UTILIZATION OF RECYCLED TYRE RUBBER WASTE AS PARTIAL REPLACEMENT OF SAND IN ULTRA-HIGH PERFORMANCE CONCRETE (RUBBERIZED-UHPC)

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ABSTRAK

Konkrit berprestasi tinggi (UHPC) adalah bahan pembinaan dengan sifat-sifat mekanikal yang cemerlang dan ketahanan yang baik berbanding dengan konkrit biasa. Di sebalik ciri-ciri yang cemerlang, UHPC juga mempunyai beberapa batasan dari segi kos dan ketersediaan bahan konstituen mentah. UHPC memerlukan sejumlah besar pasir untuk menghasilkan UHPC. Oleh itu, penggunaan bahan buangan iaitu sisa tayar getah yang dikitar semula (RTRW) sebagai elemen gantian untuk pasir di UHPC adalah satu penyelesaian yang menjanjikan bagi menyelesaikan masalah ini. Idea ini juga diilhamkan daripada isu-isu alam sekitar penting yang terhasil daripada pelupusan sisa tayar getah. Ia bukan sahaja mengurangkan kemusnahan, tetapi ia juga memberi petunjuk kepada pembangunan mampan dengan memastikan pemuliharaan sumber semula jadi. Dalam kajian ini, kemungkinan penggunaan RTRW sebagai gantian separa pasir dikaji. Empat (4) tahap peratusan RTRW yang berbeza sebagai penggantian pasir separa telah disediakan. Ianya adalah 0%, 5%, 10% dan 15% RTRW dari jumlah berat pasir digunakan. UHPC dan siri UHPC mengandungi sisa getah dilabelkan sebagai rubberized-UHPC, rubberized-UHPC5, rubberized-UHPC10 dan rubberized-UHPC15 masing-masing. RTRW terdiri daripada serbuk micromized getah (MRP) dan getah serbuk (CR). 10% daripada debu silika digunakan sebagai pengganti separa simen Portland biasa (OPC). Dalam kajian ini, sifat-sifat kekuatan spesimen dari segi kekuatan mampatan dan kekuatan tegangan pecah pada 7, 14 dan 28 hari telah disiasat. Keputusan eksperimen menunjukkan bahawa penggunaan RTRW dalam campuran UHPC membawa kepada pengurangan kekuatan mampatan dan kekuatan tegangan berpisah. Ia telah didapati bahawa peningkatan peratusan RTRW sebagai penggantian sebahagian pasir akan mengurangkan kekuatan dalam bentuk kekuatan mampatan dan kekuatan tegangan. Secara keseluruhan, penggunaan 5% RTRW sebagai separa pasir penggantian setanding di kedua-dua kekuatan dan membelah kekuatan tegangan mampatan. Di sebalik kelemahan ini, ia telah didapati bahawa UHPC mengandungi sisa getah tidak menunjukkan kegagalan rapuh Sementara UHPC biasa dipamerkan kegagalan rapuh. Berdasarkan pemerhatian ini, dapat disimpulkan bahawa UHPC mengandungi sisa getah mempunyai kekuatan yang lebih tinggi berbanding dengan UHPC biasa.

ABSTRACT

Ultra-high performance concrete (UHPC) is a construction material with excellent mechanical properties and good durability as compared to conventional concrete. Despite its outstanding properties, UHPC also has some limitations in terms of cost and availability of raw constituent materials. UHPC require large amount of fine sand in the production of UHPC. Therefore, the incorporation of waste material namely recycled tyre rubber waste (RTRW) as apartial replacement for sand in UHPC is a promising solution to these arising problems. This idea also was inspired from the crucial environmental issues that resulting from the disposal of tyre rubber waste. It not only minimize the degradation, but it also guides to sustainable development by ensuring the conservation of natural sources. In this present study, the possibility of using RTRW as partial sand replacement was investigated. Four (4) different percentages of levels RTRW as partial sand replacement were prepared. There are 0 %, 5 %, 10 % and 15 % of RTRW from total weight of sand used. The UHPC and a series of rubberized-UHPC were labelled as plain-UHPC, rubberized-UHPC5, rubberized-UHPC10 and rubberized-UHPC15 respectively. RTRW consist of micromized rubber powder (MRP) and crumb rubber (CR). 10 % of silica fume was used as partial replacement of ordinary Portland cement (OPC). In this study, the strength properties of specimens in terms of compressive strength and splitting tensile strength at 7, 14 and 28 days were investigated. The experimental results revealed that the incorporation of RTRW into UHPC mix leads to the reduction of compressive strength and splitting tensile strength. It was found that increasing the percentages of RTRW as partial replacement of sand would decrease the strength in form of compressive strength and tensile strength. Overall, inclusion of 5 % RTRW as partial sand replacement show comparable on both compressive strength and splitting tensile strength. Despite of this drawbacks, it was observed that rubberized-UHPC did not exhibit brittle failure meanwhile plain UHPC exhibited brittle failure. Based on this observation, it can be concluded that rubberized-UHPC has higher toughness compared to plain-UHPC.