International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Review Paper on Study using Waste from the China Clay Industry to Partially Replace the Fine Aggregate in M40 Concrete

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ABTRACT

Waste reduction research has centred on using industrial and agricultural waste generated by industrial processes for economic, environmental, and technological objectives. This is due to India's agricultural and industrial processes producing more than 300 million tonnes of industrial waste each year. The issue caused by ongoing industrial and technical advancement is how to dispose of garbage. Not only can building costs be reduced, but safe waste disposal can also be accomplished if some of the waste components are proven to be acceptable for concrete production. High strength concrete typically uses more cement, which frequently causes larger shrinkage and greater examination of hydration in addition to cost increases. A partial substitution of industrial waste for cement enhances the properties of freshly-poured and cured concrete, increases its durability, and ensures the waste is disposed of safely, safeguarding the environment from pollution. Around the world, cement concrete is frequently used to build constructions. Cement, fine aggregate, coarse aggregate, and water are the usual ingredients in concrete. The demand for concrete materials is rising along with the development of infrastructure in developing nations.in this paper review industrial waste which can used in construction work .

Keywords: Keywords: China clay waste, Compressive strength, Split tensile strength, Flexural strength

1. Introduction

China clay, one of the cleanest clays, contains about 55–58% silica and is a Hydrated Aluminum Silicate, or Al2O3 2SiO2 2H2O. Granite is altered by hydrothermal metamorphism to produce china clay. Depending on its tiny particle size and white colour, China Clay can be classified differently from other clays like ball clay and fire clay. Because of its physical characteristics, including brightness, shiny surface, abrasiveness, and viscosity, china clay is widely used. China clay that has been mined is utilised both processed and unprocessed. Every state in our nation, India, uses china clay for home use as well as for export marketing. Because it is present in soft nature, China clay mining in India hardly ever requires any blasting to quarry.

1.3.1 Resources Indian minerals year book-2011(part II) expresses that the country is having 2,705.21 million tonnes of China clay resources as per UNFC system as on 01.4.2010 and reserves forms for about 7% of the resources (177.16 million tonnes). Out of the total reserves, 53 million tonnes (30%) come under probable category. The resources are available in the states of Kerala (25%), Rajasthan (16%), West Bengal (16%), Odisha (10%) and Karnataka (10%). About 608 million tonnes of resources are divided into ceramic/pottery grade; 110 million tonnes of resources are classified for chemical, paper filler and cement grades; 1,980 million tonnes of resources are meant for mixed grade and the rest resources are for unknown categories

From the year 2008 -2009 to 2010- 2011, 25, 22,181 tonnes of china clay had been produced in India. In the year 2010- 2011, the states of Gujarat, Kerala, Rajasthan, Jharkhand and West Bengal produced 49%, 27%, 16%, 4% 3% of raw china clay respectively. Out of total production of china clay, 6, 81,000tonnes of raw china clay had been mined in the state of Kerala. The raw china clays are conveyed and stacked in yards near the industries as shown in Figure 1. A huge quantity of raw china clay from the mines at Thiruvananthapuram, Kerala are being brought to the processing factories near Alangulam, Tamilnadu to derive and classify the valuable base material as products.

1.3.2 Uses of China Clay C

Industries both with and without processing use china clay. The best use of raw china clay in India is in the industries that produce cement. China clay that has been treated is being consumed in the ceramic industries at the ideal rate. The processed China clay is used in a variety of industrial sectors in addition to the ceramics industry, including sealants, paper coatings, extenders in fibre glass, paints, cosmetics, medicines, and textiles, as well as filler material for paper, rubber, and plastics. Insecticide and refractory industries both use raw china clay in their manufacturing processes. Ink, ultramarine, synthetic zeolite, catalyst, water filter candles, soaps, detergents, explosives, and pyrotechnic industries are other sectors that use china clay.

Figure 1 Stacked raw materials in China clay Industries

China clay is used as anti-blocking agents in manufacturing of plastic film, video and audio tapes. Because of its light weight and high strength properties, it is utilized in the field of biotechnology by replacing the usage of ceramics.

2. Literature Review

This chapter presents a variety of studies on the use of waste materials in concrete. The performance of beam elements, durability tests on cube specimens, cost analysis, and earlier studies on the features and uses of China Clay Waste (CCW) are covered in this chapter. Waste materials that were investigated for their integration in concrete are also covered.

Rafat Siddique (2002) concentrated on achieving the perfect mechanical properties of concrete by switching out the fine aggregate for class F fly ash. Class F fly ash concentrations of 10%, 20%, 30%, 40%, and 50% were studied to see how they affected the mechanical qualities of concrete. 50% replacement was found to be the optimal amount, with all percentages of class F fly ash addition gradually improving the compressive strength, splitting tensile strength, flexural strength, and elastic modulus.

In their 2007 article, "Effect of bottom ash as replacement of fine aggregate in concrete," Aggarwal et al. discussed the consequences of using bottom ash as a partial substitute for fine aggregates produced during experimental examinations. Different strength properties, such as compressive strength, flexural strength, and split tensile strength, were looked into for cubes, beams, and cylinders, respectively. The aforementioned strengths were determined for samples that substituted bottom ash for fine aggregates to varied degrees, ranging from 10% to a maximum of 50%. This study showed that when bottom ash content and water demand increased, concrete's workability decreased. As a result, as bottom ash content rises, concrete's density, split tensile strength, compressive strength, and flexural strength all tend to decline.

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Sivaraja et al. (2010) investigated the impacts of using recycled synthetic fibres such steel, nylon, plastic, coir, and tyre. A 1:1.38:3.09 water content was planned for M20 grade concrete. The rupture modulus, compressive strength, split tensile strength, elasticity modulus, and shear strength of cubes and cylinders were all calculated. The Fibre Reinforcing Index (FRI) was also used to develop an empirical relationship, which was then compared to the experiment's results. The optimal fibre volume percentage was found to be between 0.5% and 1.0%. The experiment's results were discovered to be consistent with the empirical model.

In the paper "Study on strength and durability of concrete by partial replacement of fine aggregate using crushed spent fire bricks," Keerthinarayana (2010) emphasises the use of crushed spent fire bricks (CSFB) as a partial replacement of fine aggregate. Experimental research was done on the concrete's compressive and split tensile strengths. This investigation proved that the CSFB can be utilised for concreting because it is zone II graded.

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In his 2010 article, "The Effect of the Using Waste Marble Dust as Fine Sand on the Mechanical Properties of the Concrete," Bahar Demirel investigated the effects of using waste marble dust (WMD) as fine aggregate. To assess the mechanical properties, four series of concrete mixtures containing 0%, 25%, 50%, and 100% waste marble dust (WMD) by weight of fine aggregate were developed. We measured and compared the mixtures' dynamic modulus of elasticity, porosity, ultrasonic pulse velocity (UPV), ageing, compressive strength, and unit weight to those of other mixtures. In light of the test's results,

Lohani et al. (2012) looked at a number of solutions to the problem of a lack of natural sand in their study titled "Optimum exploitation of quarry dust as partial replacement of sand in concrete." In the trials, quarry dust was used in place of natural sand in ratios of 0%, 20%, 30%, 40%, and 50%. For 28 and 91 days, concrete's varied strengths, elastic modulus, water absorption, and durability were examined. The time that the Mgso4 and NaCl solution was submerged had no effect on the amount of quarry dust used. 30% of quarry dust consumption was advised.

The characteristics of concrete with supaflo as a chemical component and shabath stone as the coarse aggregate were studied by Murali et al. (2012). Replacements were made to 10%, 20%, 30%, and 40% of the coarse aggregate. The outcomes of the experiment compared specimens that replaced coarse aggregate with chemical admixtures that were added and those that were not added. The highest incremental improvements were obtained in both scenarios at 30% replacement.

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In their 2012 article, "Use of Glass Wastes as Fine Aggregates in Concrete," Gautam et al. covered the use of recycled glass as fine aggregate in concrete. This usage of concrete has several advantages, including the reuse and recycling of waste materials. Glass debris was substituted for fine aggregate in 10% increments. Without a doubt, the results showed that, over the course of 28 days, glass waste replacement grew slightly, up to a maximum of 20%. The results indicated that a 10% replacement of fine aggregate with glass waste was ideal.

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In his study, "Experimental studies on the flexural behaviour of reinforced concrete beams," Arivalagan (2013) studied the compressive strength, split tensile strength, and flexural strength of concrete with copper slag substituting fine aggregate.

Mamery Serifou et al. conducted research on the use of fresh concrete waste as fine and coarse aggregates in the production of concrete (2013). At 0%, 50%, and 100% of the proportions, aggregates were used in place. The rate at which coarse and fine particles were being replaced determined the design of the concrete. Compressive strength tests were performed on the mixes 1, 14, and 28 days after curing. Recycled aggregates tend to absorb more water as their composition increases. The addition of freshly crushed concrete has a negative impact on the mechanical performance of the concrete. With an R2 value of 0.92, the link between the new concrete waste content and compressive strength was developed, and it was found that the strength declined as the waste content rose. A maximum drop in compressive strength and tensile strength of 32% and 18%, respectively, was seen when the entire natural aggregates were substituted.

RamJoshi evaluated grey cast iron (GCI) and ductile cast iron (DCI) turnings as a partial substitute (2013). In place of fine aggregate, increasing amounts of industrial waste were employed to make M30 grade concrete (GCI and DCI in equal shares). The proportion of GCI and DCI that is growing is closely associated with the compressive and flexural strengths of concrete. When fine aggregate is partially substituted with GCI and DCI to the extent of around 30%, the strength of conventional concrete is raised by about 32.5%.

In 2014, Sakthieswaran and Ganesan conducted study on the effects of fly ash, copper slag, and fibres (steel and polypropylene) on the compressive strength of concrete. The impact of the mix variables on strength was also ranked in terms of hierarchy. In the studies, steel and polypropylene fibres were added to concrete along with fly ash, copper slag, and some of the cement and fine aggregate. It was discovered that as the amount of fly ash grows, the compressive strength for a given fly ash content decreases, and the amount of copper slag grows, the compressive strength for a given fly ash content increases. By substituting copper slag for 50% of the fine aggregate and fly ash for 40% of the fine aggregate, the mix's optimal strength was attained.

AnuBala et al. have studied the effects of fly ash and used tyre rubber on the behaviour of concrete composites (2014). Fly ash was utilised in place of cement, and waste rubber was used in place of fine and coarse aggregate. Concrete's density, bonding power, compressive strength, and workability have all been studied. Concrete becomes more pliable as the amount of rubber in it rises. Due to crumb rubber's lower specific gravity, concrete's density reduces from 2500 to 1600 kg/m3 with an increase of 0 to 40%. Compressive and bond strength decreased more significantly in concrete that had 40% rubber replacement and 30% fly ash. It was found that rubber may create the appropriate strength and density in place of cement and aggregates.

Priyank & Chetna examined the use of waste china clay as a cement substitute in concrete in their article on the "Performance of concrete with china clay (Kaolin) waste" that was published in 2013. Their paper mainly focused on the cement alternative that would lower the cost of concrete. It also ensured that a sizable portion of the industrial waste generated by china clay was recycled. The compressive strength and water absorption of regular concrete and cement-replaced concrete were examined through experiments. Remaining china clay was used to replace cement to the extent of 10%, 20%, and 30%, respectively, during the casting of the samples. According to the investigation, china clay-based industrial waste can replace OPC by up to 10% while still producing the best compressive strength. The study ensured that trash from china clay firms wouldn't cause as many disposal problems or adverse environmental effects.

Patil and Manekari (2013) investigated the behaviour of beam column joints under monotonic loading using ANSYS software. The investigation involves the observation of parameters such as stresses, displacement, and stiffness at the beam-column joints using models. M20 grade concrete with Fe250 and Fe415 steel reinforcement was employed in the inquiry. It was shown that when the load grew, the displacement, highest stress, and lowest stress all increased. It was also discovered that the behaviour of the corner beam column joint did not reflect that of the exterior beam column junction.

Ilangovana et al. (2008) aimed to explore the durability qualities of concrete using quarry rock dust as fine aggregate in addition to researching the strength characteristics. The mixtures for both types of concrete—conventional and quarry dust—were developed in accordance with IS, ACI, USBR, RN No.4, and British requirements. Damage and shrinking caused by fast acid during drying

"Effect of silica fume on strength and durability properties of concrete" is the title of a study by Amudhavalli & Jeena (2012) that assessed the partial replacement of cement with silica fume by 0, 5, 10, 15 and 20% on M35 grade concrete. We compared the strengths with the control at 7 and 14 days of age. 30-day immersion in 5% diluted hydrochloric acid caused 28-day-cured cube specimens to lose mass in the range of 4.40%, 2.81%, 2.23%, 2.76%, and 2.90%, as well as compressive strength in the range of 11.91%, 8.18%, 7.69%, 8.02%, and 8.35%. According to the study, silica flume strength decreased significantly above 10% replacement and the best compressive and flexural strengths were attained between 10% and 15% replacement.

3. Conclusion

The literature review on waste materials aids in determining the essential experiments to be performed to determine whether a substitute material for concrete is suitable. The literature also places a strong emphasis on using waste products from businesses or naturally occurring sources to address the shortage of natural aggregates. Additionally, the performance of beam element studies tend to determine the suitability of recycled concrete in key locations. The reviews of the durability tests illustrated the adaptability of concrete under challenging situations that are likely to damage the concrete's long-term qualities. Based on the aforementioned literatures, tests on the samples, elements, and cost analysis were conducted.

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