Rekayasa material abu sekam padi dan batu apung pada beton ringan untuk meningkatkan kekuatan mekanik semen portland komposit = Lightweight concrete containing rice husk ash and pumice materials to improve the mechanical strength of portland cement composites

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Abstrak

[ABSTRAK
Telah dilakukan penelitian pembuatan beton ringan atau lightweight concrete (LWC) menggunakan batu apug (BA) dan abu sekam padi (ASP). Sampel beton ringan yang dibuat mengandung BA dengan fraksi berbeda, adapun material semen, pasir, dan abu sekam padi volumenya dijaga tetap. Terdapat dua parameter utama yang menentukan sifat mekanik sampel LWC masing-masing adalah densitas sampel dan rasio air/semen (w/c). Sifat mekanik yang paling utama dari LWC adalah kekuatan tekan. Pada campuran dengan fraksi volume batu apung terbesar (100%) menghasilkan densitas dan kekuatan tekan paling rendah masing-masing sebesar (1389,6 kg/m3 dan 11,1 MPa). Diketahui bahwa makin rendah fraksi batu apung dalam sampel beton makin tinggi nilai densitas dan kekuatan tekannya, disebabkan oleh tingginya nilai fraksi pori baik pori terbuka maupun pori tertutup dalam sampel beton. Observasi terhadap fotomikro SEM batu apung menunjukkan bahwa terdapat sejumlah besar pori dengan bentuk memanjang ke bagian dalam dari permukaan sampel beton. Pori hadir dengan kerapatan jumlah pori relatif besar serta dengan ukuran yang bervariasi. Fakta ini menjelaskan mengapa batu apung besifat ringan karena memiliki densitas massa yang rendah. Pola difraksi sinar X sampel beton ringan memperlihatkan dominasi fasa kristalin diidentifikasi sebagai fasa quartz (SiO2). Namun dapat dipastikan sampel beton ringan terdiri dari fasa campuran antara fasa kristalin dan dengan sedikit fasa amorph.
Fotomikro SEM beton ringan menunjukkan bahwa senyawa Kalsium Silikat Hidrat (CSH) mulai tumbuh pada waktu awal proses hidrasi dan terus berkembang sampai umur beton mencapai umur hidrasi 28 hari yang ditandai dengan sifat fisik yang padat dan peningkatan kekuatan beton. Dapat dipastikan bahwa senyawa CSH ini memiliki peranan penting terhadap pengaturan sifat mekanik seperti kekuatan tekan. Penelitian ini menyimpulkan bahwa batu apung dan abu sekam padi adalah material berbasis silika amorph yang memiliki densitas lebih rendah terutama dibandingkan dengan material pembentuk beton lainnya. Baik densitas dan kekuatan tekan sampel beton ringan ditentukan oleh rasio antara batu apung dan abu sekam padi. Ditemukan rasio terkecil BA/ASP yaitu 8 menghasilkan nilai densitas dan kekuatan tekan optimal, masing-masing pada usia beton 28 hari sebesar 1891 kg/m3 dan 23 MPa. Komposisi beton ringan yang

terbaik diperoleh dari hasil penelitian ini adalah komposisi campuran PCC (1,00) : Pasir (1,00) : ASP (0,05) : BA (0,50) dengan nilai Slump 8 cm ditandai oleh nilai rasio antara kuat tekan dan densitas tertinggi adalah 1285.;
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ABSTRACT
Research studies on the manufacture of lightweight concrete (LWC) using pumice and rice husk ash (RHA) materials have been done. LWC samples were made of pumice materials with a different mass fraction, while the cement, sand, and rice husk ash materials were keep fixed. It was found that there are two main parameters that determine the mechanical properties of LWC which are density and the water and cement ratio (w/c ratio). The main mechanical properties of LWC sample is the power press. Samples with the largest volume fraction of pumice (100%) resulted in lightest density (1389.6 kg/m3) and the smallest strength of LWC (11.1 MPa). It was found that, the lower the mass fraction of pumice in LWC samples, the higher the density values and compressive strength were obtained. This was caused by the high mas fraction value of pores, which were both open and closed pores. Scanning electron micorscopy (SEM) images for the pumice showed that the there are a large number of regular and structured pores extending deep inside the surface of the sample. It was observed that pores present with pore size does not vary significantly but with the density of the relatively large number of pores, indicating pumice has a low mass density. The XRD pattern of the lightweight concrete samples indicated that the samples were dominated by crystalline phases in which the quartz (SiO2) is the main phase and a small fraction of amorphous phase was also obtained.
SEM images of lightweight concrete samples showed that the structure of Calcium Silicate Hydrates (CSH) started growing at the beginning of hydration time and continue to evolve into a more solid structure until the age of 28 days, where the compound has an important role to the mechanical properties such as compressive strength. The study concluded that the pumice and rice husk ash is are amorphous silica-based material which has a lower density compared to other concrete forming material such as cement and sands. Both density and light weight concrete compressive strength are determined by the ratio between pumice and rice husk ash, in which the smallest ratio 8 resulted in the largest density and compressive strength, which are 1890.5 kg/m3 and 23.2 MPa respectively at the age of 28 days. The study concluded that the best composition for lightweight concrete samples was the following: PCC (1,00): Sand (1,00): ASP (0,05): BA (0,50) with a slump value of 8 cm resulted in the largest value of a ratio between compressive strength and density of 1285.;Research studies on the manufacture of lightweight concrete (LWC) using
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