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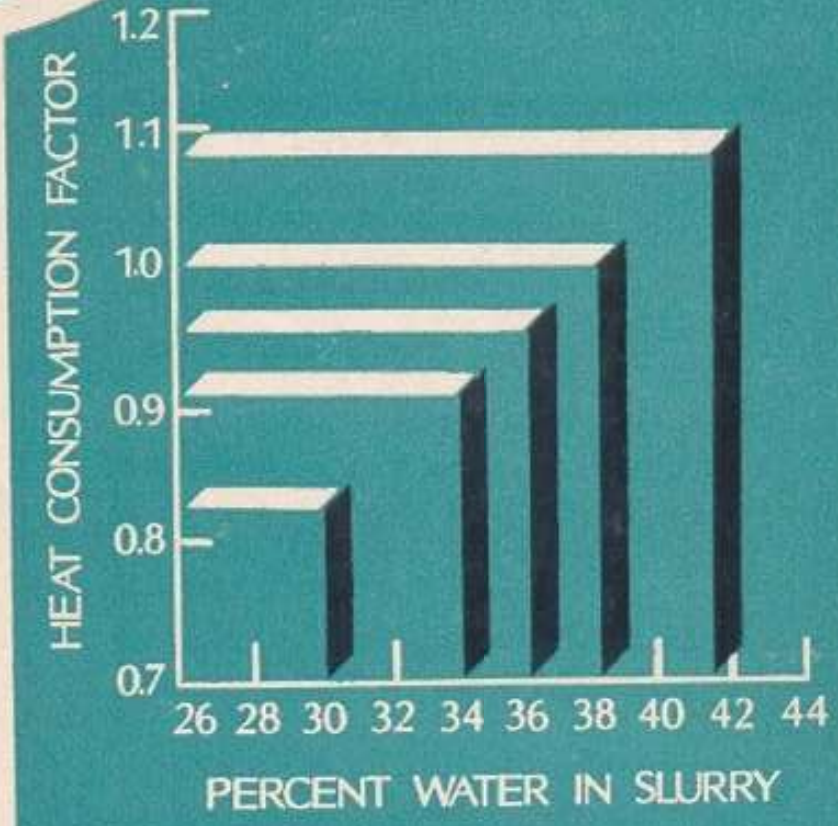
CRI TECHNOLOGY DIGEST



FUEL ECONOMY IN CEMENT MANUFACTURE THROUGH MOISTURE REDUCTION IN RAW-MEAL SLURRIES

CEMENT RESEARCH INSTITUTE OF INDIA

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INTRODUCTION

Conservation of energy—both thermal and electrical—has assumed great importance all over the world and all out efforts are taking place to achieve both fuel economy and electrical energy conservation in various industries. In cement industry, the energy cost alone accounts for over 50 percent of the cost of cement manufacture, out of which the thermal energy consumption—which is in the form of fuel consumption—is of the order of 30 percent. As this element of cost is the biggest in the cost of cement manufacture, constant efforts are being made to achieve economy in fuel consumption in cement manufacture.

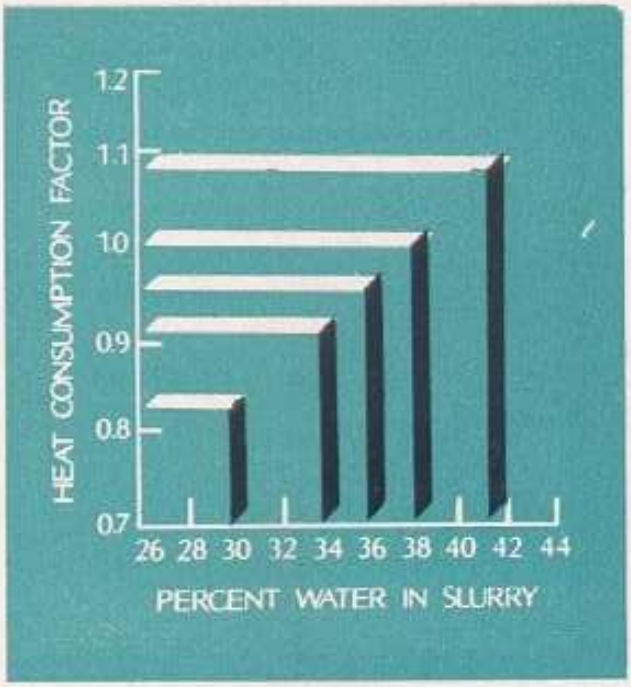
In the wet process manufacture of portland cement the calcareous and argillaceous raw materials are wet ground, homogenised and transported as a slurry through the plant pipework and storage capacities and fed to rotary kilns where it is burnt with coal to convert it into clinker. To achieve high fuel economy, large kiln throughput and full use of storage capacities, low moisture and high solids content within the slurry are desirable. However, low moisture and high solids content lead to increase in viscosity of the slurry which causes is plugging of the mills and pipelines and heavy pumping, milling costs etc. The normal moisture level in the slurries in Indian cement plants is generally kept around 33-39 percent.

Accompanying figure shows the relation between the water content of the slurry and the specific heat consumption; the lower is the water content, the lower is the heat consumption and vice versa. It has been estimated that each percent of water reduction in wet slurry increases the kiln capacity by about 1·5 percent; simultaneously, the heat requirement of clinker burning drops by about 1 percent.

SLURRY THINNERS FOR MOISTURE REDUCTION

The adjustment of viscosity and solids content in wet raw-meal slurries by thinning or deflocculation has been practised in the cement

industry abroad for almost four decades. Slurry thinning means reduction of viscosity by the chemical agents or more properly maintaining a given level of viscosity at an increased solids content. Slurry thinners are compounds which when added in small quantities to a viscous slurry reduce the viscosity of the slurry considerably. Slurry thinners are specific in action in relation to raw materials nature and surface properties and the later determine the dosage of the thinners. In other words the choice of a slurry thinner should be based on the specificity of the acting grouping, its physicochemical interaction and rheological properties and economy. Potential slurry thinners may be classified into three broad categories as under :



(i) Simple inorganic alkali compounds such as sodium carbonate, sodium hydroxide, sodium silicate etc.

(ii) Inorganic polyelectrolytes such as sodium tripoly-phosphates, sodium hexameta phosphate, sodium pyrophosphate, etc.

(iii) Organic polyelectrolytes and surface active agents such as lignin derivatives, humic acids, sulphate/sulphite liquor, calcium lignin sulphonates, molasses, etc.

R&D WORK BY CRI

CRI has identified and investigated a variety of indigenous slurry thinners for their possible application in wet process cement plants. These include inorganic electrolytes namely sodium silicate, sodium carbonate, sodium sulphite, sodium orthophosphate, sodium hexameta phosphate and tetrasodium pyrophosphate, by-products from wood pulping process namely sulphate lye or sulphite lye (commonly known as black liquor), Celex (a commercially marketed form of sulphite lye) and Sallogen (a commercially marketed slurry thinner imported from abroad).

A number of wet slurry samples from different cement plants situated in various parts of the country representing the general characteristics of Indian raw materials for cement manufacture were collected and employed in the studies on moisture reduction for fuel economy.

The slurry thinners were evaluated for their performance in moisture reduction by monitoring the rheological changes of the slurries. Two sets of experiments were done, namely :

i) Determination of viscosity of slurries with increasing concentration of the slurry thinner keeping the solid/water ratio constant, and

ii) Determination of viscosity of slurries containing an optimum percentage of the reagent at varying solid/water ratio.

The optimum concentration of the slurry thinner was taken as that amount of the reagent beyond which the effect of further increase in concentration of the reagent did not significantly change the viscosity. The laboratory results have revealed that all the slurry thinners studied have resulted in marked reduction in moisture content for the same flow. The conclusions are as under :

i) Addition of phosphates and other inorganic electrolytes in small dosages (0·06 to 0·3 percent) resulted in moisture reduction in the range 2·5 to 4·5 percent depending on the nature of the slurry and the slurry thinner.

ii) Addition of 0·08 to 0·3 percent of any of the organic surface active industrial by-products resulted in a moisture reduction of about 2·8 to 6·6 percent depending on the dosage and also on the nature of the slurry and the slurry thinner.

iii) Though all the slurry thinners studied were found to be effective in moisture reduction, the economics in most cases did not permit their use in cement plants in India. It is

only the industrial wastes/by-products such as black liquor (sulphate lye or sulphite lye) and Celex which are both technically and economically suitable for use as slurry thinners on regular basis.

PLANT TRIALS

Based on the laboratory findings, CRI has conducted five industrial plant trials by employing the imported product Sallogen and the indigenously available sulphate/sulphite lye (black liquor) and Celex. These industrial plant trials have established that the industrial by-products namely sulphate/sulphite lye (black liquor) and Celex are as efficient, if not more, as the imported and expensive slurry thinners. The plant trials further indicated that the slurry thinners can be profitably used in almost all wet process plants in India. The benefits obtained during these industrial plant trials are :

a) Significant saving in the grinding costs (saving up to 4 kWh/ tonne of raw meal),

b) Saving in fuel consumption (2 to 5 percent), and

c) Increase in kiln output (5 to 10 percent) without affecting the quality of the clinker.

The cost of the slurry thinner being not more than a rupee per kg, the net savings are substantial, and can be in the range of Rs 1-2 per tonne of clinker produced.

Based on the plant trials carried out and the technology provided by CRI some of the wet process cement plants have already started employing the CRI slurry thinners in their regular production and the feed back received from these plants has indicated that they are getting a saving in heat requirement of about 60 kcal/kg of clinker on a sustained basis which works out to nearly 4 percent saving in fuel consumption. Also a significant increase in production has been obtained without affecting either the quality of the clinker/ cement or any other parameter.

AVAILABILITY

The slurry thinner is available in the market under the trade name of 'Celex'. Alternatively, arrangement for regular supply of the black liquor can also be made with any nearby paper plant. The black liquor generally contains 10-15 percent solids of which about 50 percent is organic material and the rest inorganic. The organic portion is made up of 10-15 percent wood sugars, 40-50 percent lignin derivatives and about 20 percent tannin matter. Many paper factories subject the black liquor to certain processes in order to burn the organic matter, which is surface active and responsible for the slurry thinning action, to get the heat value and to recover the inorganic salts for recycling. Having realised the benefits cement industry can derive from the black liquor, some paper plants have already now started supplying part of their black liquor to some cement plants on a regular basis.

ASSISTANCE BY CRI

CRI extends any assistance to such cement plants who wish to make use of this important technology of slurry thinners for saving in fuel consumption in cement manufacture and has already assisted a few plants who are now adopting the slurry thinners in their regular production.

Prepared by : Dr V V Subba Rao
Edited by : Shri S S Kalra

For further enquiries write to :

CEMENT RESEARCH INSTITUTE OF INDIA
M-10 South Extension II Ring Road
NEW DELHI 110 049

Tara Art Press, New Delhi