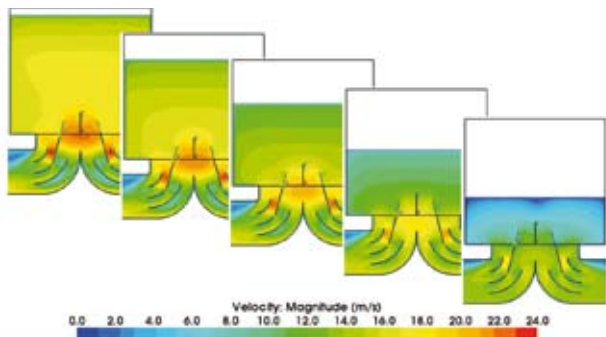


Figure 3. Gas distribution. Section planes in manifold (at compartment inlets).

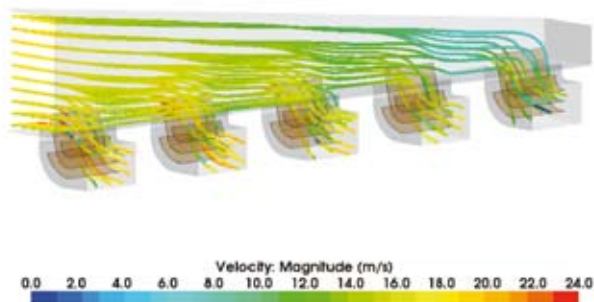


Figure 4. Stream lines. Trajectories of mass-less particles (symmetric view).

Outstanding environmental performance and low operational costs were high on the agenda for Star Cement when it opened the bidding process for its greenfield clinker plant in the northern Ras al-Khaimah emirate. The UAE recently introduced strict regulations to curb a major air pollution problem – particulate emissions must not exceed 15 mg/m³ – so the air pollution control (APC) system for the new clinker plant had to be extremely reliable and effective. Several APC equipment suppliers competed for the project. Star Cement awarded the contract to FLSmidth thanks to the high filtration efficiency, reliable performance and low long-term operating costs of its FabriClean™ Pulse-Jet Fabric Filter.

This is the first collaboration between Star Cement and FLSmidth’s Air Pollution Control unit. However, the author had previously worked with T.V.S Chidambaram, Star Cement’s Technical General Manager, on a project in Saudi Arabia that involved converting an ESP to a fabric filter. The job exceeded expectations and according to Mr Chidambaram, “the Air Pollution Control unit has an excellent reputation; they provide great service and first-rate customer relations.”

Getting the balance right

During the plant’s design phase, FLSmidth conducted a number of tests using a Computational Fluid Dynamics (CFD) program at its Valby R&D Centre in Denmark, in order to design a customised filter system to meet Star Cement’s needs. The CFD program simulates airflow velocities from the kiln through the baghouse filter and measures the distribution of gas and dust particles. Figures 1 – 4 illustrate just a few of the CFD models created during the design of the filter. Vittrup explains, “low dust and gas velocities lead to longer filter bag life. However, it is a delicate balance. Dust laden flue gas from the kiln is directed through a unique inlet gas distribution system into each baghouse compartment. Baffles and deflector plates ensure that most of the dust is deposited directly into the hoppers, reducing the dust burden to the filter bags. The remaining dust particles are collected on the surface of the filter bags, which forms a dust cake. As the dust cake builds, the ability to draw air through the filter bag decreases. The bags have to be cleaned with compressed air, which is pulsed downward inside the filter bags to dislodge the dust cake. Increased cleaning cycles accelerate wear of the filter bags, ultimately leading to flex fatigue of the fibres, which causes the bags to fail. Ideally, it is best to clean the bags as infrequently as possible in order to maximise bag life and minimise compressed air consumption, while maintaining the proper airflow through the baghouse – it is a delicate balance that is hard to get right.”

The innovative design of the FabriClean™ overcomes this challenge. The gas distribution design optimises gas flow across the entire baghouse, resulting in lower differential pressure, and reduces the amount of dust entering the individual compartments. This means the dust cake takes longer to build on the surface of the filter bags. Therefore, the bags are cleaned less frequently with lower compressed air pressure, which extends the life

of the filter bags. In addition, the baghouse is equipped with FLSmidth's SmartPulse™ Controller, which operates the compressed air cleaning system. The controller has an automatic diagnostic feature that analyses pulse duration, time interval and pulse pressure in relation to baghouse differential pressure. It automatically adjusts the parameters to minimise the use of compressed air, ensuring the most efficient operation and maximising the life of the filter bags.

FLSmidth was asked to factor the possibility for an increase in clinker production into the filter design. If Star Cement decides to increase its kiln capacity in the future, there has to be extra filter capacity available, so the layout drawings include provision for two more compartments to handle the increased airflow.

Onsite construction

With the CFD modelling complete, the final design specifications, including a kiln filter, a clinker cooler filter and a bypass filter, were delivered to the Ras al-Khaimah site. Plant construction began in June 2007, where a team of local workers constructed the filters under the guidance of FLSmidth supervisors.

The clinker plant was completed in July 2009, and went into operation soon after – and start-up has been

problem-free. “We are getting very good performance. The bag filter emission levels are below 10 mg/m³ – this is 5 mg below the legal level – so we are very pleased,” explains Mr Chidambaram.

From July to December 2009, the plant produced 700 000 t of clinker – and the clinker is transported directly to Star Cement plants in Abu Dhabi and Ajman for grinding.

Great results pave the way for future collaborations

The plant's six month inspection will take place in March. This means a complete plant shutdown, and an FLSmidth Air Pollution Control engineer will be on-hand to ensure everything goes smoothly. “The system we designed is performing well below the emission guarantee,” says Vittrup, “so we know we've got the right gas and dust distribution in the filter. We're confident in the quality and long-term performance of the filter bags since they came from our filter bag manufacturing facility in Evans, Georgia. Our AFT™ filter bags have a four year performance guarantee, so it will be some time before they need to be evaluated. If any problems do arise with the filter operation, we have an office in Dubai, 100 km from the Ras al-Khaimah Star Cement plant, so an APC specialist can be onsite to provide technical support within a few hours.” 📍

Figure 5. The FabriClean™ baghouse.

