National Council for Cement and Building Materials

GUIDELINES FOR REDUCTION OF DUST GENERATION AND EMISSION IN INDIAN CEMENT INDUSTRY

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NCB TECHNOLOGY DIGEST

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INTRODUCTION

THE cement industry is inherently characteristic in contributing to the air pollution in the form of dust emission from its various unit operations. It is to be ensured that dust emission is contained within stipulated levels so that it does not adversely affect health, comfort and well-being of people in and around a cement plant. Reduction in dust generation and emission has received close attention of NCB, and the Centre for Environmental Improvement at NCB has studied and investigated important aspects like reduction in dust generation, suppression of fugitive dust, evaluation of the performance of dust collectors and assessment of the scope for improving their performance through better design, operational and maintenance practices. This technology digest deals with certain broad guidelines for reduction of dust generation and emission aspects in Indian cement industry.

SOURCES OF DUST GENERATION

Dust sources are of two types: (i) process related sources, such as mills, kilns, coolers wherein the flow of air/gas inherent in the system entrains the dust handled in the section. Reduction in generation of this dust requires examination of process parameters, material characteristics, etc, (ii) fugitive dust sources, such as conveyor transfer points, leaking joints, open material stockpile, discharge from hoppers, wherein the generated dust becomes air-borne near the source itself. Abatement of this dust requires proper material handling system design and good operational practices.

REDUCING PROCESS DUST GENERATION

Mills and kilns constitute the major process centres in cement manufacture.

Mills

The various parameters which require detailed consideration for minimising dust generation are air velocity in the mill, mill system parameters and performance of cyclone in the circuit of air swept mills. Air velocity in the free cross-section of mill should normally be restricted to 1·8 m/sec in open circuit mill and 2·0 m/sec in closed circuit mills. General ventilation guidelines are:

	Gravity Discharge		*Air Swept Mill*	
	Closed Circuit Raw Mill	*Open Circuit Cement Mill*	*Raw Grinding Roller Mill*	*Coal Mill Tube Mill*
Nm^3/kg of product	0·3–0·8	0·4–0·8	1·5–2·5	1·2–2·6

The optimum product fineness to be ensured in different sections are given below:

Section	*Fineness (Retained on 170 mesh)*
Raw Mill:	
a) Wet grinding	10–12%
b) Dry grinding	16–18%
Coal Mill	8–20%
Cement Mill	6–8%

Kilns

The following aspects require consideration to reduce dust generation:

i) Optimum gas flow rates and hence optimum gas velocity in the kiln. These values are given in Table 1.

ii) Optimum raw meal/slurry fineness.

iii) Performance of twin cyclone in preheater.

iv) Proper chain system design in case of wet process kilns.

v) Use of properly designed seals to avoid ingress/leakage of air.

TABLE 1

Kiln System	Exit Gas Flow Rate (Nm^3/kg cl)	Gas Velocity in Kiln, m/sec.			Remarks
		In Burning Zone	*At Boundary of Calcining and Transition Zone*	*At Kiln Inlet*	
Wet	3.5–4.0	12.5–13.5	*11–12.0	7.0–8.0	*At the gas inlet to chain zone
Semi-dry	2.2–2.5	9.0–10.0	8.0–9.0	7.0–7.5	—
Dry SP	1.7–2.0	8.0–9.0	7.0–8.0	6.0–7.0	—

Process Cyclone

The performance of cyclone in grinding mill circuit and preheater twin cyclone plays an important role in reducing dust generation from these sections. The improvement in performance can be achieved by rational consideration of design and process parameters.

Procedures for improved cyclone design and measures for improving the performance of existing cyclones were developed by NCB. Following are the highlights:

i) Methods for improving the performance of existing cyclones through modification of exit and inlet dimensions.

ii) Design of cyclones to ensure maximum performance under the constraints of minimum pressure drop and surface area.

iii) Prediction of possible changes in performance due to operation/ design parameters.

NCB has so far provided improved designs of cyclones for various unit operations like crusher, coal mill and raw mill to a number of cement plants. The adoption of this improved design is expected to result in increase in the efficiency to the extent of 3–8%.

REDUCING FUGITIVE DUST GENERATION

Fugitive dust generation can be suppressed by proper material handling systems, water spray system, wherever applicable, and properly designed hoods.

Proper Material Handling Practices

Proper design of material handling system will help to reduce fugitive dust. A few illustrative steps are given below to control fugitive dust:

a) Proper inclination of crusher hopper for smooth flow of materials.
b) Appropriate design of hopper to avoid immediate release of displaced air, and thus preventing entrainment of dust.
c) Proper covers are to be placed on inclined chutes, discharging the crushed product to avoid the dust dispersion into the atmosphere.
d) Minimum drop height from chute to the belt at each conveyor transfer point to ensure reduction of fugitive dust generation.
e) The direction of flow of material as far as possible should be in the direction of velocity of belt conveyor.

Water Spray System

The use of water spray system at the feed material before the crusher and on unpaved roads will help to reduce fugitive dust. As such the water spray system can be envisaged in two ways:

i) Pre-wetting of the material ahead of the dust generation points so that the fine particles cannot rise up as dust. It is recommended for primary dust sources, i.e., size reduction units, etc.
ii) Spraying of water on the dust source to knock down the air-borne particles before they can spread. It is used where pre-wetting is not possible.

Design of water spray system should take into account its effectiveness, maintenance aspects and proper control of sprayed water. Use of wetting agents are suggested to improve effectiveness of water spray as they reduce interfacial tension. Wetting agents, should be non-toxic and be used in proper concentrations. However, as the wetting agents are quite expensive, techno-economic analysis of its use would be required prior to each application.

Ventilation Hoods

While use of hoods is known and is being practised, their effective operation is a must and should be ensured. Design of hoods should take into account material flow rate, velocity of induced air, particle sizes and system design of conveying system etc. NCB has done extensive work in this direction and has evolved guidelines for effective hood design.

Reducing Dust Emission

In order to collect the dust generated and thus to reduce its emission into the atmosphere, various types of dust collectors are being used in Indian Cement Industry (Table 2). While the dust collectors, such as fabric filters and electrostatic precipitators (ESP), are designed for a guaranteed performance, there could be a variety of reasons due to which the actual performance would have deviated from the design value. The parameters affecting the operation of fabric filters can be diagnosed by considering the type of filter media used, filtration velocity, dew point of gas, pressure drop, gas flow distribution in various compartments, cleaning system and its operation and maintenance practices followed by plant. Guidelines for the operation of filters and for the selection of filter media have been evolved by NCB.

The extensive data collected by NCB from a large number of cement plants indicate that the problems faced by the cement industry in satisfactory operation of ESPs are mainly the following:

i) Carbon-monoxide in the flue gases exceeding 0·5 percent owing to incomplete combustion.

ii) Abnormal gas flow rates (in relation to design specification) and consequent higher dust loads.

iii) Insufficient water in the conditioning tower leading to reduced humidity and higher gas temperatures at ESP inlet.

iv) Uneven gas flow distribution in the ESP.

v) Improper maintenance of ESP and conditioning tower.

In addition to above, studies of design and process parameters, and their analysis be conducted for working out suitable remedial measures.

TABLE 2

VARIOUS DUST COLLECTORS USED IN INDIAN CEMENT PLANTS

Sl No	Dust Collector	Location								
		Crusher	*Raw Mill (Dry Grinding)*	*Coal Mill*	*Kiln*	*Clinker Cooler*	*Cement Mill*	*Packing Plant*	*Silos*	*Conveyor Transfer Points*
1	Smoke Chamber				X					
2	Cyclone	X	X	X		X	X			
3	Multicyclone				X	X				
4	Fabric Filter	X	X	X	X		X	X	X	X
5	Electrostatic Precipitator		X	X	X	X	X			
6	Wet Scrubber/Water Spray	X		X						X

NCB's Assistance

NCB's Centre for Environmental Improvement, with its expertise and capability developed over the years in the area of environmental improvement, and latest equipment facilities of testing and monitoring, is in a position to extend all technical and technological assistance to the cement and building materials industries in the area of reduction in dust generation and emission.

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