Firing technics for the reduction of fluoride emission by producing bricks

LIFE99 ENV/NL/000236

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Project description:

Background

The ceramics industry is one of the major sources of fluoride emissions, which causes important concerns both at national and international level. Up until a few years ago some 90% of the facilities of the Dutch ceramics industry exceeded the emission standard of 5 mg/Nm3 at 18% oxygen. Then about 20 of the 50 production companies in the Netherlands installed an end-of-pipe flue gas cleaner. This made it possible to comply with the emission standards but created a new problem as the flue gas residues are hazardous wastes. Research carried out by the Technical Centre for the Ceramic Industry and by others demonstrated that the emission of fluoride could also be reduced in a process-integrated manner, so that investments and operational costs of flue gas cleaners (in particular the costs of calcium split and waste treatment costs) could be reduced. Waalsteenfabriek De Bylandt B.V. decided to carry out a full-scale demonstration of the research results. A new kiln was built and a new manner of placing the products on kiln cars was developed. The beneficiary obtained a Life grant in 1999. The project was a successful continuation of a research contract under the 1991-1994 Research Programme of DG Environment (contract EV5V CT94 0526 – “Fluoride emission abatement in heavy clay products manufacture by process modification and control”). In the current project a number of the measures suggested in this research were implemented in practice.

Objectives

This project aimed to achieve a significant reduction in fluoride emissions arising from the production of ceramic bricks. The project consisted of the engineering, construction and demonstration of a new type of tunnel furnace. The expected results were that by using an innovative stacking method, tunnel kiln and firing technique, fluoride emissions could be reduced by approximately 90%, to around 5 mg/Nm3, at 18% O2, so that the emission requirements could be met without using a flue gas cleaner. The project included the following tasks: 1. Task 1 Engineering 2. Task 2 Foundation, building, construction 3. Task 3 Start-up and commissioning 4. Task 4 Monitoring 5. Project management 6. Dissemination

Results

The project achieved good results. The full-scale demonstration of the innovative kiln was successful and Waalsteenfabriek “De Bylandt” BV continues to achieve good results in the areas of production capacity, product quality, energy consumption and emissions reduction. Production flexibility is also greatly enhanced. This means that there is greater freedom to pile stacks of bricks on the kiln cars than there would be in conventional cases, so there are possibilities to produce a larger number of different products with different dimensions. These extra production opportunities have also improved the viability of the company. However, the initial objective of 90% reduction of fluoride emission through process-integrated measures appeared to have been too ambitious. Nonetheless, a significant step in the right direction was made, with a 24% lower emission concentration and a 38% load reduction of fluoride emissions by the process-integrated measures in the new kiln, as compared to a reference project. The remaining flue gas residue is recycled in the production process itself so that there is no waste to be disposed of. An additional environmental benefit is the improved energy efficiency. The new kiln uses 20% less natural gas per tonne of product than existing kilns. This also means a 20% reduction in the emission of carbon dioxide (a greenhouse gas). The production of paver ceramics is usually based on tunnel kilns. The products are carried through the tunnels in enormous stacks on kiln cars. The most commonly applied stacking method in Europe is based on a ‘quadratic pattern’, whereby square blocks of products are placed on the wagons mechanically. During the last few decades disc structures have become increasingly popular, as they allow better heat transfer between the kiln gases and the products. Research has shown that a stacking method that enables a larger part of the load to come into direct contact with the kiln flue gases, allowing better absorbtion of the released fluorides, has a positive effect on the emission concentration of fluoride. Pilot firing tests were subsequently undertaken, whereby products were stacked differently on a kiln car, in comparison with a conventional stacking method, which was used as a control. Suitable stacking methods as well as loading/unloading machines for the production of both fired pavers and masonry bricks have been developed on the basis of this research. This has facilitated the requirement to maximise the contact surface to be fully taken into account. The heating zone of the new kiln was also extended beyond the normal thermodynamic requirements. The total passage time through the existing furnaces 1 and 2 is approx. 35 hours. The new furnace has a total passage time of approx. 50 hours. In order to maximise the

exchange of substances in the heating zone, high-speed burners are used in this part of the kiln. The high output speed of the flue gases from these burners results in strong turbulence and an ejection effect, so that the absorption of fluorides by the product is intensified. Most river clay used in the Netherlands naturally contains calcium carbonate, so that the requirement for fluoride binding in the heating zone of a tunnel kiln is met for most product types. The key innovative elements of the new kiln and way of packing are: 1. The extremely small discs of products that are packed together and fired in a grid structure; 2. The flue gas cycle is raised to a maximum to achieve better absorption of fluorides by the products, in combination with intensive circulation of the flue gas in the preheating zone; 3. The loading and unloading equipment for very specific stacking of products on the kiln cars; 4. The car transport and safety in relation to the (unstable) loading method; 5. The extended pre-heating zone of the tunnel kiln, in order to improve the contact time between the flue gases and the product. In the heavy clay sector, the full re-use of the flue gas residue in the raw materials (so that no residue has to be sent to waste disposal) is also considered to be innovative. Pay back times are approximately 6 years (for the process integrated measures) or 20 years (for the total investment). The benefits are the lower use of energy and the reduced cost of fluoride emission treatment. The extra flexibility is also an important benefit (higher flexibility improves the viability of the company) but cannot be calculated in terms of payback times. The sustainability of this first full-scale application is ensured, as the Waalsteenfabriek De Bylandt is very satisfied with the new kiln. Dissemination has been limited but effective: some 50 plant managers from the ceramic industry of Belgium, Germany and the Netherlands attended an information meeting and have seen the kiln in full production. According to the Technical Centre for the Ceramic Industry, the proposed firing technique can easily be used in other companies as it is a combination of proven technologies. The reproductive capability of this technique is not geographically bound. It could be applied successfully in other areas, and in other sectors where similar processes are involved. In terms of transferability, the main limiting factors are: 1. Relevant tests have to conducted to show that this is also suitable for application in other cases; 2. Local cost and benefits; 3. Local emission standards. The results of this project could be extremely useful in the process of the production of best available techniques reference documents (BREFs) under the IPPC Directive. The Technical Centre expects no spontaneous applications of this technology in the next few years as investments in this industry stopped recently due to a crisis in the building sector.

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Environmental issues addressed:

Themes

Air & Noise - Air pollutants
Industry-Production - Non-metallic minerals

Keywords

end-of-pipe technology, flue gas, hazardous waste, ceramics industry, emission reduction

Target EU Legislation

- Air
- Directive 84/360 - Combating of air pollution from industrial plants (28.06.1984)
- Waste
- Directive 91/689 - Hazardous waste (12.12.1991)
- COM(1996)399 - Communication on an updated "Community strategy for waste management" (30.07.1996) ...
- Industry and Product Policy
- Directive 96/61 - Integrated Pollution Prevention and Control (IPPC) (24.09.1996)

Natura 2000 sites

Not applicable

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Beneficiaries:

Coordinator	Waalsteenfabriek 'De Bylandt' B.V.
Type of organisation	SME Small and medium sized enterprise
Description	The beneficiary, Waalsteenfabriek “De Bylandt” BV, is a producer of ceramic bricks. The business is located in Tolkamer, The Netherlands, where there are four tunnel furnaces. The Company has a workforce of about 50 people. The Technical Centre for the Ceramic Industry and the Hans Lingl Anlagenbau und Verfahrentechnik GmbH & Co were the main subcontractors to the project.

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Administrative data:

Project reference	LIFE99 ENV/NL/000236
Duration	01-JUL-1999 to 31-DEC -2001
Total budget	5,797,269.15 €

EU contribution	598,479.38 €
Project location	Gelderland(Nederland)

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Read more:

Project web site	Internet Site
Project web site	Internet Site
Publication: Layman report	Title: Layman report Author: Bylandt Year: 2002 No of pages: 6

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