Comparing Intergrinding and Separate Grinding of Blended Cements

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1. INTRODUCTION

This paper gives a brief overview on the findings from the state of the art on intergrinding versus separate grinding of blended cements. A good understanding of the grinding technology is one of the first steps in the development a multi-component cement. The overall goal is to compose an all-round Portland-composite cement in which at least 30% of the clinker is replaced by supplementary cementitious materials, such as fly ash, granulated blast furnace slag, natural pozzolanas, limestone, etc. Grinding is an important element within the design of such a cement.

2. LITERATURE STUDY

Whether separate grinding or intergrinding is preferred depends on the type supplementary materials used, their replacement levels, the necessary fineness and on the required strength and durability properties of the blended cement. The main difference between intergrinding and separate grinding of a multi-component cement is that during intergrinding the different components interact with one another. The interactions between the constituents are mostly due to the relative difference in grindability.

In a two-component system some general trends have been observed. In the early period of grinding (at low fineness), the harder component will enrich in the coarser fraction and the softer will dominate the finer fraction of the particle size distribution (PSD). The harder component stays coarser and abrades the softer one. The softer component will get a wider PSD and the harder one will get a narrower PSD. Upon progressed grinding the breakage of the harder component starts and it approaches gradually the smaller and softer ones. As a result, it has been seen that after a considerable time of grinding or at a high fineness, the difference between intergrinding and separate grinding is less than when compared in the early stage of grinding or at low fineness. In three or four component systems the interactions are more complex.
It should be noted that the PSD of the powder after grinding is strongly dependent on the type and the size of the mill.

The interactions between the different components might both reduce or lengthen the necessary grinding time to obtain a certain fineness, or even make it impossible to reach a certain fineness for one of the components by for example one component shielding another.

3. CONCLUSIONS

Based on the findings from the state of the art, it was decided to grind the materials separately in the first stage of the practical study in developing a ternary blended cement. In this way the influence of the fineness of the different components on the cement properties can be well controlled and studied systematically. In this stage grinding will be performed with a laboratory mill of 10 kg capacity. It must be kept in mind that the resulting powder will differ both in PSD and in chemistry from the powder which would be obtained with a full-scale mill.

Whether intergrinding or separate grinding will be chosen for actual production, depends on whether it is possible to obtain the desired finenesses of all the components with intergrinding. If not, one or more components could be ground separately. Besides technical feasibility, one should also compare the energy and time demand of both procedures, and the availability and/or cost of infrastructure.

4. PROJECT DATA

COIN - Concrete Innovation Centre - is one of 14 Norwegian Centres for Research based Innovation (CRI), which is an initiative by the Research Council of Norway. The main objective for the CRIs is to enhance the capability of the business sector to innovate by focusing on long-term research based on forging close alliances between research-intensive enterprises and prominent research groups.

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COIN has a budget of NOK 200 mill over 8 years (from 2007), and is financed by the Research Council of Norway (approx. 40 %), industrial partners (approx 45 %) and by SINTEF Building and Infrastructure and, NTNU (in all approx 15 %). The present COIN partners are the Research Council of Norway, SINTEF, NTNU, Norcem, Unicon, maxit Group, Borregaard, Spenncon, Rescon Mapei, The Norwegian Public Roads Administration, Veidekke and Aker Kværner.

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