



Natural minerals mixture for enhancing concrete compressive strength

Abdoullah Namdar

Faculty of Civil Engineering & Earth Resources, Universiti Malaysia Pahang, Malaysia
ab_namdar@yahoo.com

ABSTRACT. The construction material quality is required to be improved in order to enhancing structure stability, optimizing construction cost and quality. The kaolin and bentonite have been mixed in equal quantity and treated by heat for 1 hour under 600 °C, 800 °C and 1000 °C to create new minerals under high temperature condition to introduce an acceptable concrete additive for achieving concrete compressive strength in early age. To study micro properties of additive-cement mixture, X-ray and FESEM experiments have been used. The results indicate that acceptable proportion of unheated kaolin-bentonite is improving the concrete compressive response. But if kaolin-bentonite mixture treated by heat under 800 °C and in quantity of 12 % has been used in concrete mixed design, then the concrete compressive strength of 7 days shows the best result. The result is due to the development of new minerals under high temperature condition in mineral mixture and also kaolin-bentonite additive change cement past crystal and lead to enhancement of nano structural cement bonding.

KEYWORDS. Concrete additive; Kaolin; Bentonite; Heat treatment; New minerals.

INTRODUCTION

The use of high-fast strength concrete has many applications, both technical and economical. Over last decade, the high strength concrete in short time was very important issue for researcher. The reconnaissance on economically and feasibility concrete additive is highly significant in construction industry.

A high strength concrete is introduced by using large volumes of low calcium as an additive and compressive strength of 80 MPa was for 28 days [1]. The various chemical and supplementary cementitious materials are investigated on improvement concrete compressive strength [2-3]. And also fly ash, bottom ash and coarse aggregate mechanical properties and quality are evaluated for enhancement of concrete compressive strength [4-7]. The natural minerals are shown good results among other techniques. The investigation show natural minerals are improved concrete compressive strength and cement geopolymer [8-11]. From other view of point the investigation on materials macroscopic quality and minerals in concrete mix design is important topic for construction industry [12-13]. For example geopolymers can be synthesized from aluminosilicate powders including natural pozzolans [14-15]. The replacing cement by mineral additions resulted in lower early age strength and low cement quantity consumption [16]. The modern construction projects are trust to high strength concrete [17]. To optimize admixture cost and better improvement concrete characteristics many methods have been introduced [18-20]. The natural minerals mixture treatment by heat to develop new minerals based on kaolin-benonite interaction minerals in high temperature for produced new materials which can be useful as a concrete additive in concrete mixed design process have been investigated in order to improve concrete compressive strength in short term for minimizing construction time and cost.



METHODOLOGY

The natural minerals have ability in producing new material or modifying characteristics of materials. In this research work the kaolin and bentonite have been selected for improve concrete compressive strength. The kaolin and bentonite have been mixed in equal weight and subjected to the heat for 1 hour for 600 °C, 800 °C and 1000 °C. The main propose for mixing kaolin and bentonite before submitting to heat is to analysis minerals of kaolin and bentonite interaction in high temperatures. The unheated and new produced materials have been mixed with concrete for 6% and 12% of cement weight (Tab. 1). The compressive strength of concrete for 7 days and 14 days has been tested. To study macro properties of additive-cement mixture X-ray experiment and FESEM have been used.

RESULT AND DISCUSSION

In Figs. 1-3 the image of FESEM shows Nano particles of cement past without additive and, when 6% and 12% additive have been used in concrete mixed design. In Fig. 1 the Nano particle have almost plane shape and in Fig. 2 the shape is convert to the lengthy shape and in Fig. 3 this process is increased, and subsequently resulted in improving concrete compressive strength. The additive creates new crystal structure in cement past. The result is indicated that 6% proportion of unheated kaolin-bentonite is improving concrete compressive. And if kaolin-bentonite mixture treated by heat under 800 °C and in quantity of 12 % of cement weight has been used in concrete mixed design the concrete compressive strength of 7 days is resulted in improving concrete compressive strength in maximum level. It is due to develop new crystal morphology under high temperature condition in bentonite-kaolin-cement mixture and also considerably enhancement bonding of cement. If quantity of bentonite-kaolin mixture treated by heat increased in concrete mixed design resulted in better enhancement compressive strength, and it is not for unheated bentonite-kaolin mixture.

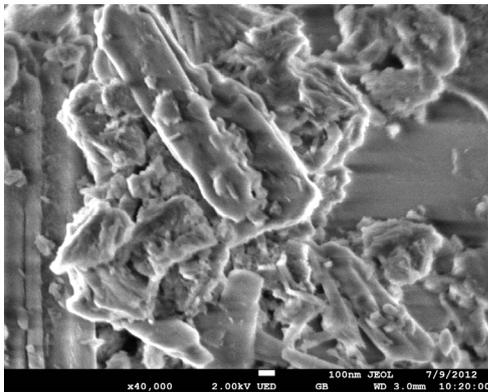


Figure 1: Image FESEM of cement.

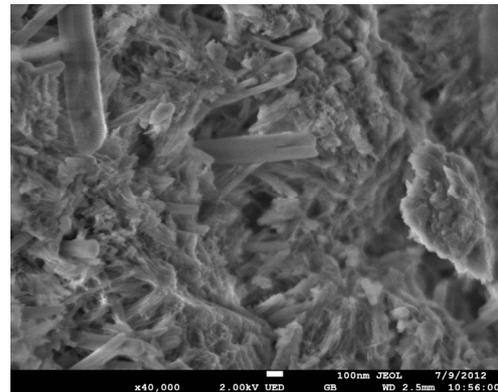


Figure 2: Image FESEM of cement mixed with 6% additive.

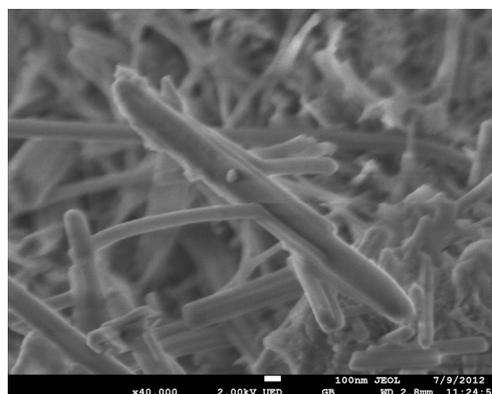


Figure 3: Image FESEM of cement mixed with 12% additive.



The Fig. 4 is highlighted XRD pattern of cement, and cement- kaolin-bentonite mixture, the kaolin-bentonite was submitted to 800 °C heat for 1 hour. The XRD pattern shown that Ca(OD) is converted to Ca(OH)₂ but no significant change in XRD pattern in increasing kaolin-bentonite mixture from 6% to 12% in concrete mixed design.

The Tab. 2 and Fig. 5 show the result of different mixed design for compressive strength of concrete. The result is indicated appropriate proportion of natural minerals mixture can improve concrete compressive strength without and treatment process.

Sl No	Con type	Unheated additive (%)	Additive produced by 600 °C (%)	Additive produced by 800 °C (%)	Additive produced by 1000 °C (%)
1	40	-	-	-	-
2	40	6	-	-	-
3	40	12	-	-	-
4	40	-	6	-	-
5	40	-	12	-	-
6	40	-	-	6	-
7	40	-	-	12	-
8	40	-	-	-	6
9	40	-	-	-	12

Table 1: Concrete-additive mixture ratio.

Sl No	Type of concrete	Additive (%)	7 days Stress (N/mm ²)	14 days Stress (N/mm ²)
1	Without additive	-	25.77	30.48
2	Natural additive	6	33.65	34.50
3	Natural additive	12	21.87	28.44
4	Additive produced under 600 °C heat	6	18.70	33.07
5	Additive produced under 600 °C heat	12	25.14	40.19
6	Additive produced under 800 °C heat	6	30.95	35.15
7	Additive produced under 800 °C heat	12	40.32	42.39
8	Additive produced under 1000 °C heat	6	27.05	31.70
9	Additive produced under 1000 °C heat	12	31.97	33.44

Table 2: Concrete compression strength.



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