Effective removal of secondary dust in the HKM steel plant

German steel producer Hüttenwerke Krupp-Mannesmann (HKM) has improved the dust removal in the processes of the steel plant. An advanced dust removal and gas cleaning plant was designed, built and implemented that goes far beyond the parameters of a conventional dust collector. The existing installation was augmented with a new bag filter which increased the existing suction power of approx. 700,000 m³/h by a further 600,000 m³/h. Using this new filter the threshold values at the ladle treatment, hot metal desulphurisation and treatment plants as well as alloying stations have been significantly reduced.

Figure 1. Filter No. 5 of the HKM steel works

For nearly 200 years, steel has been refined in Germany's Ruhr district - for 100 years at the location Huckingen in Duisburg, the largest steel-producing town in Europe. Not only since the foundation of Hüttenwerke Krupp Mannesmann (HKM) in 1990, investments in protecting the environment at the location have been continually realised.

During the 1960s, the stacks of the German steel industry were still pouring out 10 kg of dust for every tonne of crude steel produced. With a production of up to 45,000,000 t of steel per year, the national steel industry was responsible for a total of 450,000 t of dust emissions. On the one hand, these dust emissions had an impact on the environment. On the other hand, this meant a huge amount of product was being wasted. HKM has integrated environmental protection into its business approach, implementing innovative measures in order to continually reduce dust emissions. Today, dust emissions are at less than 0.7 kg per tonne. Figures such as these can only be achieved with efficient dust removal installations (figure 1).

In recent years, globalisation has significantly changed the steel industry, with companies taking on new dimensions. The incorporation of the steel-producing locations Rheinhausen (Krupp) and Hüttenwerke Huckingen (Mannesmann) into HKM is a groundbreaking step for competition amongst steel producers. This year, HKM celebrates its 100th anniversary of steel-production in Duisburg-Huckingen.

Advanced secondary dust removal in steel works

The commissioning of the new filter No. 5 in the HKM steel works in Duisburg is another significant step on the path towards reducing dust emissions. The existing installation was augmented with a new bag filter which increased the existing suction power of filter No. 4 of approx. 700,000 m³/h by a further 600,000 m³/h. The dust removal from the torpedo ladle siphoning pit and hot-metal desulphurisation needed to be optimised. Implementing these measures was a serious task. HKM has chosen the plant manufacturer Küttner as its partner and supplier for upgrading its secondary dust removal, with

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Intensiv-Filter as the filter supplier. It was essential that the rail transport, truck supply and steel ladle transport links were not to be disrupted during the conversion process. In addition to this, the work had to be carried out while the existing filter No. 4 was still in operation.

An innovative solution was eventually yielded together with HKM: The new filter was built in an open space opposite the steel works. As a result of this, it was necessary to bridge the distance of approx. 50 m between the steel works and the filter entry with a self-supporting, 20 m high crude gas pipe.

In addition to this, a junction **(figure 2)** was added to the crude gas collection pipe on the roof of the steel works in order to distribute the various suction points properly between the two filters. Since then, the existing filter No. 4 and the new filter No. 5 have been running simultaneously. This guarantees effective dust removal for all the gases in the charging area and all other areas of the steel works.

Figure 2. Junction of the crude gas collection pipe

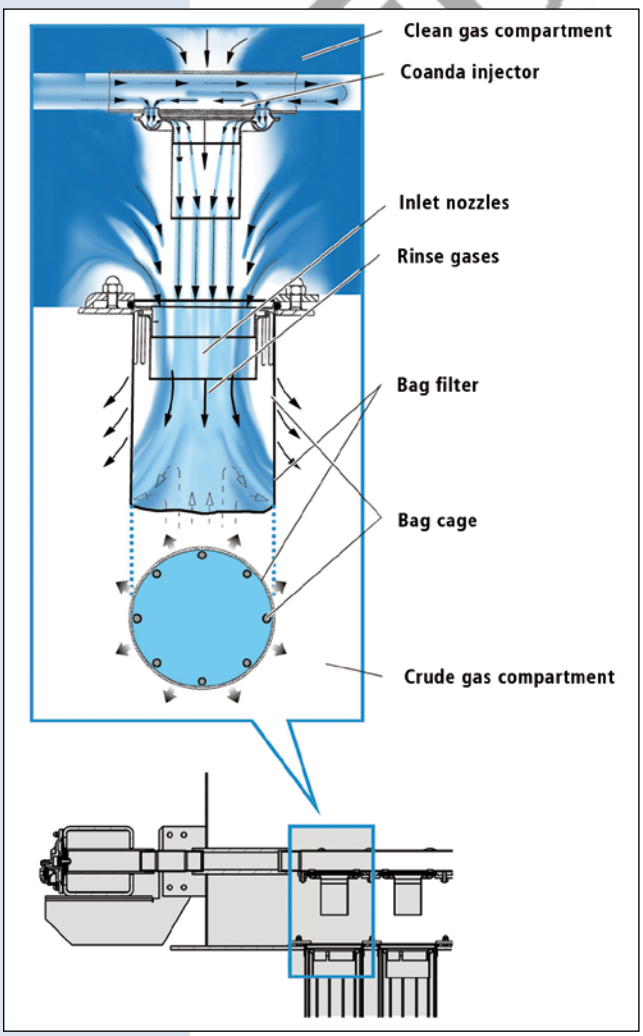

Figure 3. Detailed view of the Coanda injector

Dust removal with bag filters

A two-row bag filter cleaned with compressed air was applied as a so called “double filter”. The double filter features a compact design, with a combined crude and clean gas channel, which allows a lot of space to be saved. The baffles and deflectors in the channel ensure that the crude gas flow is distributed properly, and also reduce wear on the filter bags by screening them and directing the flow.

The bag filter used has some interesting characteristics. The filter is made of polyester needle felt, with a bag length of 6,750 mm. A cleaning control unit according to the requirements is used to clean the filter with automatic admission pressure control in off-line mode.

The valuable benefits of Intensive bag filters are:

- high operational safety due to established technology,
- low operating costs due to low pressure loss in the filter when cleaning in off-line mode,
- low residual dust content with the right filter bag quality,
- minimal installation space required due to the use of long filter bags,
- effective cleaning with the patented Coanda injector system,
- improved dust collector performance, as secondary air is fed through during the cleaning phase,
- guaranteed quality and adherence to schedule due to standardised modules and serially manufactured components.

Filter cleaning

For “off-line“ cleaning, the filter chamber to be cleaned is taken out of the filtration process by closing the valve. Cleaning is carried out by injecting compressed air the opposite direction to the filtration flow via the two-

stage, patented "Coanda" annular gap injector. A ventilator is used to channel the rinse gas out of the clean gas flow and through the rinse gas channel to the individual compartments. This "off-line" cleaning ensures that fine dust is thoroughly channelled into the dust collection chamber via a downward flow after the filter bags have been detached. Once a filter compartment has been cleaned, the next filter compartment is switched into the cleaning system.

The mode of the filtering installation is automatically adjusted to the necessary operational requirements by controlling the cleaning level. The decisive control variant for this is the filter resistance, which is determined using differential pressure measurement.

The filter is operated with two independent pressure control circuits – one for each half of the filter (figure 3). Both control circuits work with the same nominal values, which are specified by the control system of the installation. Each control circuit contains a pressure transmitter for determining the actual value of the cleaning pressure and the control valve.

If pressure exceeds the nominal value, a safety valve secures the filter's rinse gas system. There is a shut-off valve between each filter compartment for performing maintenance work, e.g. repairs or checks, on individual areas while the installation is running.

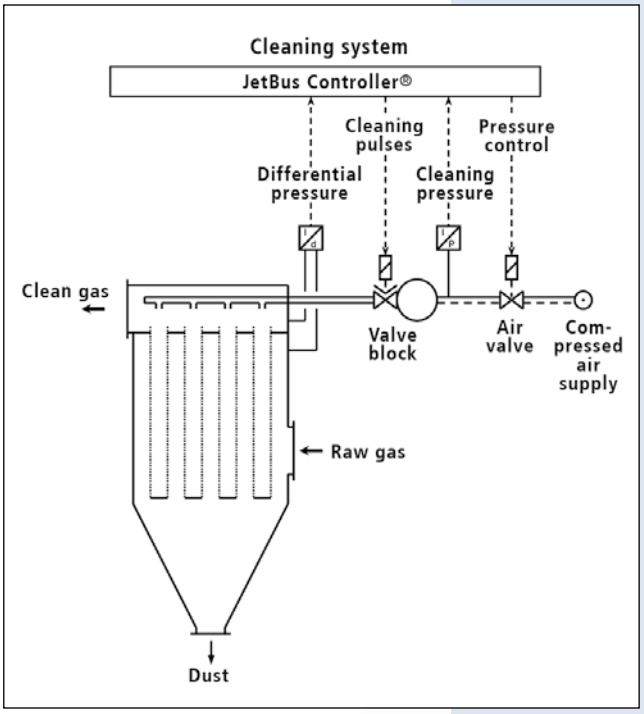

Figure 4. Diagram of the cleaning pressure control system

Gas volume	600,000 m³/h
Rinse gas flow	26,000 m³/h
Temperature operation range	20 - 60°C (80°C)
Intensiv Filter type	IFRC 85/30-6.750 D
Filter surface area gross / net	8,922 m²/8,030 m²
Filter medium	Polyester needle felt
Construction time	8 months
Required residual dust content	< 20 mg/m³ (s.t.p., dry)
Pressure loss	< 0.8 kPa
Cleaning pressure (admission pressure control)	250 - 600 kPa
Cleaning	off-line

Table 1. **Technical data of the secondary dust removal by the steel works filter No. 5**

Safe residual dust according to legal requirements

Since January 14, 2008, the new filter No. 5 has been in operation in the steel works. The dust concentration at the ladle treatment, hot metal desulphurisation, treatment plant and alloying workstations have been significantly reduced compared to those with the old filtering installation, which now only empties the siphoning pit. The clean gas dust content readings in the blow-out stack are well below the legal limit.

Küttner and Intensiv-Filter designed the dust removal and gas cleaning for HKM using the modern design variants described above. On the basis of the specific customer conditions, the dust removal represents a complex waste gas cleaning installation which required the implementation of process engineering solutions. The gas cleaning installation can only be devised for a specific purpose if all circumstances relevant to measuring, operating methods and the selection of materials are known. The installation concept from Küttner and Intensiv-Filter goes far beyond the parameters of a conventional dust collector (table 1).

Well experienced in customized filter design

Intensiv-Filter has trusted to be one of the largest and most successful system providers for dedusting technology and product recovery for more than 85 years. The company offers a full range of products and services for filtering and dedusting systems, from planning, engineering and production, to installation, commissioning and service. The product range includes process bag filter systems for up to 2 million m³/h capacity, standard filters, circular filters, CIP filters, cyclones, cooling systems and fans. Intensiv-Filter also manufactures and distributes customised filter media and guarantees optimal selection and maximum quality and fit. The Intensiv-Filter Group includes Infastaub GmbH and Solidux GmbH & Co KG, in addition to Intensiv-Filter GmbH & Co. KG. Infastaub and Solidux complete the product range with series-produced small filters and dust collectors, as well as sound insulation. ■