

STUDIES IN CALCINATION OF CEMENT RAW MEAL NODULES IN SHAFT REACTOR

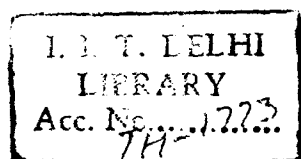
A Thesis

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**by
J D BAPAT**

**Department of Chemical Engineering
Indian Institute of Technology
New Delhi 110016
INDIA**

TH
666.9.02.2
B+IP-S



TH-1723
1.2.91



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ABSTRACT

The thesis work covers theoretical and experimental studies on the performance of shaft reactor for calcination of cement raw meal nodules. The reactor has been considered as a precalcining unit integrated with the rotary kiln process of cement manufacture.

The literature review showed that the information regarding calcination of cement raw meal is scarce and related mainly to pure calcium carbonate. A necessity of obtaining information on relevant parameters for drying and calcination reaction under non-isothermal environment related to actual cement raw meal was recognised. In addition, no established procedure for design of vertical shaft reactors of this kind, on engineering basis, was available.

For the purpose of theoretical studies, green nodules feed has been considered. An expression was developed for drying of raw meal under non-isothermal environment. Further, expressions for solids and gas temperature profiles were developed. Finally, expressions to predict the degree of calcination in the moving bed reactor, were developed. The use of these expressions needed estimation of actual rate as well as process parameters. For that purpose, experiments were carried out in the thermal analysis equipment and in the shaft reactor.

Experiments on drying of raw meal nodule were carried out in the thermal analysis equipment under heating rates of 10, 15 and 25 degree Celsius per minute and surrounding atmosphere was air. The experimental results were substituted in the theoretical expression and a single linear relationship was obtained for different heating rates and mass of samples upto the b.p of water. After that there was some deviation.

In order to determine the rate controlling step and estimate the kinetic parameters for calcination reaction, another set of experiments were carried out in the thermal analysis equipment under heating rates of 10, 15 and 25 degree Celsius per minute. Chemical step was found to control the overall reaction. The kinetic parameters were estimated. The calcination reaction occurring in the raw meal nodule was found to be first order and the activation energy of reaction varied with the heating rate, in the range of 54.20 to 44.40 K cal / mole. Similar results have been reported in the literature by several workers in the area.

The experiments on calcination of dry nodules were carried out in the shaft reactor of 0.25 to 0.30 tonnes per day capacity (clinker basis). The experimental gas temperature profiles and the degree of calcination were compared with the theoretical predictions. The agreement is reasonably good.

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