Dust emissions following start-up or shutdown of a sinter plant

This document explains the issues associated with the abatement of dust emissions from a sinter plant equipped with advanced electrostatic precipitators (ESP) prior to a plant shutdown or after a plant start-up. It proposes to set conditions within the permit that will allow emissions during these periods to be adequately considered. This is based, however, upon knowledge of the current sinter plant abatement system. It is possible that this may need revising in light of the introduction of lignite injection and the modifications made to bring normal operating emissions below the emission limit value of 40 mg/Nm³. For example, it is not known whether a longer time period of stabilisation will be required to meet the daily mean of 40 mg/m³ rather than the hourly average of 115 mg/m³. Once improvements to the abatement system are completed, it is proposed to study the abatement performance prior to a plant shutdown and following a plant start up with a view to refining condition.

Advanced electrostatic precipitators (ESPs) are the most commonly used devices for the de-dusting of sinter plant waste gas emissions. For many years now they have been regarded as best available technology for this application and they have been applied at numerous sinter plants worldwide. Advanced ESPs are cited as best available technology for sinter plants in the current edition of the EU BAT reference document.

The operating principle of the ESP is based on the creation of an electrostatic field normal to the flow of particulate matter carried by the waste gas stream. The particles acquire a negative charge by interaction with electrons emitted by the discharge electrode and subsequently migrate towards a series of positively charged collector plates. Accumulated dust is removed from the plates by periodically rapping them with a series of hammers, thus causing the dust to fall into collection hoppers located beneath the plates.

The main advantages of advanced ESPs are as follows:

(i) they are capable of treating large volumes of waste gases at a relatively low pressure drop;

(ii) they have a relatively low maintenance requirement;

(iii) the dust is recovered dry and is easy to handle and amenable to recycling through the process ;

(iv) they are capable of treating high-temperature gas streams with high moisture contents.

The collection efficiency of advanced ESPs is dependent upon the characteristics of the gas and the dust particles carried by the gas stream. Advanced ESPs work most efficiently under steady conditions of volume (velocity) flow and temperature, and the design of an advanced ESP for optimum performance is based around the steady-state conditions that are likely to be generated in the process, in terms of waste gas temperature and composition, particle characteristics and dust loading. The electrical resistivity of the dust is an important factor and to achieve high collection efficiencies

with conventional advanced ESPs the specific resistivity of the dust particles should ideally be in the range 104 to 109 Ωcm.

For sinter plants the optimum temperature range for advanced ESP operation is 120 to 160°C and outside this range abatement performance is significantly compromised. This means that the performance will be reduced when the process conditions deviate widely outside the design specification. The widest deviations from standard operating conditions occur during the cold start-up and /or complete shutdown of the sinter plant for planned maintenance. Other shorter-term stoppages may occur from time-to-time a result of operating problems, which may last for a few minutes or several hours.

In the period before a plant shutdown (30 minutes), steady state conditions cannot be maintained because process changes are needed in this period to make the strand ready to be stopped. These changes include changing the strand speed, and, or, the burden that will affect the permeability of the bed.
These process changes will significantly affect the temperature and the volume of the waste gas to be treated by the advanced ESP and so the efficiency of dust capture will be reduced, resulting in emissions above the current compliance limit of 115 mg/Nm^3 and the future limit of 40 mg/Nm^3.

It is recommended by ESP plant manufacturers that the advanced ESP should only be started up when the optimum waste gas temperature has been attained. This means that during start-up, especially from cold after a planned or un-planned maintenance shutdown, the dust emissions will exceed substantially the current compliance limit of 115 mg/Nm^3 and also the future limit of 40 mg/Nm^3 that is to be met from March 2016.

The advanced ESPs at Scunthorpe Sinter Plant were designed and installed by Lodge Cottrell. The manufacturer has advised that the advanced ESPs can only be operated when the optimum operating conditions had been attained.

For these reasons, the efficiency of dust capture of the advanced ESP will be significantly reduced in the period before a shutdown (30 minutes), and the period after start-up (120 minutes) when steady state conditions cannot be achieved.

The current permit for Scunthorpe Sinter Plant recognises this, and states that “no limit applies for the hourly periods that coincide with a 30 minute period before a shutdown or a 120 minute period after a start up.”

In order to ensure the continued operation of Scunthorpe Sinter Plant after March 2016 with regard to the new dust emission limits, the new permit should continue to reflect the operational characteristics and performance of advanced ESPs and state “no limit applies for the hourly periods that coincide with a 30 minute period before a shutdown or a 120 minute period after a start up.”