NCB ASSISTANCE

NCB is ready to transfer the technology of making magnesia-spinelide refractory with improved resistance to cement clinker, to interested refractory manufacturers.

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MAGNESIA-SPINELIDE REFRACTORY WITH IMPROVED CLINKER RESISTANCE FOR CEMENT ROTARY KILNS

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NCB TECHNOLOGY DIGEST

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INTRODUCTION

PROLONGED life of refractory lining is one of the foremost requirements for long un-interrupted run of cement rotary kilns (CRK). Any premature failure of refractory results in kiln stoppage and causes loss of production. Towards reducing kiln downtime and increasing kiln availability—both key factors for higher productivity in a cement plant, it has been the endeavour of all concerned to develop a more durable refractory lining material for the burning zone of CRK.

In contact with portland cement clinker, high alumina bricks become unsuitable above 1350°C, irrespective of their Al_2O_3 content. Yet they are being commonly used in India in the burning zone of CRK, where the most severe thermo-chemical activity takes place in an environment of much higher temperature. The practice abroad is to use basic bricks of various types, taking advantage of the basicity of cement raw mix.

But, like ordinary mag-chrome bricks, some of these have some undesirable microstructural features, eg large voids, silicate bonding of low fusing type and total lack of direct grain-to-grain bond. These shortcomings render such bricks somewhat sensitive to the clinker components, kiln gases, etc, eventually shortening lining life.

In this context, NCB has developed Magnesia-Spinelide Refractory (MSR) for use in the burning zone. The bricks have also been produced in a refractory plant and duly evaluated. The improved clinker resistance characteristics of the bricks is expected to prolong lining life.

This technology digest highlights the salient features of MSR developed by NCB.

HMOR at 1400°C kg/cm² : 60-65
~~Resistance to thermal spalling~~ at 1300°C (Cycles) 7-8
(As per IS 1528 (iii) 1980)

PRODUCT DEVELOPMENT

The raw materials chosen for making magnesia-spinelide bricks are indigenously available dead-burnt magnesite of low grade, chromite ore and additives.

In making these bricks, optimisation of the following constitutes the major steps: (i) C/S ratio, (ii) amount of additive, (iii) proportion and granulometry of the raw materials, (iv) proportion of binder, (v) forming pressures, (vi) drying regime, and (vii) firing regime.

Physico-chemical characteristics

Following are the important properties of the bricks as evaluated:

Apparent porosity, %		15—~~17~~ 18
Bulk density, g/cc		3·0—3·1
~~P C E, °C~~		~~1900~~
R U L (t_a), °C		~~1660~~ 1580-1600
Chemical analysis, %	MgO	72—73
	Cr_2O_3	10—12
	SiO_2	~~4~~—5 - 6

Optical microscopy studies confirm (*see* Fig. 1) the presence of dicalcium silicate, a highly refractory phase, in the matrix of the refractory.

Refractory-Cement Raw Mix Interaction

a) *Eutectic of the intimate mixture*

Accelerated fusion temperature studies of intimate mixtures of cement raw mix and refractory in different proportions were carried out for 70%

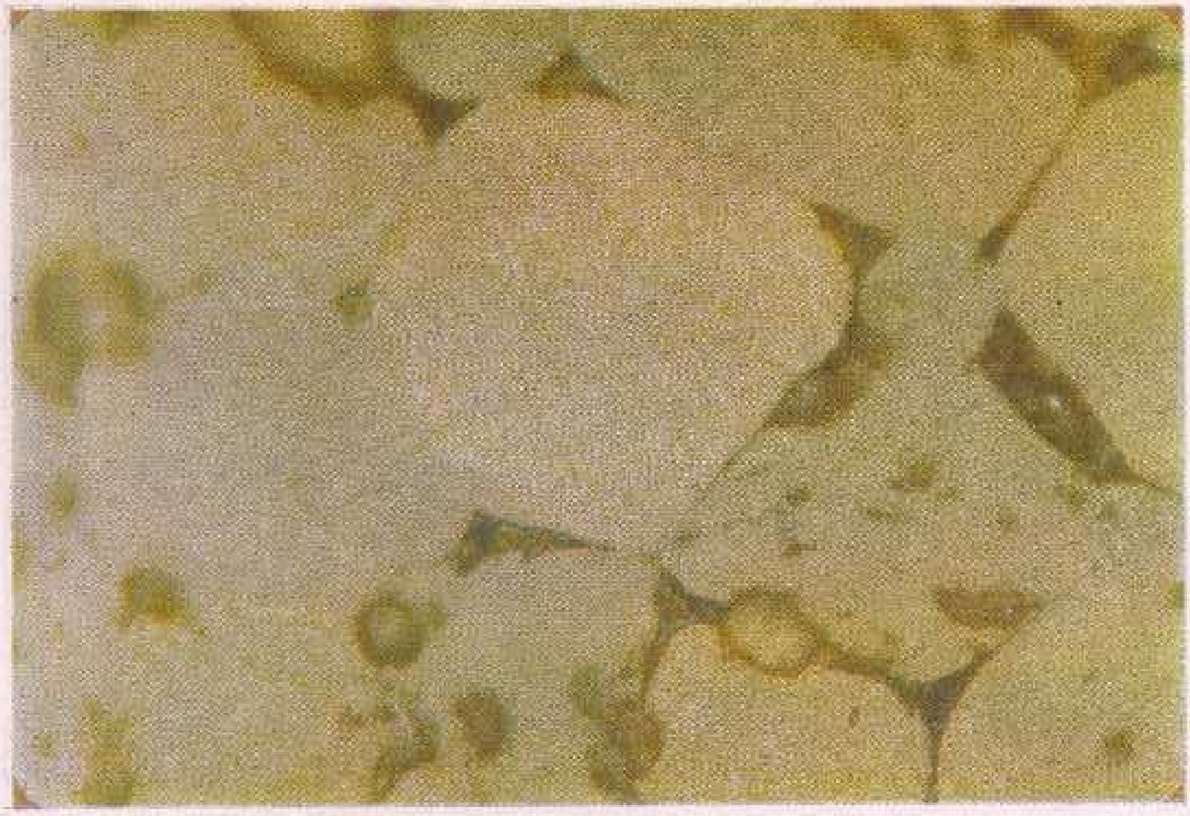

Fig. 1 Micrograph of magnesia-spinelide brick showing periclase, chrome-spinel and calcium Silicate

alumina, mag-chrome and the MSR developed, employing a Leitz heating microscope. The results are shown in Fig. 2. The lowest fusion temperatures for 70% alumina, mag-chrome and MSR are 1280°C, 1550°C and 1600°C respectively, confirming the limitation of using high-alumina bricks vis-a-vis basic bricks at higher temperatures. The improvement of 50°C over the mag-chrome refractory becomes particularly significant if one remembers that low-grade indigenously available raw materials have been used to make the NCB magnesia-spinelide refractory bricks.

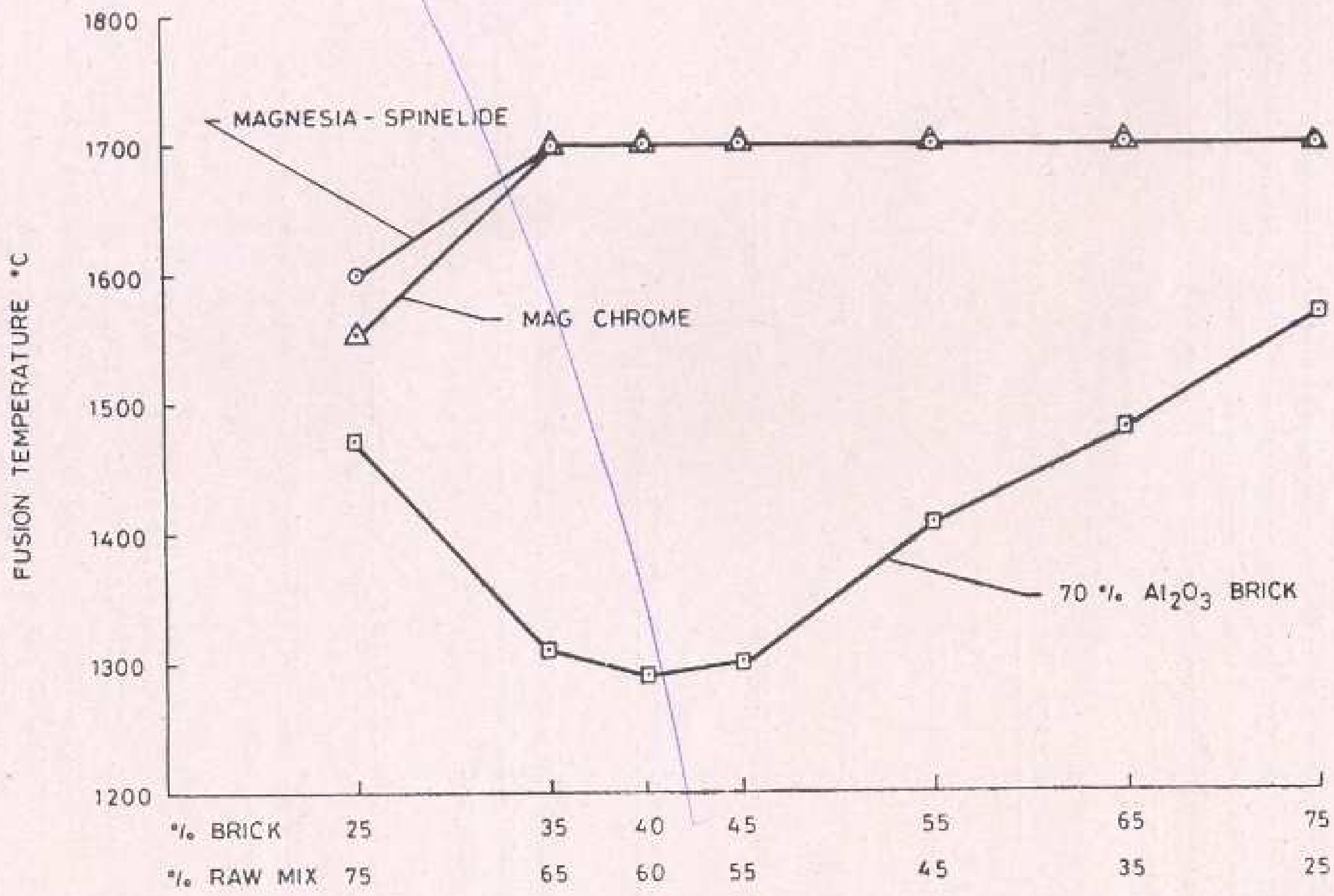

Fig. 2 Fusion temperatures of cement raw mix-refractory mixtures

b) *Interaction on surface-to-surface contact*

Cube specimens of 3-mm size made from a cement raw mix and from the refractory were heated with their surfaces in intimate contact with each other up to 1450°C for 20 minutes in the same heating microscope. Qualitative assessment of the interaction between the cement raw mix and the three refractories is depicted in Fig. 3. The degree of their interaction is in the following order :

Refractory Type	*Degree of Reaction*
70% Alumina	Intense
Mag-chrome	Slight
Magnesia-spinelide	No reaction

DURABILITY AND APPLICATION

Because of higher clinker/refractory eutectic and lower open porosity, the clinker coating will freeze on to the refractory hot face with the following advantages:

i) Lower tendency to spall during kiln stoppages

ii) Ease of stripping clinker coating from refractory during kiln stoppages.

Studies on bricks made in the laboratory as well as plant have established the improvement envisaged in the newly developed brick over conventional mag-chrome refractory. Accordingly, these bricks could be strong contenders for use in the burning zone lining of cement rotary kilns and increase lining life. Owing to its durability, the tonnage of magnesia-spinelide required per annum will be less too.

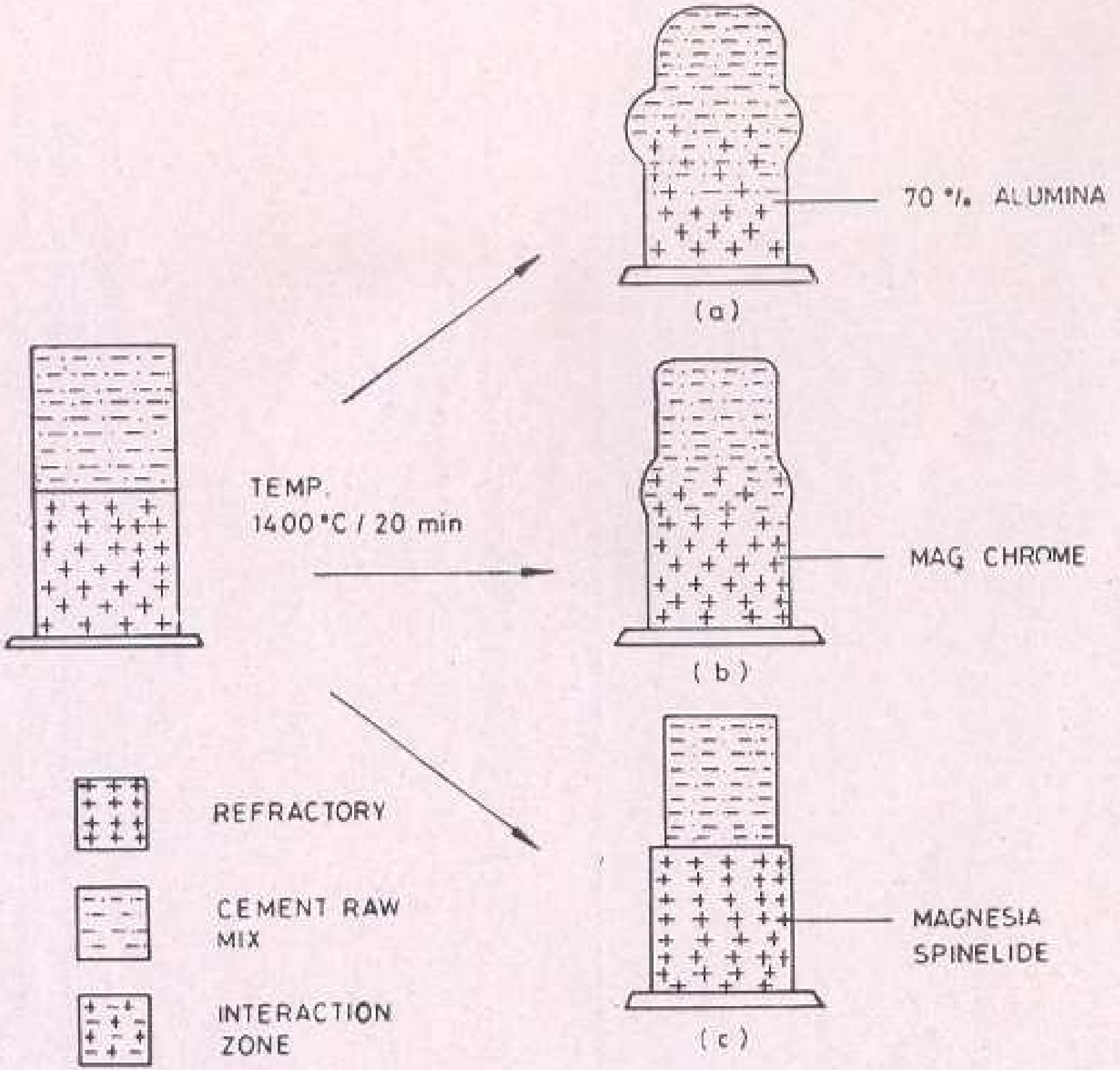

Fig. 3 Refractory-Cement raw mix interaction studies