# Reduction of Dioxin Emission from Hoogovens Sinter Plant with the *AIRFINE*® System

A. Smit*, T.H.P. Leuwerink*, A.L.J. van der Panne*, W. Gebert, C. Lanzerstorfer, H. Riepl and K. Hofstadler

*Hoogovens Steel Primary Products, PO Box 10000, 1970 CA IJmuiden, The Netherlands
VOEST ALPINE Industrieanlagenbau GmbH, PO Box 4, 4031 Linz, Austria

## Introduction

A major source of dioxins in the iron and steel industry are sinter plants. In these plants a mixture of iron ore, recycling material of the steel work, lime and coke are ignited under the ignition hood and forming sinter on the travelling grate.
At Hoogovens Steel three sinter strands, with suction areas of 1 x 90 $m^2$ and 2 x 132 $m^2$, produce approx. 4.4 million tons of sinter per year. Like other steel plants, Hoogovens Steel[1,2] have to meet strict environmental regulations with respect to emissions from their sinter plant. The combined off gas of these three sinter plants (580 000 $Nm^3/h$) is treated with the *AIRFINE*® system. Through this treatment the dioxin emissions are reduced to a level of 0.2 to 0.24 ng I-TEQ/$Nm^3$.

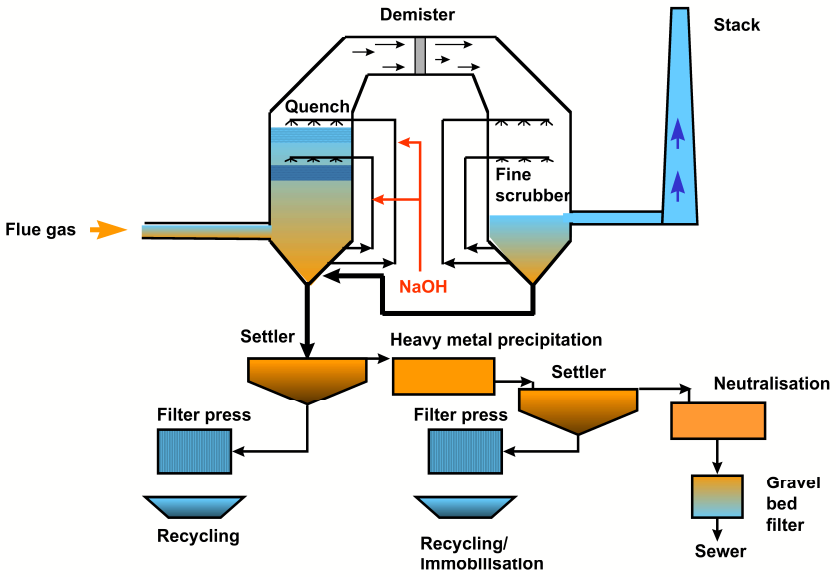


**Figure 1 Schematic drawing of *AIRFINE*® system**

The *AIRFINE*® -process [3,4] (Figure 1) can be divided into three main systems:

1. Quenching system for coarse dust separation, waste gas cooling and water saturation
2. Fine scrubber system for fine dust separation and simultaneous gas cleaning
3. Water treatment facility for by-product separation

The heart of the *AIRFINE®* process is a fine scrubber system where specially developed dual flow nozzles eject water and compressed air as high-pressurised fine droplet spray into the cooled and water saturated waste gas stream. This allows for the removal of the finest dust particles and noxious gas components[5] (PCDD/F, heavy metals, HCl, HF, $SO_x$) to a degree of efficiency which is unattainable by employing conventional systems.

The discharge water is cleaned in a three-stage water treatment plant (by-product separation, heavy metal removal and neutralization). By-products, like ferrous components are recovered, separated and recycled to the sinter strand.

## Materials and methods

All dioxin measurements in the raw gas (inlet of scrubbing system) and clean gas (in front of stack) were done according to VDI 3499 respectively DIN-EN 1948. The filter cake samples, sludge and clean water are averages of three to five samples.

## Results and discussion

## Dioxin and dust removal

The fine dust particles are separated from the flue gas in the fine scrubber. The washing liquid in the fine scrubber system is atomised with compressed air and sprayed in co-current flow to clean the gases.

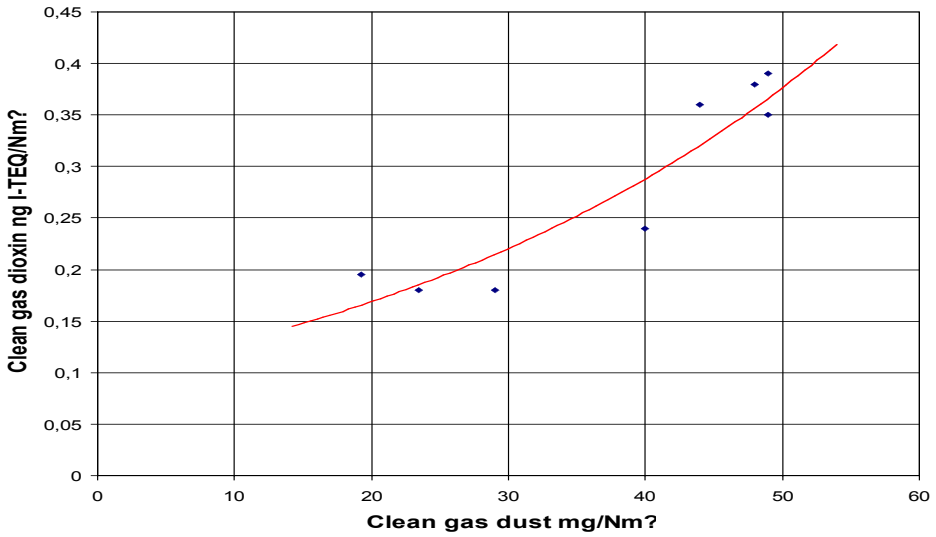


**Figure 2 Correlation of dust and dioxin removal**

Water droplets with a size of approx. 50 µm remove the dust particles from the gas stream by means of a combination of the following separation mechanism:

- inertia forces (high relative velocity between droplet and dust)
- diffusion (high concentration of droplets in flue gas)
- local supersaturation effects (cooling by the expansion of compressed air)

Simultaneously, the dioxins, which stick to fine dust particles, are separated from the flue gas too (Figure 2). The first reason for the correlation between the dust and dioxin removal is the extremely large surface of the fine particles available for adsorption and condensation, during the quench-cooling. The second reason is the large surface of the droplets at the fine scrubber which is again available for condensation and/or adsorption of the gaseous PCDD/F. Additionally the supercooling in the nozzle jet (expansion of compressed air) enhances the dioxin removal.

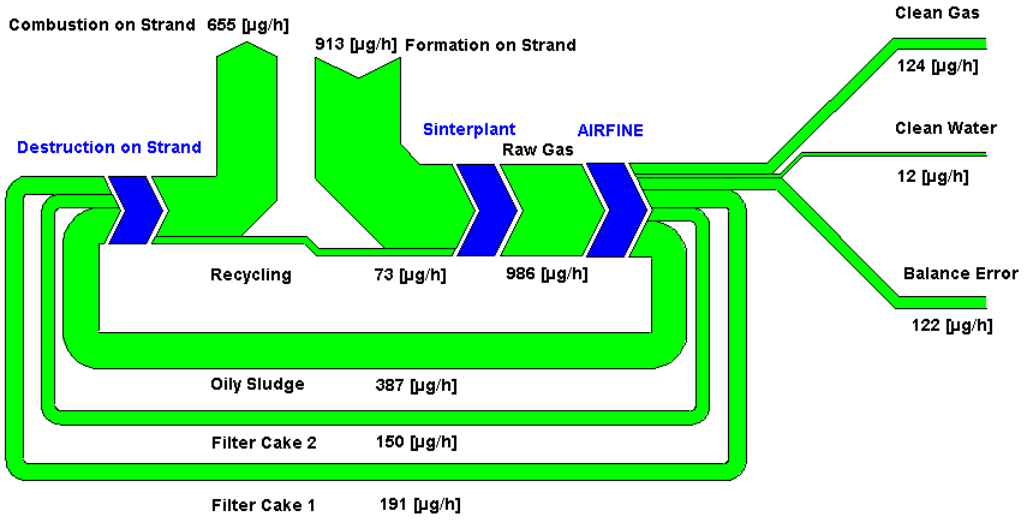


**Figure 3 Overall flow of dioxins**

## Recycling loop and dioxin destruction

The filter cake No.1 (containing undisolved solids) and filter cake No.2 (heavy metal precipitation) from the water treatment are recycled. A large quantity of iron(III) hydroxide flocs are formed during the heavy metal precipitation, which helps the removal of organic substances and improves the sedimentation properties. Both filter cakes are returned to the sinter plant.

The oily sludge, which is treated to remove excess water, is also returned to the sinter plant. All organic substances (condensation starting at 60°C) form small particles and/or will be adsorbed on the surface of dust particles and water droplets. In the sedimentation basin No.1 is an oil skimmer installed to remove this sludge from the surface of the water.

Important for the recycling of dioxin containing substances is that the dioxins are bound on or into particles which keep them in the sinter mix until they are burned. If separated dust, without any treatment, is recycled, the destruction efficiency on the strand is very low, because dioxin can evaporate before any destruction can occur.

The AIRFINE®system operating in Hoogovens clearly demonstrates that this recycling loop (Figure 3) is an optimum solution to solve the dioxin problem in sinter plants[6].

## Acknowledgement and references

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