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Kaunas University of Technology, Faculty of Civil Engineering and Architecture
Studentu st. 48, LT-51367 Kaunas, Lithuania
E-mail: konf.statyba@ktu.lt

Lightweight Concrete with Aggregates Made by Using Industrial Waste

Diana Bajare, Janis Kazjonovs and Aleksandrs Korjakins

Riga Technical University, Faculty of Civil Engineering, Kalku st. 1, LV-1658, Riga, Latvia. E-mail: diana.bajare@rtu.lv, janis.kazjonovs@rtu.lv, aleks@latnet.lv

EXTENDED ABSTRACT

The disposal and treatment of solid and hazardous industrial waste is quite expensive for any industry; therefore it brings challenges to find a solution that permits to obtain new, usable products by waste utilization in a technically and economically sustainable as well as environmentally friendly way.

The production of lightweight concrete by using aggregates made by industrial by-products and hazardous solid waste such as expanded fly ash, slag, sludge etc. is well known. This research provides possibilities to reuse waste called non-metallic product (NMP) from aluminium scrap recycling factories for the manufacturing of lightweight expanded clay aggregates and lightweight concrete. Characterization of NMP is described in the preliminary publications (Bajare et al. 2012).

The manufacturing cycle of lightweight expanded clay aggregates were simulated in laboratory by sintering the clay - waste mixes in the rotary furnace up to 1200°C. Lightweight expanded clay aggregates with rather different pore structure were obtained due to slight variations of mixture composition and sintering temperature. Produced aggregates were with bulk density from 320 kg/m^3 to 620 kg/m^3. Different types of lightweight aggregates were used to produce lightweight concretes. Mechanical, physical and thermal conductivity tests were performed for hardened concrete specimens according to standard procedures.

Keywords: Lightweight concrete, expanded clay aggregate, industrial waste.

CONCLUSIONS

Lightweight aggregate with different density (from 320 kg/m^3 to 620 kg/m^3) and crushing strength (from 0.8 MPa to 4.2 MPa) can be produced by using laboratory rotary kiln with the identical sintering temperature of 1180°C and regime, but changing NMP amount in composition of raw materials. They can substitute commercially available lightweight aggregates in low and high strength lightweight concrete.

Laboratory sintered aggregates LA and LB are with significantly lower water absorption up to 12% compared with the commercially available aggregates A1 and A2 (~18%). The water absorption for laboratory sintered aggregates is equivalent to high strength aggregates B1 (~12%).

Obtained concrete bulk densities ranged from 1600 kg/m^3 to 2020 kg/m^3. Hardened concrete bulk density for CLA, CA1 and CA2 was from 1550 kg/m^3 to 1600 kg/m^3, therefore it was declared as lightweight concrete. High strength lightweight concrete CLB, CB1 and CCLB samples showed bulk density under 2000 kg/m^3, but concrete composition CCB1 showed result 2020 kg/m^3.

Concrete made with lightweight aggregates with lower crushing strength and bulk density showed lower mechanical properties. Low strength lightweight concrete specimens CLA, CA1 and CA2 showed similar results in compressive strength after 28 days ranging from 20 to 24 MPa, and in flexural strength ranging from 4 to 5 MPa. Compressive strength of high strength lightweight concrete CLB and CB1 were 32 and 54 MPa after 28 days, and flexural strength were 5.5 and 6.7 MPa, respectively. Additional SF and admixture improved the mechanical properties of CCLB and CCB1, where compressive strength after 28 days were 43 and 62 MPa, and in flexural strength 6.9 and 7.6 MPa.

REFERENCES

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