

ABSTRACT

Belite is the one of the most important components in hydraulic cement clinker that can be synthesized from calcium oxide and any kind of silica sources including that of geothermal sludge (GS). The amorphous state of silica in GS provides an advantageous since synthesis of belite can be done at relatively low temperatures. In the present work, the occurrences of phases of belite were carefully investigated. A mixture of silica and calcium oxides was calcined at 1000°C followed by rapid or slow cooling to room temperature. Chemical stabilizer of BaCl₂ and NaF was added in the mixture to maintain the presence of β type belite in the desired product. Experimental results showed that to obtain β belite in the final product, calcination followed by rapid cooling (quenching) is required for the mixture with no chemical stabilizer. Addition of small fraction of BaCl₂ was able to preserve the presence of β belite and suppresses formation of non-hydraulic γ belite even though the calcination was followed by a slow cooling process. The presence of BaCl₂ was also found able to accelerate formation of β belite during calcination. In addition to experimental work, a kinetics model of reversible β to γ phase transformation was proposed. The results showed that below 600°C β phase is not stable and tend to convert to γ phase. Results from this work suggested that to keep concentration of β -phase in the final product high, rapid cooling (quenching) or/and addition of BaCl₂ as chemical stabilizer is preferable.

Keywords: Belite, Geothermal Sludge, Polymorphic transformation, Stabilizer, Kinetics

INTISARI

Belite adalah salah satu komponen terpenting dalam klinker semen hidrolik yang dapat disintesis dari kalsium oksida dan segala jenis sumber silika termasuk lumpur geothermal (GS). Silika amorf dalam GS memberikan keuntungan karena sintesis belit dapat dilakukan pada suhu yang relatif rendah. Dalam penelitian ini, kejadian fase belite diselidiki dengan cermat. Campuran silika dan kalsium oksida dikalsinasi pada 1000°C diikuti dengan pendinginan cepat atau lambat hingga suhu kamar. Stabilisator kimia dari BaCl_2 dan NaF ditambahkan dalam campuran untuk mempertahankan keberadaan tipe β belite dalam produk yang diinginkan. Hasil percobaan menunjukkan bahwa untuk mendapatkan β belite dalam produk akhir, kalsinasi diikuti oleh pendinginan cepat (pendinginan) diperlukan untuk campuran tanpa bahan kimia penstabil. Penambahan fraksi kecil BaCl_2 mampu mempertahankan keberadaan β belite dan menekan pembentukan α belite non-hidrolik meskipun kalsinasi diikuti oleh proses pendinginan yang lambat. Kehadiran BaCl_2 juga ditemukan dapat mempercepat pembentukan β belite selama kalsinasi. Selain pekerjaan eksperimental, model kinetika transformasi β ke α fase reversibel diusulkan. Hasil penelitian menunjukkan bahwa fase di bawah 600°C β tidak stabil dan cenderung tertutup ke fase α . Hasil dari pekerjaan ini menyarankan agar konsentrasi β -fase dalam produk akhir tetap tinggi, pendinginan cepat (pendinginan) atau / dan penambahan BaCl_2 sebagai penstabil kimia lebih disukai.

Kata kunci: Belite, Geothermal Sludge, Transformasi polimorfik, Stabilizer, Kinetics