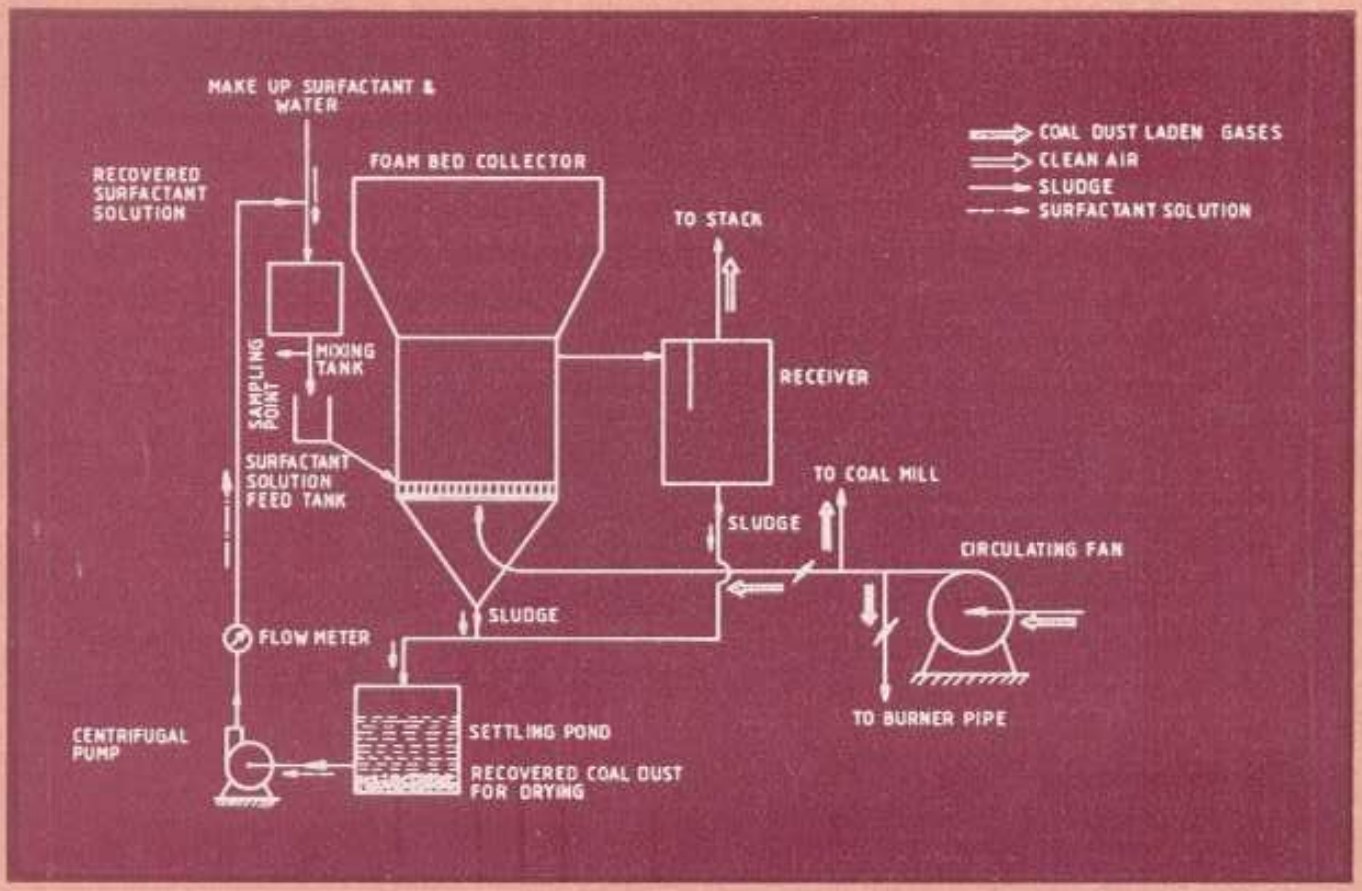
National Council for Cement and Building Materials

NCB FOAM BED COLLECTOR FOR (SMALL CAPACITY) COAL MILLS



JULY 1987

NCB TECHNOLOGY DIGEST

NCB FOAM BED COLLECTOR FOR (SMALL CAPACITY) COAL MILLS

INTRODUCTION

IN cement industry, coal dust emission poses problems as the cyclones have an upper limit of efficiency for collecting fine dust. Although the vent air from cyclones is reused mostly in the coal mill section by recycling, some amount of air is ventilated, especially while grinding high moist coal containing fine dust. For small and medium capacity mills the use of fabric filter or ESP as final dust collector may be expensive. While attempts towards increasing cyclone efficiency can be pursued, the development of a dust collector to collect the fine coal dust will indeed be useful. An area which shows great promise is the foam scrubbing collector. The advantages of the foam bed collector are low pressure drop, low installation cost, less space requirement, suitability for handling explosive dusts and high collection efficiency.

NCB R&D STUDIES

This Technology Digest describes the developmental work carried out by NCB to evaluate feasibility of using Foam Bed Collectors for coal dust collection including possibility of recycling the collected dust. System design, operation, maintenance and techno-economic feasibility have been studied.

THE SYSTEM DESIGN

The foam scrubber consists of two stages of operation, namely, foam generation and particle collection. The addition of surface active agents to water produces foam. The effectiveness of the collection of particulates over conventional wet scrubbers is increased by the use of foam. High efficiency is achieved by allowing the dust laden gas encapsulated in bubbles to be retained in this condition for a sufficient time for the impingement of particles to take place. The potential of foam scrubbers to control fine particles would seem to be good if the bubble sizes are smaller and the residence time is sufficiently longer to collect fine particles. The parameters considered for design are bubble size, foam stability, residence time, particle size, gas velocity and temperature of gas.

NCB FOAM BED COLLECTOR

Figure 1 shows NCB's Foam Bed Collector. It consists of a vertically arranged vessel of square cross-section with an inlet and distribution facilities for the contaminated gas at the bottom, which is also fitted with a paraxial sludge outlet. The greater part of the vertical vessel is filled with foam bed which is formed by supplying a surfactant liquid from an

Fig 1 NCB Pilot Scale Foam Bed Collector

inlet just above the distributor and the foam bed is supported by the grid of the gas distributor.

OPERATION

A dense wet mobile foam is obtained by dispersing dust laden air in the surfactant liquid to such an extent that the liquid content of the resultant foam will be 0·2 to 3% by volume (Figure 2). The interfacial areas enveloping the innumerable bubbles of the foam bed provide efficient barriers to the gas borne dust particles which are intercepted. The particles are exposed to adhesive forces that make them adhere to the moist bubble interfaces at even the slightest contact. The smallest particles are separated almost as efficiently as the bigger ones, and the size of the dust particles is of minor importance.

The scrubber has been tested with coal dust. The surfactant concentration was varied from 0·1-0·3% (Vol) and dust concentration was varied from 5-40 g/Nm^3. The overall collection efficiency of foam bed ranged from 95-98% depending on the dust concentration as indicated in Fig 3. The pressure drop varies from 50-80 mmwg. Water requirement is 375 litres/1000 Nm^3 of air. 28 ml of surfactant is required to collect 1 kg of coal dust.

Sludge discharged from the scrubber has a high content of dry solids. Hence further treatment towards recovery is easy. Figure on the cover page shows the flow sheet of NCB Foam Bed Collector in coal mill circuit. The sludge is transported to a settling pond from where supernatant liquid can be pumped to surfactant solution circulating tank after monitoring its concentration. The recovered sun-dried coal dust can be used as fuel in auxiliary furnaces.

MAINTENANCE

As there are almost no moving parts in the system and surfactant is non corrosive, it is almost a maintenance free system.

THE ECONOMICS

A comparison of efficiency and capital cost of various dust collection equipment is shown in Table 1.

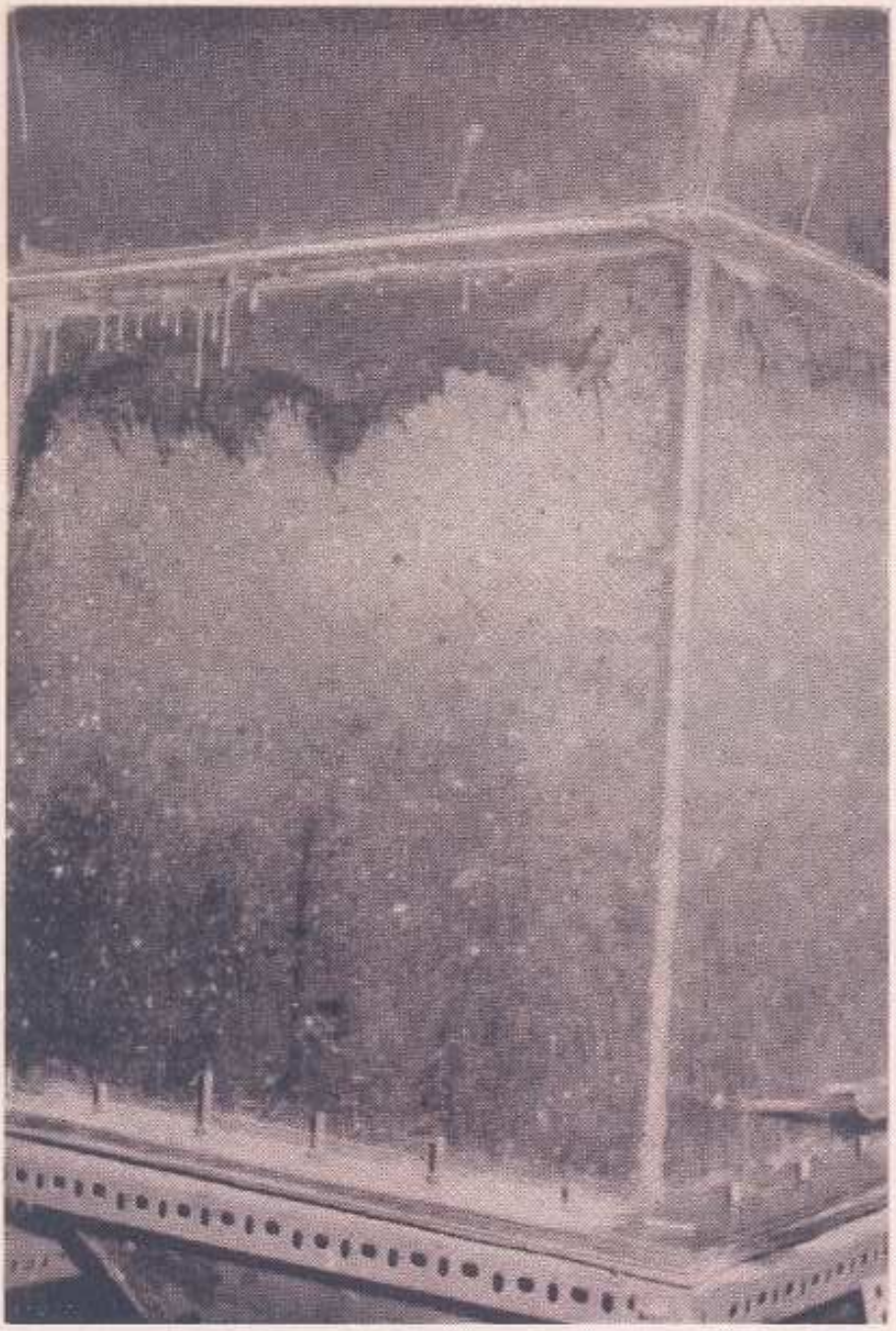


Fig 2 NCB Foam Bed Collector While in Operation

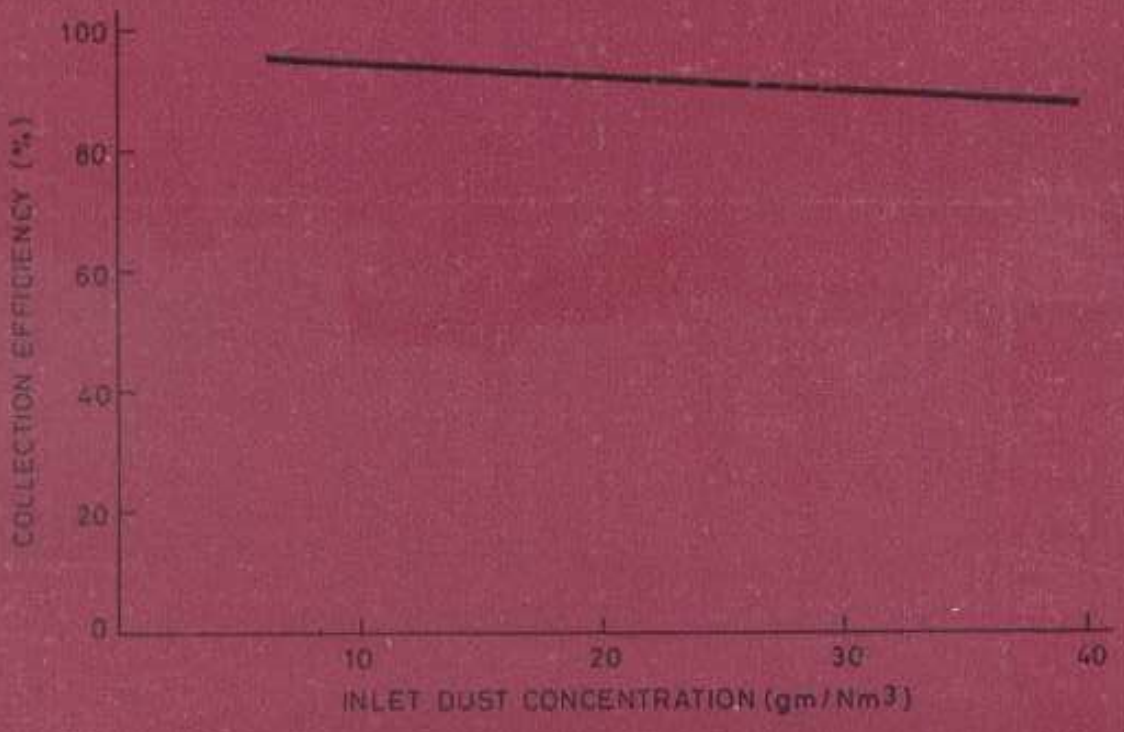


Fig 3 Efficiency versus Dust Concentration

Table 1

Sl No	Dust Collection Equipment	Efficiency %	Capital Cost ($Rs/m^3/h$)
1	Fabric filter	90-99	19-38
2	ESP	95-99·5	73-86
3	Wet scrubber	90-95	5-16
4	Foam bed collector	95-98	5-11

Table 1 indicates that the capital cost of the foam bed collector is less than that of fabric filter and ESP and it is comparable to high energy wet scrubbers. A comparison of pressure drop and water requirements of conventional wet scrubber and foam bed collector is given in Table 2. Foam Bed Collector has less water requirements and low pressure drop.

Table 2

Sl No	Dust Collection Equipment	Pressure Drop *mmwg*	Water Requirement *litre/1000 Nm^3 of air*
1	High energy wet scrubbers	250-750	400-900
2	Foam bed collector	50-80	375

The major expenditure in the operating cost for foam scrubbing is the cost of surfactant. Using a cheap surfactant and increasing the recycle percentage or reducing the liquid to air ratio at the distributor, reduces the surfactant cost. As far as energy consumption is concerned, the foam bed collector requires much less energy than other conventional dust collectors as given in Table 3.

Table 3

Sl No	Dust Collector	Energy Consumption ($kWh/1000\ m^3$)
1	Electrostatic precipitator	1·2 — 2·4
2	Fabric filter	1·6 — 2·4
3	Wet scrubber	1·1 — 3·4
4	Foam bed collector	0·2 — 0·4

The foam bed collector requires 2m×2m×5m space for 7 TPH coal mill which is less than that required by other dust collectors like ESP, Fabric filter, wet scrubber. Most of the old cement plants in India have installed small capacity (<7 TPH) coal mills and are equipped with only cyclones. Foam Bed Collector developed by NCB can be used as a final

dust collector in this section to collect the valuable coal dust which otherwise is being emitted to the atmosphere.

NCB EXPERTISE

NCB expertise and consultancy services backed by its sophisticated and modern R&D facilities are available for transfering the technology or foam bed collectors to interested users.

Prepared by : Shri J P Saxena, Shri S N Mehrotra and Shri R A Ramanujam

Edited by : Shri S S Kalra

For further enquiries, please write to :

Chairman & Director General
National Council for Cement and Building Materials
M 10 South Extension, Part II
New Delhi 110049 INDIA

Published by Shri S K Khanna on behalf of National Council for Cement and Building Materials, M 10 South Extension II, New Delhi 110 049 and Printed at Indraprastha Press (CBT), Nehru House, New Delhi 110 002