CRI TECHNOLOGY DIGEST

NCB'S APPROACH TO COMBAT NOISE POLLUTION IN CEMENT INDUSTRY

National Council for Cement and Building Materials

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INTRODUCTION

THERE is a worldwide realisation for abatement of environmental pollution. Of the three kinds of pollution, viz, water, air and noise, the cement industry is concerned with the latter two. Whereas the air pollution is mostly caused by particulates, noise pollution is due to various machineries, such as crushers, grinding mills, fans, blowers, compressors, etc.

Considering the need for assessing the magnitude of the noise pollution in cement plants and evolving appropriate remedial measures, NCB has been investigating these problems. This Technology Digest highlights the work done by NCB and gives the basic principles involved in abatement of noise pollution.

NOISE AND ITS EFFECTS

Detrimental and unpleasant sound energy transmitted from one area to another is classified as 'Noise'. As a hazard it has the following effects:

a) Interference in speech communication in job

b) Adverse effect on human behaviour

c) Causing temporary hearing loss and

d) Causing permanent damage to hearing.

The effect of noise as a hazard varies with the intensity and the exposure time. Noise emission regulations abroad, therefore, list noise intensity and the corresponding safe exposure time. OSHA, 1970 regulation of USA prescribes the following classificatien:

Duration/day (h)	8	4	2	1	½
Threshold sound level (dBA)	90	95	100	105	110

CHARACTERISTICS OF NOISE

Sound pressure level (dB) is given by:

$$Lp = 10 \log \left(\frac{P}{Pre}\right)^2 = 20 \log \left(\frac{P}{Pre}\right)$$

Where

Lp = Sound pressure level in dB,

P = RMS sound pressure, and

Pre = International reference pressure (.0002 microbar)

The sound pressure level varies with frequency of the noise. In order to measure and analyse the noise, the variation of sound pressure level with frequency is required. The preferred frequencies for acoustical measurement are detailed in IS : 2264-1963.

NOISE LEVEL MEASUREMENT AND ANALYSIS

There are a number of instruments which can be used for the measurement and analysis of noise. The main measuring instruments include sound level meter, magnetic tape recorder, graphic level recorder, noise dosemeter, and real time analyser.

Sound level meter gives the values of sound pressure levels with the help of a suitable filter set. The variation of sound pressure level with frequency can be used to characterise the noise. Typical sound pressure level equipment is shown in Fig 1. Graphic level recorder provides the plot of pressure level versus frequency. Noise dosemeter provides an average exposure in terms of pressure levels for a predetermined period of time. Thus, it gives both short-term and long-term impact of noise, thereby enabling the assessment of effects of noise emissions. Magnetic tape recorder records the noise

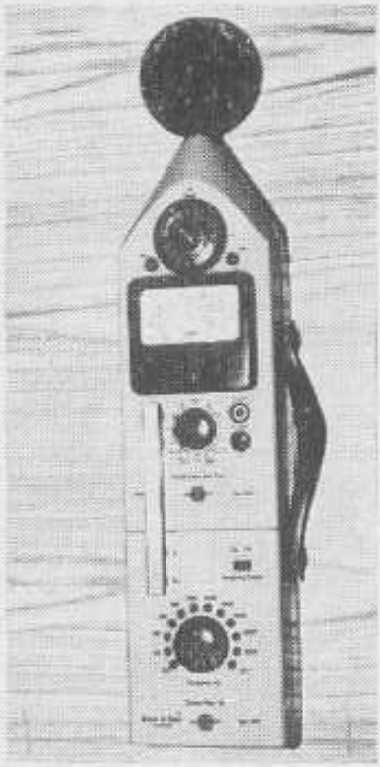

Fig 1 Sound level meter (Model B & K 2203)

data and the recorded data can be analysed using a real time analyser to know the pressure levels and frequencies of the noise.

NOISE ABATEMENT TECHNIQUES

Noise control techniques are essentially directed towards the three interrelated elements, viz, the source, the transmission path and the receiver.

Source Control

Noise reduction at the source is the most preferred way as 'prevention is better than cure'. The important methods of noise control at the source are:

i) Using vibration damping pads beneath the machine base.

ii) Isolating the vibrating components from the main body of the machine or isolating the complete machine from the general floor area.

The choice of the method is dictated by the transmissibility (TR) of the system which is defined as:

$$TR = \frac{1}{\left(\frac{n}{no}\right)^2 - 1}$$

Where n = frequency of vibration generated by the machine and

no = natural frequency of the machine.

When TR is less than 1, isolation is effective and when it is greater than 1, vibration pad is effective.

Transmission Path Control

Noise control at transmission path entails modification of the airborne sound field by reflection, diffraction, insulation or dissipation. It can be done by using acoustic barriers, enclosures etc. Typical materials include plaster board, mineral fibre, lead, plywood, etc. The choice of material and the layout of enclosure depends on the noise characteristics, characteristics of material and the accessibility requirements of the machines.

The effect of barrier in reducing noise exposure was experimented in NCB in the case of a ball mill. The details are given in Fig 2 where noise reduction of 20-25 dB has been achieved.

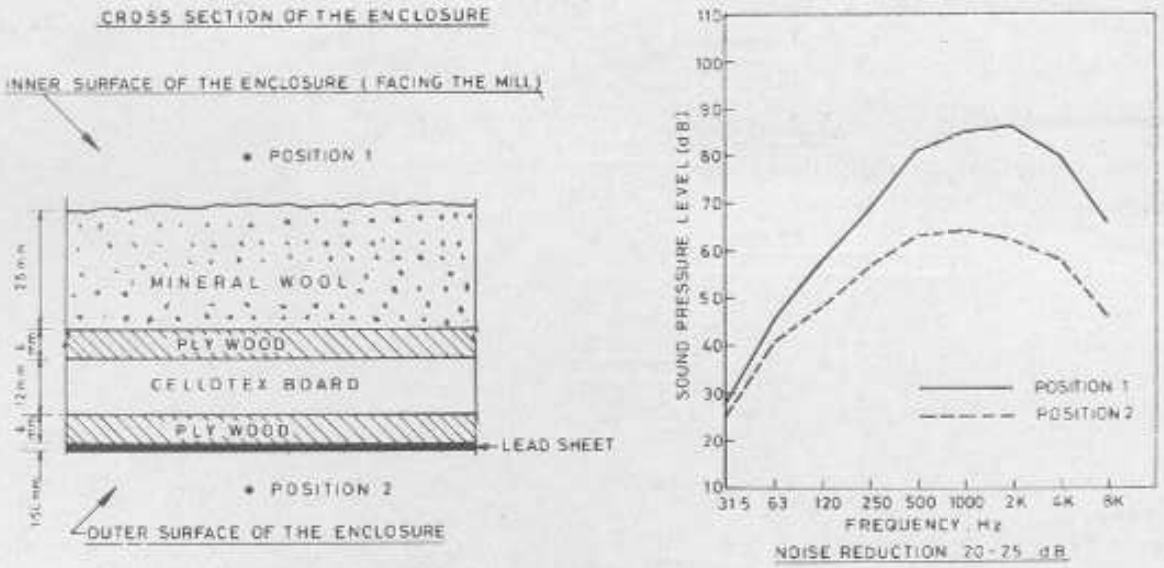

Fig 2 Effect of partial enclosure for batch mill

Receiver Control

Where above methods are not economically or technically feasible, the noise control at the receiver should be done. It involves using ear plugs or muffs, using an operator booth with viewing windows, use of remote control devices to operate machines, reducing the exposure time of personnel to noise by planning activities in each section of a cement plant, etc.

NOISE MEASUREMENTS AT CEMENT PLANTS

NCB has carried out noise measurements in different sections of a few wet and dry process cement plants in India. The data are given in Fig 3. It can be observed that it varies from 89 dBA to 104 dBA. Sound pressure levels also depend on the type of process, frequencies of sound and layouts of the plants. The various noise control measures that can be adopted at the plant layout stage, machinery design stage, and at the operating units are as fallow:

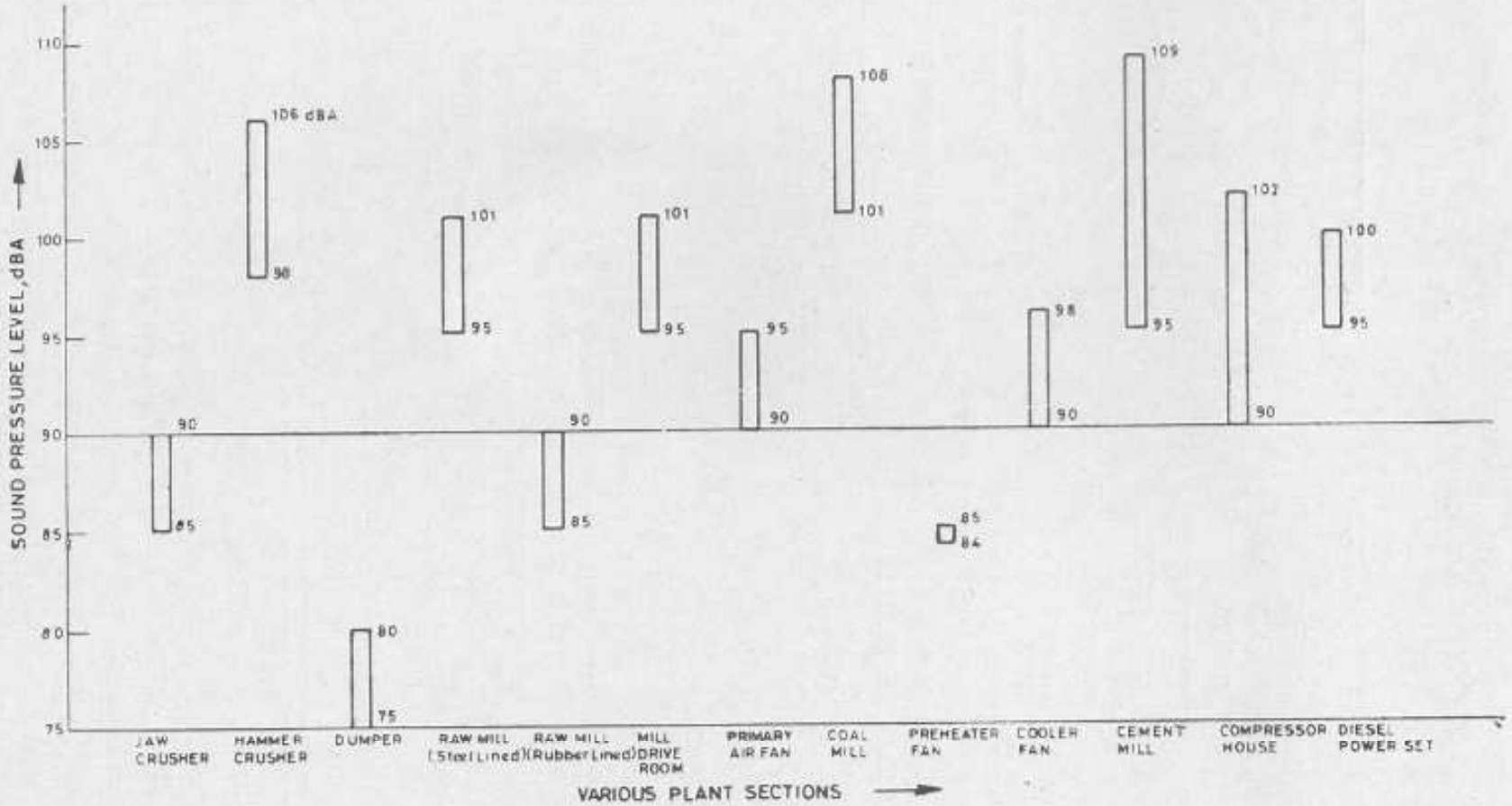

Fig 3 Noise levels in cement plants (dBA)

Noise Control Measure at the Plant Layout Stage

a) The noisy installations should be kept as far away from adjacent residential areas as possible.

b) Silo installations should form a closed continuous barrier between noisy installations and the adjacent residential areas.

c) Noisy machines should be installed in closed, acoustically insulated buildings.

d) The height at which noisy machines are installed should be as low as possible with reference to ground level. However, safety and maintenance aspects are also to be kept in view.

e) Installing crushers below floor level wherever feasible. However for plants located in heavy rain prone zones and where maintenance requirements and cost of construction are envisaged to be high, detailed investigations are necessary.

f) The number of doors, windows and ventilation openings in the buildings should be as minimum as possible consistent with the comfort of the operating staff and safety of the electrical drives.

g) Adequately sound insulated control rooms should be provided for operating personnel in noisy areas.

Noise Control Measures at Plant Machinery Design Stage

a) Proper balancing of rotating masses; ensuring higher accuracy of machining and surface finish for rotating masses.

b) Power transmission through fluid couplings or flexible couplings. However, maintenance aspects and availability of spares should be kept in view.

c) Selecting helical gear with low module in the case of gear design.

d) Selecting quiet running bearings, and cast-iron housing for bearings to ensure high internal damping properties.

e) Ensuring sufficient number of stiffening ribs in welded structure. However, maintenance and operating conveniences should be kept in view while selecting the number of stiffening ribs.

f) Selecting low speed motors as far as practicable; in the case of big motors, the one with water-cooled systems is preferred than those with air-cooled system.

g) Selecting high-efficiency, low-speed fans and small impeller clearances, and ensuring streamlined flow path for air in aerodynamic design.

Noise Control Measures for Operating Units

a) *Crushers:* Installations should be in enclosed sound insulated building; sound insulated control cabin for operating personnel.

b) *Mills:* Sound insulated control cabin for operating personnel; rubber liners in the case of wet grinding mills, positioning the operating personnel preferably well above the mill horizontal central plane.

c) *Kiln Drive:* Acoustic screening of walls or aecoustic nclosures with sound absorptive linings which also act as thermal insulators.

d) *Grate Cooler:* Sound insulation of cooler fan casings; sound attenuators for cooling air intake.

e) *Fans:* Enclosing whole fan and its drive with suitable intake and exhaust duct silencers; mounting the fan on damping pads or vibration isolating materials.

f) *Compressors:* Installing in sound insulated rooms with proper intake and exhaust ducts for the room; proper intake and exhaust duct silencers for the compressors; installing vibration isolating mountings.

g) *Motors:* Providing enclosures with silenced ventilation.

h) *Diesel Power Sets:* Installing in sound insulated rooms; vibration isolating mountings for set; acoustically treated control cabin for the operators; lining sound reflective surfaces with sound absorbing materials.

NCB's EXPERTISE

Measures for noise reduction indeed are necessary for improved environment. NCB has the expertise and equipment facilities to undertake the above task and its sponsored services are indeed available to interested cement plants.

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