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CRI TECHNOLOGY DIGEST

CEMENT RESEARCH INSTITUTE OF INDIA

INSUFFLATION TECHNIQUE FOR UTILIZATION OF ROTARY KILN DUST

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INTRODUCTION

Dust is generated in almost every unit operation of cement manufacture by virtue of fine powders handled in them. The dust from all unit operations, except that from kiln section, is similar in physico-chemical nature to the material processed in them and hence can be directly utilized in the process by refeeding. However, in the case of kiln dust, the problem in its utilization in the process arises from two factors, viz, the differences in the granulometry and chemical character of the collected dust and kiln feed, and the present trend of adopting higher efficiency dust collectors and the consequent need to utilize relatively higher quantities of the dust collected. Disposing of the collected dust as waste is not economical in view of the resultant loss of a semi-processed material having the potential for being converted to clinker and the proportionate waste of valuable raw materials besides the associated energy loss.

The above considerations have, therefore, spurred research and development activities in the area of cement technology and many methods of utilization of kiln dust have already come into practical use. Significant among them is the use of dust by feeding it into the kiln through the firing end, together with the fuel or separately. This is usually referred to as 'Insufflation'.

SYSTEM DESIGN CHARACTERISTICS OF INSUFFLATION SYSTEM

The dust insufflation system essentially comprises:

a) Transportation of dust from dust collectors to kiln firing end.

b) Storage and feeding of dust.

c) Injection of dust into the flame.

Two methods are generally available for transporting the dust from the bottom of hoppers of the dust collectors to the burner platform, viz, belt conveying system and pneumatic conveying system. In view

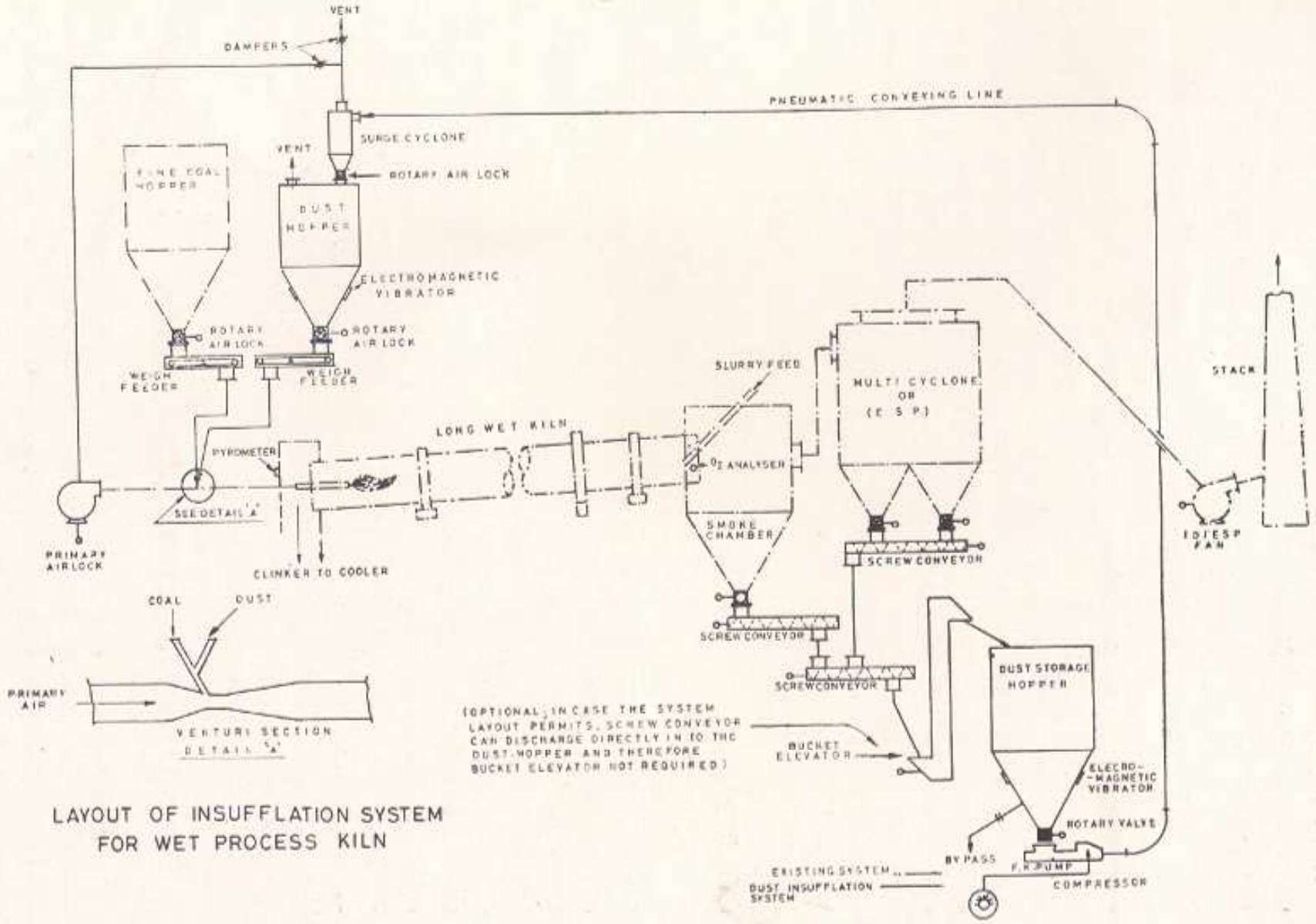
of the less space and low maintenance requirements of pneumatic conveying system, it is preferable to use this system. A schematic diagram of the dust insufflation system using pneumatic conveying of dust is given in the Figure.

It can be seen that the collected dust is stored in a hopper, and by means of a pneumatic pump transported to another hopper at the burner platform and through weighfeeder fed to the burner pipe. Depending on the layout conditions a short screw feeder might be necessary. The dust is added to the burner pipe by means of a chute at the venturi section wherein coal is also added. This enables to achieve smoother transport of dust in view of the high velocity prevailing in that section. It has thus been possible to overcome some of the operational problems, such as agglomeration of dust in conveying lines, back pressure problems at the dust feed pipe, etc, with the proper selection of the system design components.

The dust injection can be done by two methods, viz, together with the fuel or separately. In coal fired kilns, both types of injection are practicable, while in oil fired kilns the dust can only be injected separately. However, this limitation is insignificant in the context of our cement industry where only coal is being used as the primary fuel.

PROCESS ENGINEERING OF INSUFFLATION SYSTEM

In the operation of the kiln, in general, the flame must be so shaped as to ensure proper distribution and transfer of heat to the material in the burning zone. It is necessary to see that the insufflated dust does not upset this balance. Principally this balance, and consequently the amount of dust that can be insufflated depends on the flame characteristics, type and quality of coal, and physical and chemical characteristics of dust. Coal quality is significant from the point of view of the flame temperature and the heat transfer characteristics. The addition of dust causes a drop in flame temperature, and this drop is usually made up by injection of specified amount of coal. This ensures maintaining the flame temperature at the original value apart from supplying necessary heat for the conversion of dust to clinker. In case of poor coals, however, when there is difficulty in ensuring desired flame temperature, the injection of dust might affect the clinker burning. Hence, it is preferable to use insufflation system only when coal quality is such that the net calorific



LAYOUT OF INSUFFLATION SYSTEM
FOR WET PROCESS KILN

value is more than 4700 k cal/kg coal. With coal of calorific value lower than this, the insufflation system can be applied only by considering the specific details, such as firing system, raw material characteristics and process parameters of the particular kiln system in question.

The amount of extra coal required to offset the flame cooling effect due to insufflation and other adjustments required can be calculated from a detailed material and energy balance considerations. In general, the heat supplied will be in excess of what has been taken up by the dust for clinker formation to maintain the enthalpy level of the flame and consequently its temperature, and this excess heat minus the losses in the system can be effectively utilised by an increase in the raw mix feed rate. Thus insufflation system offers potential for increase in production both from clinkerization of the dust and the increase in raw meal feed rate. It is possible to predict the extent to which this increase in raw meal feed rate can be effected for the various process conditions.

CONTROL OF INSUFFLATION SYSTEM

The effective operation of the insufflation system depends, among other factors, on the effective control of the various process parameters. Especially, the dust and coal feed rates need measurement and control to suit the conditions in the burning zone. This can be achieved through installation of weighfeeders. Screw feeders can be considered as an alternative. The effective clinker burning should be ensured through a measurement and control of the temperature at the burning zone and a radiation pyrometer can be used for the purpose. To identify the excess air factor and hence the effective combustion of coal, an oxygen analyser is necessary to be installed at the back end. These, together with the usual control schemes for the operation of the kiln, can be used to effectively monitor the operation of insufflation system.

ECONOMICS OF INSUFFLATION SYSTEM

The advantages of insufflation system are apparent when one considers the economics associated with it. An economic analysis of the insufflation system for a 600 tpd kiln considering only 5% increase in production is given below :

Budgetary estimate for equipment	Rs 25 lakhs

Operating cost per annum, including depreciation and interest on capital	Rs 18 lakhs
Extra income from increased production per annum	Rs 20 lakhs
Net profit per annum	Rs 2 lakhs

APPLICABILITY OF INSUFFLATION TECHNIQUE

The insufflation technique offers one of the simplest way of utilizing the collected dust with several advantages, such as :

a) Increase in production.

b) Better heat transfer at the burning zone due to the presence of glowing dust particles in the flame.

c) In wet process plants possibility of manufacturing low alkali clinker as all alkalies are almost volatilised as the dust passes directly through the flame.

d) Profitable utilization of dust and consequent maintenance of good ecological conditions.

The technique is widely used in USA and in many European countries. In our country, only a few wet process plants have adopted this practice as the refeeding of dust by mixing with the slurry is not practicable in many cases due to the characteristics of dust. The reason for the insufflation system being uncommon in dry process plants is that in such plants the dust is simply being utilized by refeeding into the homogenising silos. However, from a study of the system design and process engineering characteristics of the insufflation system *vis-a-vis* the techno-economic benefits, it appears that the system can be used in both wet and dry process plants.

Towards this, Cement Research Institute of India (CRI) is in a position to help the interested cement plants.

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