A Detail Discussion on Variation in Light Weight Concrete

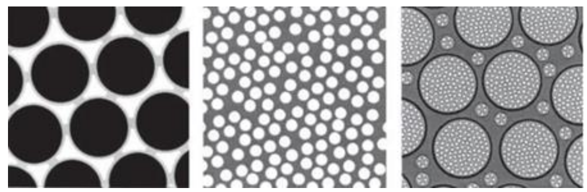
Sagar Singh Thakur[1], Kushagra Pandey[2]
[1,2]Civil Department, Kalinga University, Raipur, C.G., India

***Abstract* - Lightweight aggregate concretes are widely incorporated in construction and development. As we know, pre-foaming method or the mixed-foaming method can be used to make foamed concrete. Here, OPC and PPC cement are chosen mainly based on their different properties effect the light concrete. This paper is the literature survey of extensive work of previous work done on Light weight foam concrete (LWFC). The review is done based on several categories such as LWFC with foaming agents, LWFC with different aggregate as partial replacement, LWFC made with External Materials such as Coconut fiber, Cork granules, Plastic Waste, Oil Palm Shell, Marble Waste. Because of the significant demand for foamed concrete constructions with good mechanical and physical features, the use of foamed concrete is expanding at the moment. This has been concluded that for betterment advancement of the lightweight concrete blocks research study has to be continuous by examining and analyzing more research study.**

***Index Terms* - LWFC, OPC, PPC, Foaming Agent.**

1.INTRODUCTION

Lightweight concrete (LWC) is a versatile material that has produced a lot of attention and a lot of industrial demand in a variety of construction projects in recent years. LWC kinds are classified based on their production process. These are the types: a) Using lightweight aggregate with a low specific gravity in place of standard weight aggregate, where the specific gravity of the lightweight aggregate is less than 2.6. This form of concrete is commonly referred to as lightweight aggregate concrete. b) concrete or mortar mass incorporated by bubble voids. This type of concrete is known as aerated, cellular, foamed. c) Eliminating the fine aggregate from the mix so the coarse aggregate of ordinary weight is generally used. Thus, known as no fines concrete (Brooks 2010).



(a) (b) (c)

Figure 1 (a) No-fines concrete(b)Aerated concrete (c)Lightweight aggregate concrete

The general properties after reviewing several articles, the typical light concrete are explained here by-

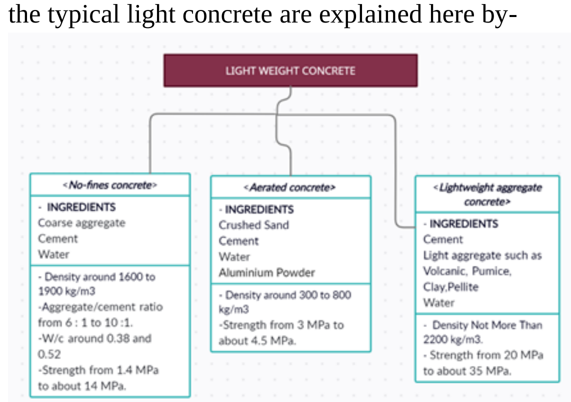


Figure 2 Basic Details of different types of Light weight concrete

2. DISCUSSION ON VARIATION IN LIGHT WEIGHT CONCRETE

2.1 Based on foaming agents

Portland cement, tap water, and foaming agent were utilized in this experiment (Kadela, Kukiełka, and Małek 2020). The purpose of this research is to evaluate the qualities of foamed concrete with densities of 500, 700, 800, and 1000 kg/m3 manufactured by applying a synthetic polymer-based foaming agent. The compressive strengths achieved were higher than that observed in the literature for foamed concrete of the same densities. The synthetic foaming agent contents were 8.0, 6.0, 5.0 and 4.0 dm3 per 100 kg of cement. The results showed that the volume of foam frequently caused air voids, leading to reduced density. Depending on the density of the foamed concrete samples, the variances between the density of the mixture and the density of the hardened sample were up to 170 kg/m3; significant differences were found for higher densities. The number of air-voids was larger and the average thickness of the air bubbles wall was thinner in foamed concrete with a density of 500 kg/m3 than in the other densities. Smaller creep deformations were recorded as the density of foamed concrete increased.

The AAC is a masonry material that is lightweight, easy to construct, and economical to transport(Wahane 2017). AAC is one of the materials which can cope up with the shortage of building raw materials and can produce a light weight, energy efficient and environmentally friendly concrete. The study deals with the manufacturing process of the autoclaved aerated concrete blocks.

2.2 Based on Different type of aggregate

A series of tests were performed on the lightweight aggregates to evaluate their quality and physical attributes, comprising chemical analysis, grading, density and water absorption determination, strength, and clay percent. The chemical analysis results of aggregates are based on macroscopic observations; aggregate samples have a significant number of light grey (pumice) and thick light grey segments (tuff, less than 10 percent). For such mix-design of this experiment, ACI concrete procedures had been used. (T.Parhizkar et Al" 2012) observed water absorption rates of 9.5 percent per minute for light weight fine aggregate and 30 percent per minute for coarse aggregate. Taking account, it was discovered that the compressive strength of Light weight coarse and natural fine aggregate concrete is 20 to 40% lower than control concrete, although they are around 30% lighter. Light weight coarse and fine aggregate concrete have a compressive strength that is roughly 50% lower than control concrete, but they are typically 40% lighter.

This author discusses advancements in the utilization of recycled wood aggregate for concrete blocks. Questions exist about the product's economic performance, and (Stahl et al. 2002) investigated this further to analyze the effect of curing blocks in the uncontrolled external circumstances characteristic of the block industry. The sawdust is experimented from a sawmill as fine aggregate for light weight concrete masonry unit (Rashwan, Hatzinikolas, and Zmavc 1992). The outcome of a simple mix based on replacing the volume of coarse aggregate in a conventional mix with wood aggregate, as well as a mix that included some stone aggregate in addition to the wood aggregate, as well as a sodium silicate treatment for the wood.

The performance of lightweight expanded polystyrene concrete containing silica fume was examined, and it was found that as the replacement levels of silica fume in concrete increased, the rate of strength development increased while total absorption values reduced (K.Ganesh Babu and Saradhi Babu 2003). The technical properties of polystyrene (PS) aggregate concrete when natural coarse aggregate is partially replaced (Sabaa and Ravindrarajah 1997). Nine distinct mixtures were prepared and tested with a water to binder ratio (W/B) of 0.8 with different SPS content ratios of 0, 60, and 100 percent as partial replacement of natural fine aggregate by equivalent volume at fly ash replacement levels of 0, 20, and 40% with Portland cement. At the age of 28 days, the parameters of concrete studied in this paper were compressive strength and ultrasonic pulse velocity (UPV). Thus according (Herki, Khatib, and Negim 2013), increasing the amount of polystyrene and fly ash in concrete reduces compressive strength and UPV.

(Ramesan, Babu, and Lal 2015) investigated the suitability of recycled plastics (high density polyethylene) as coarse aggregate in concrete by performing various tests such as workability by slump test, compressive strength of cube and cylinder, splitting tensile strength test of cylinder, and flexural strength of R.C.C. and P.CC. beams to determine the properties and behavior in concrete. The effect of replacing coarse aggregate with various percentages (0 to 40%) of plastic aggregate on concrete behavior was explored experimentally, and the best replacement of coarse aggregate was determined. The results demonstrated that adding plastic aggregate to the concrete mixture increased its characteristics.

2.3 Based on External Materials such as Coconut fiber, Cork granules, Plastic Waste, Oil Palm Shell, Marble Waste

Concrete cylinders with size of 150 X 300 mm were cast to perform compressive and tensile testing, and the data shows that the compressive strength of concrete increased with curing age but reduces as the quantity of coconut fiber rises, even though its tensile strength increases. The ultimate compressive strength obtained was 3.0 MPa. (Agrawal, Dhase, and Agrawal 2014)has raised awareness in the field of Civil Engineering about the possibilities of using coconut fiber as a moderate construction material. The fundamental objective is to inform about the benefits and uses of coconut fiber, as well as to introduce it as a cheap and easily accessible natural fiber that does not harm the environment. The mechanical properties of epoxy polymer concrete reinforced with natural fiber. Later, (Gunasekaran and Kumar 2008)reported that concrete reinforced with coconut fiber has a 24 percent higher water absorption than PC. They found that after 28 days of curing, the compressive strength of concrete improves by 19.1 percent compared to Portland cement. It was concluded that when there is more coconut fiber in the concrete than 3 % cement, the strength of the concrete decreases, causing it to be waste.

Significant research has been conducted in recent years on lightweight concrete, primarily using inorganic materials such as fly ash, expanded clay and expanded shale, vermiculite and perlite and organic aggregates such as sawdust, wood shavings, peat, rice husk, coconut fibers, and jute-stick granules. (Aziz, Murphy, and Ramaswamy 1979)experimental work entails analyzing the physical properties of cork granules, fabricating cork concrete specimens of various mixes with varying water-cement ratios, curing under various conditions, and finally testing those specimens for density, strengths (compression, tension, flexure), shrinkage, permeability, and thermal conductivity. As a result, it was found that the ranges of values of both compressive and tensile strengths of cork lightweight concrete are lower than either existing structural lightweight concretes, but higher than those of aerated, no-fines, cellular, and foamed lightweight concretes.

In order of choice, plastic material can be recycled with one of three methods: recycling, incineration, or landfilling (Gertsakis and Lewis 2003). The most common thing of incorporating plastic waste into concrete mixes necessitates sorting the plastic and cleaning it before shredding it into particles of various shapes and sizes (Ferreira, De Brito, and Saikia 2012), (Ismail and AL-Hashmi 2008). ASTM 2020 provisions were used in the methodology. The fresh concrete was subjected to yield and slump tests in accordance with the NZS 3112.1:1986 standard. (del Rey Castillo et al. 2020). Furthermore, the results showed that plastic aggregates produced through shredding, palletization, and extrusion processes can be used to generate lightweight concrete with a density of 1800 kg/m3 and relatively good compressive strength properties of 20 MPa after 28 days. It was concluded that the concrete mix described herein can be employed for a wide range of applications, including non-structural facades and highway sound barriers. Additional research is needed to investigate the durability of concrete with artificial aggregate included in the mix, particularly if the product will be subjected to wear and strain, as in driveways or warehouse slabs.

The most popular approach for developing lightweight concrete is to utilize lightweight aggregate (LWA), and in most instances, the lightweight concrete is produced with a lightweight coarse aggregate and a normal weight sand for the fine aggregate (S.R. Boyd and T.W. Bremner 2006). Moreover, the durability of OPS concrete is comparable to that of other conventional lightweight concrete (Teo, Mannan, and Kurian 2009). The author (Shafigh, Jumaat, and Mahmud 2010) analyzed the use of old OPS in the manufacture of high strength lightweight concrete (HSLC). The essential variables were tested: density, air content, workability, cube compressive strength, and water absorption. The effects of five different curing conditions on 28-day compressive strength was examined. The study results showed that it is possible to manufacture OPS concretes with a 28-day compressive strength of about 43–48 MPa and a dry density of about 1870–1990 kg/m3 by using limestone powder or without it. The compressive strength of OPS HSLC is affected by the absence of curing. The water absorption of these concretes is comparable to that of good concrete. Based on Compressive strength test by NDT

(Bogas, Gomes, and Gomes 2013)investigated the non-destructive ultrasonic pulse velocity method for determining the mechanical properties of a wide range of structural lightweight aggregate concrete mixes. It has been found that mix design parameters impact light-weighted and conventional concretes differently. Additionally, the non-destructive ultrasonic pulse velocity test is often used to determine the compressive strength of concrete. (Trtnik, Kavčič, and

Turk 2009) obtained better correlations when other variables such as the w/c ratio, aggregate volume and size, concrete age, and curing conditions were also evaluated. Regarding the relation between the ultrasonic pulse velocity and the density and elasticity of concrete, a simplified formula for calculating compressive strength is proposed, regardless of the kind of concrete or its composition. It has been observed that the strength of lightweight concrete increases with age and reduces with w/c ratio and aggregate volume. However, unlike UPV, which is also influenced by the percentage of mortar materials, the type of w/c ratio has little effect on the tensile. For a given compressive strength, UPV variations of close to 100 m/s were obtained.

Waste is a major issue affecting all biological life and all industrial activities (Talah, Kharchi, and Chaid 2011). The use of marble powder to replace up to 15% of the Portland cements in composite cement improves the longevity of the concrete without reducing its compressive strength (Talah, Kharchi, and Chaid 2011). The purpose of the current study is to recover marble waste and expanded perlite aggregate (EPA) for use as an additive in cementitious matrix building materials. The primary purpose is to create a new lightweight concrete (LC) insulation block floor by combining sand from the waste marble crushing process (SWM), natural sand, and EPA (Alyousef et al. 2019). The results demonstrated that the addition of SWM greatly improved the mechanical characteristics and thermal insulation of LC when compared to natural sand. These suggest that the current insulation block floor could be employed in composite slabs.

3. CONCLUSIONS

After studying the articles, the light concrete properties have been explored by different researcher made great impact in development of this special type of concrete but there is certain field area in respect of industrial waste, medical waste which can be incorporated with the lightweight concrete in field of research. Also, as per material attainment or their testing stipulations differ from location to location. Hence, a nominal design mix guidelines has to be implemented for easy understanding and standardizing of design mix of light weight concrete.

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