EFFECT OF COLLOIDAL SIO_2 CONTENT ON THE MORPHOLOGY OF COATED CERAMIC PARTICLES

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Abstract
Coated structure on fly ash particles was produced by liquid stirring of colloidal SiO_2. Morphological study by means of scanning electron microscope has consent to controlling the present of outer layer by the addition of variable amount of colloidal SiO_2. Similar studies on uncoated and coated particles were also done for comparative purposes. The results exhibits that the SiO_2 coating on the fly ash particles was successfully produced by liquid stirring method. It is suggested that the low amount of colloidal SiO_2 content results more skinny coating on particles.

Keywords: Colloidal SiO_2, Fly ash particles, Liquid stirring, Morphology study

Introduction
In recent years a variety of ceramic particles have been incorporated in metal matrices by liquid techniques including stir casting and infiltration processes. However, the basic problem encountered in the fabrication of these composites is the rejection of the ceramic phase by the liquid metal due to their lack of wettability [1]. To improve wetting of ceramics by liquid metals, a possible approach is to apply metal coating on ceramic particles, which essentially increases the overall surface energy of the solid, thereby promoting wetting by the liquid metal [2]. Potential metals for such coatings are nickel and copper [3,4]. Unfortunately, metal coating on ceramic particles was an expensive technique and has a limited number of equipments in order to perform this type of coating in our country. Therefore, the development of liquid silica (SiO_2) coating on fly ash particles was seemed to be a suitable method to overcome this limitation. The preliminary experiments found that the skinny layer of coating structure could promote the incorporation of particulates reinforcement in molten metal. Furthermore, it also provides more strength and stable layer to avoid the degradation of reinforcement particles in abrasive action during vigorous stirring action at semisolid state. Thus, the aim of this study is to design a skinny silica (SiO_2) coating structure on ceramic particles surface.

Experimental Procedure
The ceramic particles used in this current work were fly ash particles which were supplied by the Sultan Sallahudin Abdul Aziz Generation Station, Kapar, Klang, Selangor. As-received fly ash powder was seized at 10 um and ultrasonically cleaned by acetone. It was then dried at 70^oC for 8 hours. The fly ash was heat-treated at 750^oC for 3 hours. For coating procedures, the AS30 colloidal SiO_2 (Aldrich Chemical Co. Inc) was mixed by distilled water. The amount of colloidal SiO_2 used was varied from 1 to 20 wt.%. Heat-treated fly particles were immersed into SiO_2 solution. The mixture was kept under stirring at 500 rpm for 2 hours and it was then sediment for 30 minutes. Pre-coated particles were filtered and dried at 70^oC for 8 hours. Finally, thermal treatment was carried out at 600^oC for 5 hour. The morphology characterization was studied by means of scanning electron microscope (SEM); FEI QUANTA 400.

Results and Discussion
The morphological of as-received fly ash particles shows the smooth surface surrounded by precipitate nanoscale nodules (Figure 1a). Considering the fact that the fly ash particles were composed by variable size of oxide compounds [5], thus the nanoscale nodules was strongly believed one of the fly ash oxide compound that attracted to larger particles resulted by moisture activity during sampling. Dried pre-coated of particles morphology were shown by Figure 1(b). It clearly shows that the SiO_2 coating on the fly ash particles has successfully produced. However, the particles were observed surrounded by irregular thick layer of SiO_2 on the particle surface.

Figure 2, shows the morphology of sintered fly ash particles that coated by difference amount of SiO_2 colloid solution. Compare to unsintered particles surface in Figure 1(b), it clearly shows that the thickness of SiO_2 coating layer on the fly ash particles was found more thinny. This occurrence was believed resulted by diffusion of the colloidal SiO_2 into particles micropores. Figure 2(a) shows the morphology of particle surface that coated by 1 wt.% of colloidal SiO_2 forms smooth and skinny coating layer. The thickness of coating layer was seen slightly increases by using of 5 wt.% of colloidal SiO_2 (Figure 2b). The increasing of the coating thickness was dramatically increase by the increasing of colloidal SiO_2 amount as shown in figure 2(c) and 2(d). The morphology of coated structure was found promotes uneven and irregular surface by using large amount of colloidal SiO2 content.

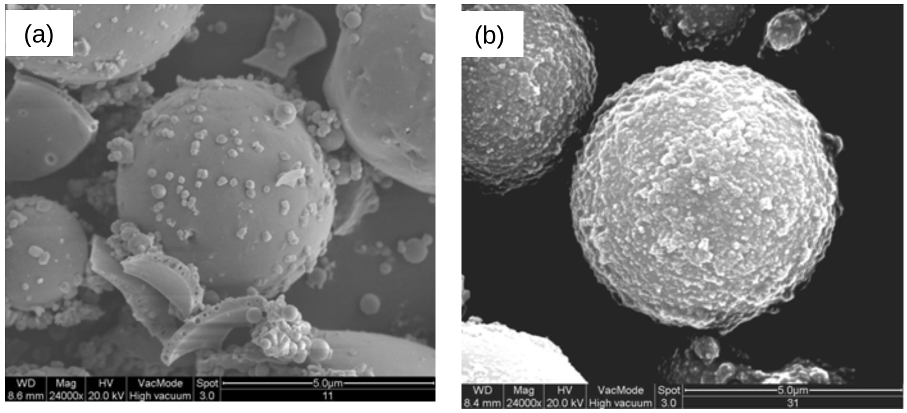

Figure 1: SEM micrographs on (a) as received, (b) heat-treated fly ash particle.

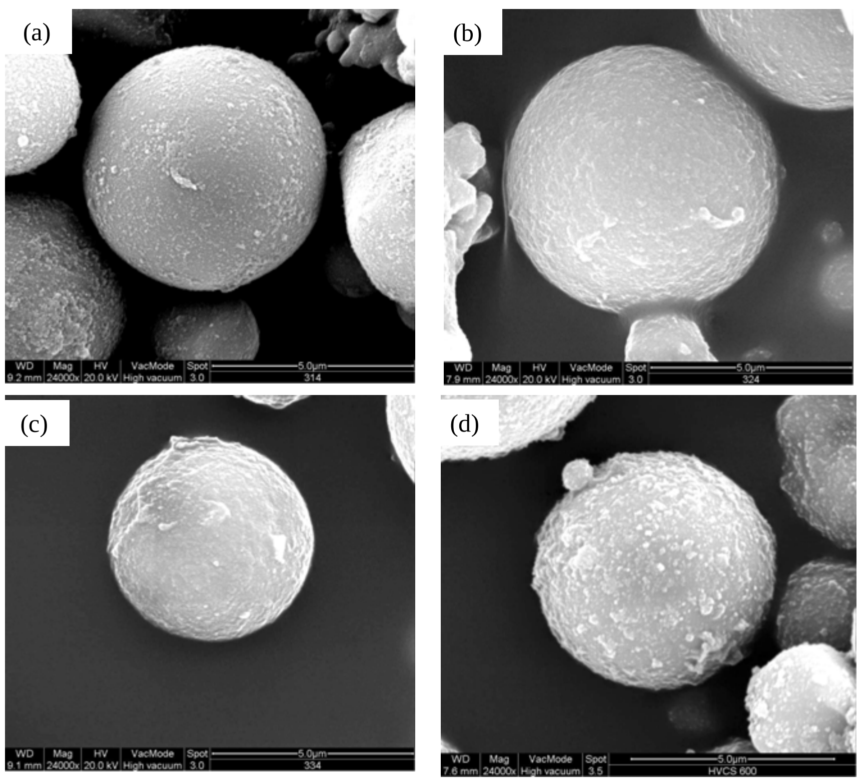

Figure 2: SEM micrographs on coated fly ash particles with (a) 1 wt.%, (b) 5 wt.%, (c) 10 wt.% and (d) 20 wt.% of colloidal SiO_2.

Conclusion

Coating of fly ash particles has successfully produced by liquid stirring of colloidal SiO_2 solution. It can be stated that by using large amount of colloidal SiO_2 content promotes the increasing of thickness and irregular coating layer on particles surface.

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