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A Study Comparison of Different Aggregate Between Concrete Mixture with Processed Recycled Waste and Conventional Concrete Mixture With Gravel

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Abstract: This comparison research was developed to compare the performance of concrete mixture that used waste recycled materials as the alternative replacement of coarse aggregate with a conventional concrete mixture that use common granular materials. This is important as different types of materials used in concrete mixture may affect the strength of a concrete. This is due to the nature differences of the material that varies in sizes, grip, endurance, and stability which greatly affects the strength of a concrete mixture. The use of recycled materials in construction industry would greatly affect total waste production. At the end of the comparison, the results shows that the use of recycled materials can be done to replace conventional granular coarse aggregate in concrete mixture.

Keywords: Performance, Materials, Comparison

1. Introduction

Civil Engineering has been an aspect of life since the beginnings of human existence. In decades of human history various type of materials have been used in constructing building and mega monuments that we still can be seen today. One of the most advanced construction related history was the invention of concrete mixture in 1824, the Portland Cement by Joseph Aspdin that change the way how modern civil engineering works. This composite material is widely used and it is the base of all building and structure construction.

Therefore, this project was made to conduct a comparison for the past research on the use of waste materials as a replacement of gravel for concrete coarse aggregate. The study will include the comparison of concrete strength, curing time, and materials that were used in the concrete mixture.

General waste that can be recycled should be reuse as an alternative in using raw materials and the vast amount of innovation in construction industry would lead to a greener technology which could reduce the total amount of waste produced.

1.1 Scope of Study

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The study is designed to investigate the overall strength of concrete mixture that are using processed organic and non-organic waste as aggregate in comparison of conventional aggregate to see the difference of the concrete performance with different set of materials. Only different types of course aggregate was used as variable for the purpose of concrete mixture performance comparison research to limit the variables while comparing other prospect of materials, methods of experiment and data evaluation used in present research.

2. Literature Review and Methodology

A mixture of concrete is basically a composite material of cement, fine aggregates (sand) and coarse aggregates (granular) that were bonded together using fluid (water) that hardens over time. In a building development, concrete mixture is utilized for the fabrication of foundations, columns, beams, slabs, and other load bearing elements. There are distinctive sorts of binding medium used other than cement such as lime used in lime concrete, and bitumen material used in asphalt concrete which is utilized for street development.

The proportion of water and cement have an imperative role which impacts different properties such as workability, quality, and toughness. Appropriate amount of water to cement ratio is needed to produce a workable concrete. When fluid mixed with binding materials, a reaction occurs between cement and water that cause hydration. In response, this helps the concrete mixture to mould into a hard mixture that binds the materials together into a solid component used in construction. A concrete mixture that has not harden can be formed into various shape and sizes of configuration or formworks that are used to provide different shapes that is required in the design. Most structural components in a building member such as beams, slabs, footings, and columns were constructed using concrete.

2.1 Literature Review

There are a few complications in preparing a scientific treatise using concrete as main component in construction. Although concrete's usage apparent simplicity, it is profoundly a complex structure. In table 1, past researches have been made to see the suitability of different materials that were used in concrete mixture testing.

Table 1: List of past research related to abnormal aggregate material

Title	Author	Year Published	Material Used	Data Included
Use of waste plastic in concrete mixture as aggregate replacement.	• Zainab Z. Ismail • Enas A. AL-Hashmi	2007	Waste plastic	• Load-deflection curve
Innovative techniques of waste plastic used in concrete mixture.	• Pramod S. Patil • J. R. Mali • Ganesh V. Tapkire • H. R. Kumavat	2014	Waste plastic	• Compressive strength
Lightweight concrete made from crushed oil palm shell: Tensile strength and Effect of initial curing on compressive strength	• Payam Shafigh • Mohd Zamin Jumaat • Hilmi Bin Mahmud • Norjidah Anjang Abd Hamid	2011	Oil-palm shell	• Slump • Compressive strength
Effect of palm oil clinker (POC)	• Fuad Abutaha	2015	Oil-palm clinker	• Slump

aggregates on fresh and hardened Properties of concrete	• Hashim Abdul Razak • Jegathish Kanadasan			• Compressive strength
A comparative study of concrete properties using coconut shell and palm kernel shell as coarse aggregates	• E. A. Olanipekun • K. O. Olusola • O. Ata	2005	Waste coconut shells Palm kernel shells	• Compressive strength • Water absorption
High-strength lightweight concrete made with scoria aggregate containing mineral admixtures	• Alaettin Kilic • Cengiz Duran Atis • Ergul Yasar • Fatih Ozcan	2003	Scoria	• Compressive strength • Flexural tensile strength

Concrete mixtures were used as building material utilized for foundation, column, beam, walls, slabs, and other major component in a building. It is exceptionally adaptable to use due to the simple mixture that are combined to form a semi-liquid mixture that are capable to be casted into any shape depending on the matrix of the structure, before it dries into the solid material. In various concrete structures, metal reinforcement, such as wire mesh or rebar, is added for increase strength and to diminish the cracking that may happen in pure solid concrete.

Concrete mixture naturally composed of cement, sand as the fine aggregate, and gravel used as the coarse aggregate. The addition of fluid will activate the cement, which is the main component used to bind the mixture together.

Mortar on the other hand is another building material consists of cement powder with fine sands, that were mixed along with crushed limestone to improve the sturdiness of the by-product. Adding fluid to this mixture will activate the cement and the process of curing and harden will be the same as normal concrete. Mortar mixture is not as robust as concrete and are naturally not used as a main building material that supports heavy loads and weights. It usually used as a binder that holds bricks, concrete block, stone, and other materials together.

2.2 Methodology

The flow chart provided in Figure 1 shows the methodology and the overall sequence to develop the concrete mixture product comparison research. This chart was provided as a guide to make sure the progress of this research is under control. The figure describes the entire process in plain overview and there is also a thorough steps and procedure that explain the method used throughout the research were conducted. All of the equipment involved in this experiment were also explained on how to handle it properly.

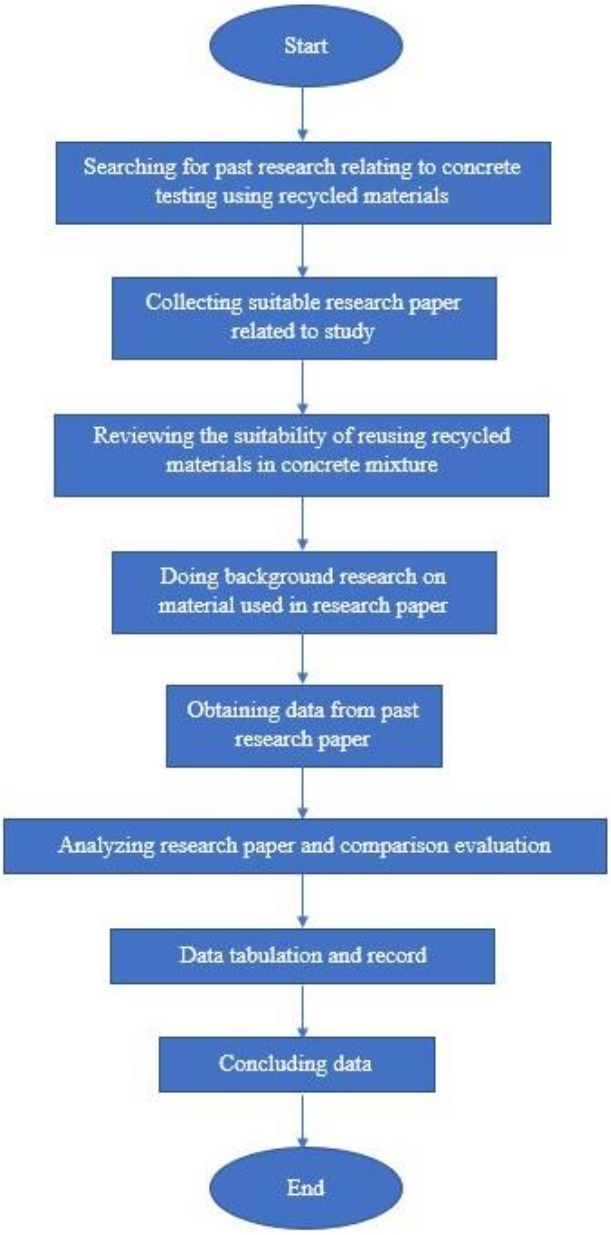

Figure 1: Methodology of comparison research

3. Results and Discussion

Each of the research paper was using different method of conducting the test. However, the data that have been obtained have similarities in criteria and this can be used as a viable comparative information. The data from all of the research will be tabulated to see the differences of the concrete mixture using different materials. Minimum strength were chosen as a benchmark to see how low the performance could be by using the different type of waste materials.

3.1 Results

Different test produced different batches of concrete mixture of proportioning ingredients by volume or by weight. In each of the research paper used different method and focusing on different test criteria while obtaining almost the same data for evaluation. The main focus of this comparison is the compressive test to see the performance comparison between different materials. Table 2 and Figure 2 shows the result of the comparison.

Table 2: Data comparison from previous research

Research	Minimum Strength (N/mm^2)	Curing Age (days)	Materials Used	Total Dry Density (kg/m^3)	Amount of Alternate Aggregate (%)
Requirements for Prescribed Mix					
20P	20.00	28	CA	-	-
25P	25.00	28	CA	-	-
30P	30.00	28	CA	-	-
Waste Materials					
1	25.00	28	WP	2115.53	20
2	9.11	28	WP	2168.39	50
3	43.25	28	OPS	1877.00	100
4	33.01	28	POC	2074.00	100
5a	15.50	28	CS	1630.00	100
5b	14.00	28	PKS	1680.00	100
6	28.00	28	SA	1860.00	100

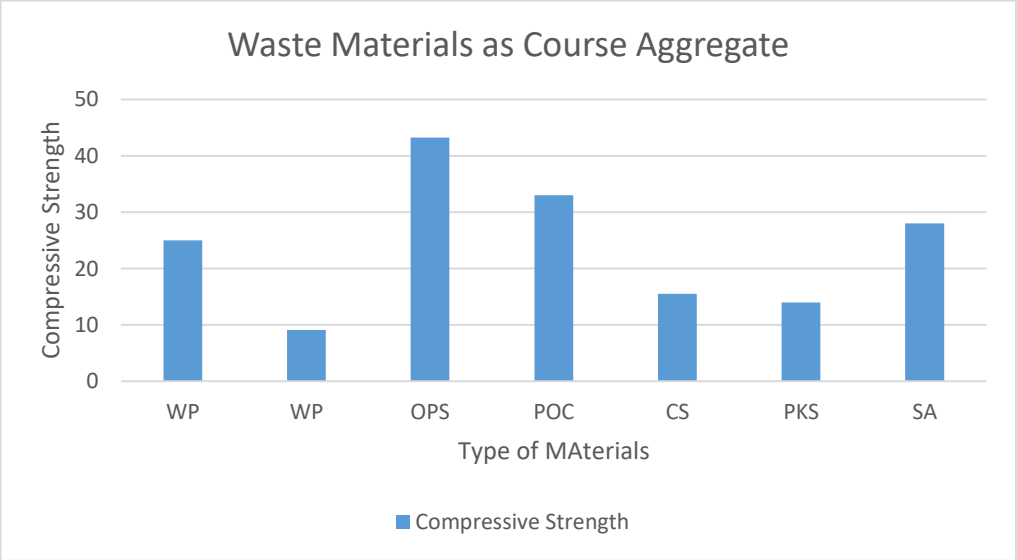

Figure 2: Performance of each material

3.2 Discussions

A better comparison can be made if the variables were reduced as much as possible to avoid any errors during comparison as the differences in procedure, method used, tool used, or the condition of initial testing can affect the result of the testing.

It is advisable to conduct an actual testing to thoroughly reduce any variable, and to make the comparison more viable to not compromise the result of the experiment. An actual experiment would be more favourable to get a more accurate result in comparison.

4. Conclusion

This research was developed to compare the strength of concrete mixture that use different types of alternative replacement for the coarse aggregate that is used in concrete mixture. Based on this comparison, it is determined that other organic, and non-organic materials can be used to some extent,

as a replacement for a conventional natural coarse aggregate material. A few of the data that have been chosen shows quite promising result that can be used in light construction sector, but is not really suitable for heavy usage or for building components that have high traffic volume that have continuous heavy loads.

The waste mixture does have the same strength as the gravel-cement mixture of concrete, with the right ratios. It is proved that the increase of waste material used in the concrete mixture may affect the compression strength of the concrete. The amount of waste materials used as replacement is inversely proportional to the compressive strength and the load that the concrete can handle.

Acknowledgement

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