National Council for Cement and Building Materials

RADIOTRACER — A DIAGNOSTIC TOOL FOR DETERMINATION OF MATERIAL MOVEMENT IN A CEMENT ROTARY KILN

Vol 4 No 9

AUGUST 1990

NCB TECHNOLOGY DIGEST

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INTRODUCTION

IN order to make the rotary kiln system of manufacturing cement clinker perform at higher levels of efficiency, it is important to know the exact profile of material movement inside the kiln. The tracer technique provides a simple, convenient, rapid and accurate method for monitoring material movement in Cement Rotary Kilns. Radio isotope as a tracer is not affected by any of the inherent problems, such as dust loaded gases, undesirable coating formations, severe thermochemical changes inside the kiln and thus make it most suitable for precise determination of differential material movement in the various zones of the kiln.

SELECTION OF RADIOTRACER

The main factors considered important in the selection of radiotracer are that, it should (i) have a short half-life but sufficient to complete the experiment, (ii) have sufficient intensity of γ-radiation to penetrate the refractory lining and kiln shell taking into account the dilution factor and should be within the safe limits of exposure to human body, and (iii) be stable at high temperature prevailing in the kiln. Considering the above parameters, Lanthanum (La 140) isotope in solution form with γ-radiations is found to be most suitable which ensures full safety to the plant operating personnel, absolutely zero after-effects and generation of reliable data.

METHOD

The material movement studies were carried out by NCB in association with Bhabha Atomic Research Centre in wet and dry process kilns of 600 and 680 tpd respectively. The radioisotope in solution form was injected from the feed end after mixing with the raw meal slurry in the case of a wet process kiln and with the semicalcined raw meal in dry process SP kiln. As the material moved down the kiln, the time of arrival of material at various predetermined locations along the kiln length was monitored by radiation detector probes. These radiation detector probes were enclosed in specially designed water cooled jackets so that the detector crystal was not exposed to temperature of more than 45°C.

APPLICATION/RESULTS

The material movement profile in a wet process kiln as shown in Fig 1 reveals that beyond the calcination zone (125 m) i e, in the transition and burning zones the spread of observation becomes so wide that the times of arrival of tracer at location 12 and 14 are marginally earlier than those at locations 11 and 13. The spread may be attributed to the formation of clinkers of various sizes. While the coarser nodules tend to move faster by rolling, the finer grains follow slowly by sliding process. Since the volume of material containing the activity at 125 m of kiln length, gets distributed statistically into all particle sizes moving at different speeds, the total radioactivity front becomes very much elongated. The extent of uncertainity caused by the relatively faster movement of coarser nodules is depicted by the shaded area. The above material movement profile together with material temperature at the corresponding locations along the kiln, provides the time-temperature schedule which the material actually undergoes in the kiln. These data are very vital, as these lead to predicting the possible increase in the output of a kiln by using a predefined composition of raw meal and the heating/cooling schedule most appropriate to a particular kiln as determined by radiotracer technique. The data generated in a dry process kiln, Fig 2, shows that the material travels very fast up to about 30 metres of the kiln length and thereafter slows down considerably. This provides a vital information on possible scope for improving heat transfer in this particular zone/region of the kiln.

Apart, from the above application in the kiln, the radiotracer technique can also be used to determine the actual path of material in preheaters/precalciners and for grinding mills as a design tool. It may be emphasized that at present there is no other practical/direct method of actually determining the material movement in such systems.

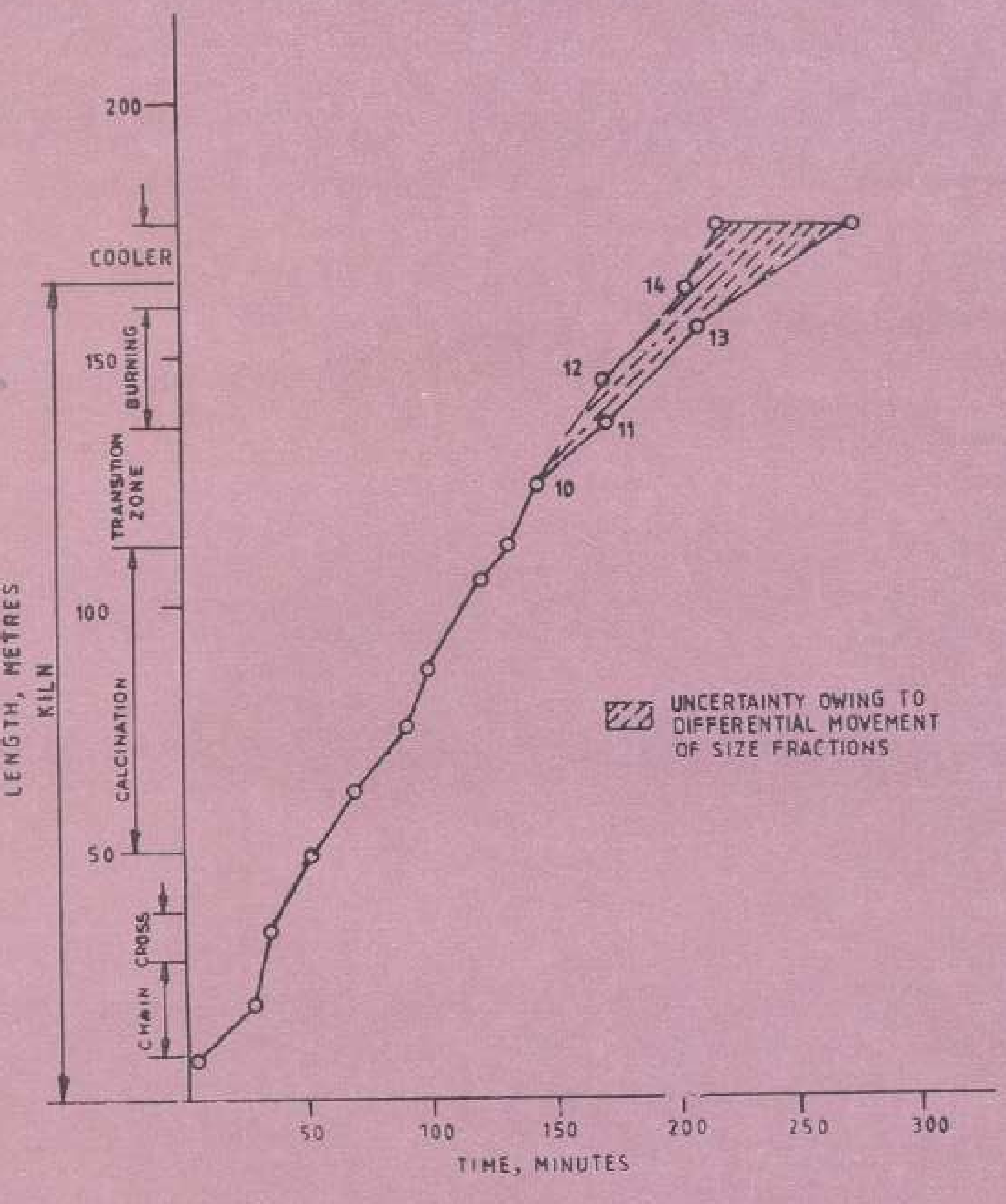

Fig 1 Material movement profile in a wet process cement kiln as indicated by Radiotracer

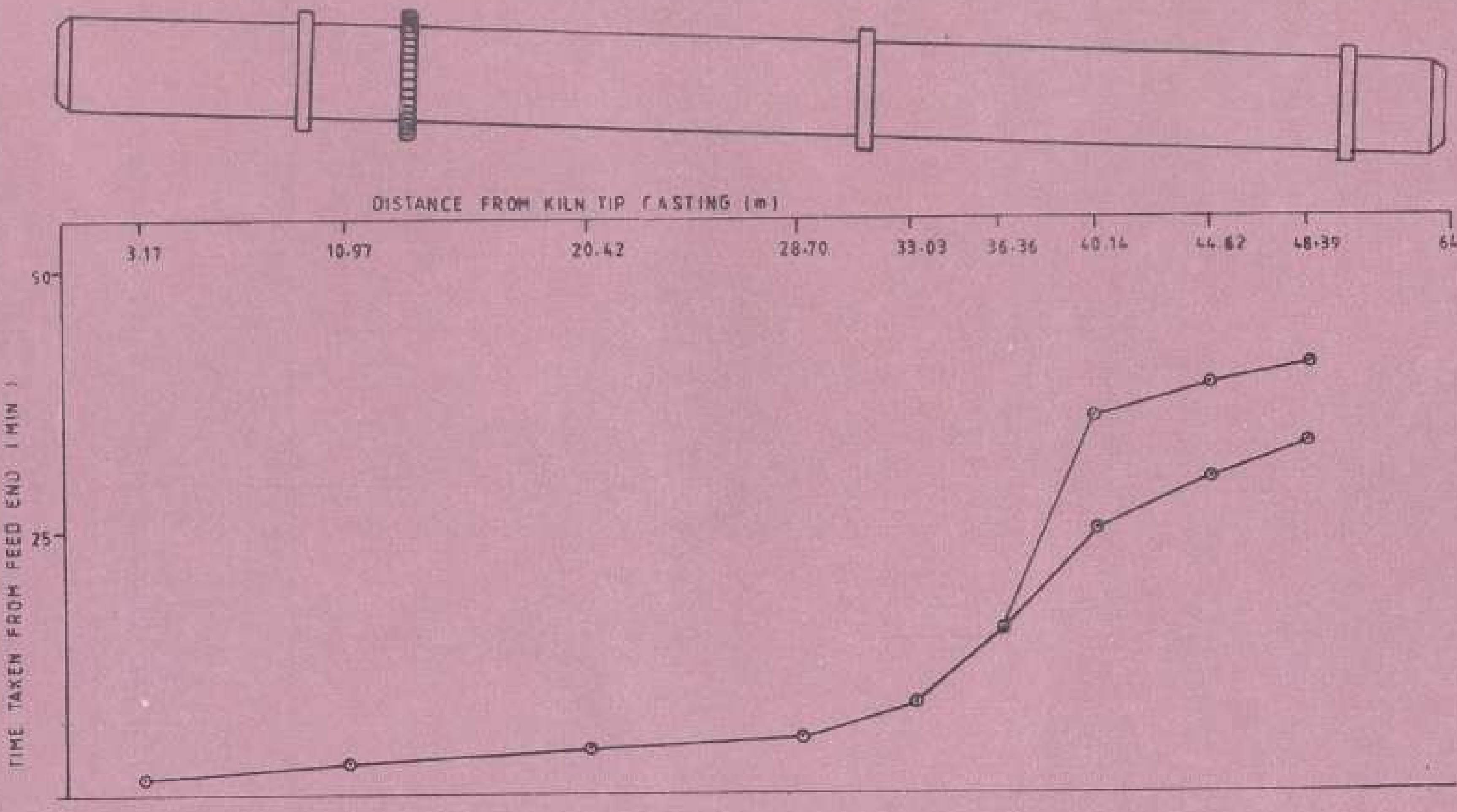

Fig 2 Material movement in the kiln as a function of time

NCB EXPERTISE

Having carried out such detailed investigation, NCB can extend its expertise for using this technique as a tool for the determination of actual material movement in kilns and for predicting the behaviour of various alternate raw mixes in terms of output without actual experimentation on the kiln and instead simulating the same conditions in laboratory, identify the zone in the kiln for improving its heat transfer efficiency so that the optimum choice of raw mix and kiln control parameters could be made.

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Printed, published and edited by Shri S K Khanna, General Manager (PR) on behalf of National Council for Cement and Building Materials, M 10 South Extension II, New Delhi 110 049 and Printed at Indraprastha Press (CBT), Nehru House, New Delhi 110 002

Regd. No. : RN 47303/86