Analysis of the Compressive Strength of Concrete Using Kakawate *(Gliricidia sepium)* Jacq. Kunth Ex Walph. Wood Ash Cement

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Abstract

The acceptable disposal waste such as ash and sludge is a growing problem. A related problem is the recycling of other waste materials such as tires, glass and plastics. Because of the high-volume of kakawate tree in the region and that ash of kakawate wood is considered waste taken from dirty kitchen of every household, the researchers as engineers instigated to recycle the ash for admixture construction material for low-cost housing projects. With this study the researchers first proved that the compressive strength of concrete cylinder mixed with kakawate (Gliricidia sepium) Jacq. Kunth ex walph using the proportion 20% ash and 80% cement for the mixture 1:2:3 can achieve the consistent quality demanded a safe concrete structures. The result of the laboratory testing can be a basis in proceeding with other proportions. Information is needed about the wood material's physical properties. Further, environmental and waste management issues must be discussed as basis for the acceptability and practicability of waste and recycled material (WRMs). Researchers may consider the sustainability and practicability of kakawate ash and cement ratio recommended for construction of low-cost housing projects without sacrificing the strength of the structure.

Introduction

Background of the Study

Concrete is the only major building material that can be delivered to the job site in a plastic state. This unique quality makes concrete desirable as a building material because it can be molded virtually to any form or shape. Concrete provides a wide latitude in surface textures and colors and can be used to construct a wide variety of structures, such as highways and streets, bridges, dams, large buildings, airport runways, irrigation

structures, breakwaters, piers and docks, sidewalks, silos and farm buildings, homes, and even barges and ships.

The two major components of concrete are the cement paste and inert materials. The cement paste consists of portland cement, water, and some air either in the form of naturally entrapped air voids or minute, intentionally entrained air bubbles. The inert materials are usually composed of fine aggregate, which is a material such as sand, and coarse aggregate, which is a material such as gravel, crushed stone, or slag.

It is a known fact that the cost of Portland Cement is increasing. Thus, alternative materials or admixture to reduce the quantity of cement in concrete while maintaining its strength, need to be studied.

Admixtures are developed specifically to provide better performance benefits to concrete. It can be used to reduce cement content and allow additional pozzolanic materials–fly ash, silica fume, and ground granulated blast-furnace slag–to be incorporated to extend production capacity, helping producers optimize the cement content of their mixes. It is effective in producing concrete mixtures with different levels of workability, including applications that require cement using self-consolidating concrete. Several researches were conducted on the effect of these admixtures to concrete. Study on the use of fly ash has proven to have a positive effect on concrete. Derived from burning coal, fly ash is a valuable additive that makes concrete stronger, more durable and easier to work with. The cement with flash or the so called pozzolanic is already out in the market Another study is the Rice Husk Ash which is used as pozzolana to replace ordinary Portland cement or as admixture and was found to have better resistance to acidic attack.

Most in the rural areas are still using clay stove for cooking. The firewood being used by most is the Kakawate wood because of its abundance in the locality. Kakawate is referred to as a quick-stick due to its characteristic of growing almost right away just by cutting it and directly planting it in the ground. It is a fast growing tree with a maturity height of I0 meters (33 feet). It is adaptable to almost any soil environment, including infertile soils. It is tolerant to salt spray and water logging. It can tolerate drought for up to 6 to 8 months. The tree is common in the southern Tagalog areas, shedding leaves around December and flowering February and March. The wood, being hard and durable, is used for small housing needs, posts, implement handles and firewood.

Objectives of the Study

The study aimed to determine the compressive strength of concrete with kakawate ash as admixture to cement. It specifically sought to find out:

The compressive strength of Kakawate Wood Ash Cement using the proportion, 80% Portland Cement and 20% Kakawate Wood Ash.

Significance of the Study

Concrete, which is a combination of cement and aggregates is the most commonly used construction materials for buildings. Cement as one of the components is the most expensive ingredient of concrete and the cost is increasing. The use of additional material to concrete can reduce the cost of concrete.

The researchers were prompted to conduct a study on the Kakawate Wood Ash as admixture to concrete because the cost of production is cheaper, these can only be taken from the dirty kitchen of every household. Instead of throwing these ashes, these can be utilized as admixture to cement. When this Kakawate Wood Ash is mixed to an Ordinary Portland Cement and was able to reach the desired compressive strength of concrete, this can be beneficial. It will not only reduce the cost of concrete, but it will also be a source of income to those housewives using clay stove for cooking.

Review of Related Literature

Concrete is an artificial engineering material made from a mixture of portland cement, water, fine and coarse aggregates, and a small amount of air. It is the most widely used construction material in the world. The two major components of concrete are cement paste and inert materials. The cement paste consists of portland cement, water, and some air either in the form of naturally entrapped air voids or minute, intentionally entrained air bubbles. The inert materials are usually composed of fine aggregates, such as sand, and coarse aggregates, such as gravel, crushed stone, or slag. In general, fine aggregate particles are smaller than 6.4 mm (.25 in) in size, and coarse aggregate particles are larger than 6.4 mm (.25 in). Depending on the thickness of the structure to be built, the size of coarse aggregate particles used can vary widely. In building relatively thin sections, a small size of coarse aggregate, with particles about 6.4 mm (.25 in) in size, is used. At the other extreme, aggregates up to 15 cm (6 in) or more in diameter are used in large dams. In general, the maximum sire of coarse aggregates should not be larger than one-fifth of the narrowest dimensions of the concrete member in which it is used. (Microsoft® Encarta, 2006.)

ACI 318M-I1 states that an admixture to be used in concrete shall be capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with selection of concrete proportions. It is any material other than the basic components of concrete which is used as an ingredient of concrete to modify its properties and to enhance its capabilities. This can

be air-entraining admixtures, water-reducing admixtures, retarding admixtures, and water-reducing and accelerating admixtures. Fly ash or other pozzolans are one of the few admixtures used in concrete.

Derived from burning coal, fly ash is a valuable additive that makes concrete stronger, more durable and easier to work with. Fly ash sources in 30 states are linked to a nationwide network of terminals and transportation equipment - ensuring customers receive quality material when they need it. With nearly 20 million tons of ash products under management annually, Headwaters Resources offers concrete producers the support they need to make ash a part of their every day production. In addition to unparalleled customer service, Headwaters maintains its own extensive laboratory and engineering capabilities. Highly qualified chemists, materials scientists and engineers are on hand to ensure product quality and assist in solving challenges faced by individual customers.

Enhancing Concrete Workability

The difference between fly ash and portland cement is apparent under a microscope. Fly ash particles are smaller and almost totally spherical in shape, allowing them to fill voids, flow easily, and blend freely in mixtures.

Additionally, when water is added to portland cement, it creates two products: a durable binder that glues concrete aggregates together and free lime. Fly ash reacts with this free lime to create more of the desirable binder.

The "ball-bearing" effect of fly ash particles creates a lubricating action when concrete is in its plastic state. This creates benefits in:

Workability. Concrete is easier to place with less effort, responding better to vibration to fill forms more completely.

Ease of Pumping. Pumping requires less energy and longer pumping distances are possible.

Improved Finishing. Sharp, clear architectural definition is easier to achieve, with less worry about in-place integrity.

Reduced Bleeding. Fewer bleed channels decrease permeability and chemical attack. Bleed streaking is reduced for architectural finishes.

Reduced Segregation. Improved cohesiveness of fly ash concrete reduces segregation that can lead to rock pockets and blemishes.

Scope and Limitations of the Study

The study is limited on the testing of strength of a concrete with kakawate ash at age 28 days using the proportion 1:2:3 (I bag kakawate ash cement, 2 boxes sand, 3boxes gravel). The kakawate ash cement is proportioned as 80% Portland Cement and 20% Kakawate Wood Ash.

Methodology

This section presents the research design, sample, and data gathering procedure.

Research Design: This study utilized the descriptive method. Out of the data gathered, findings were summarized, analyzed, and interpreted.

Sample. The samples used in this study are three pieces concrete cylinder with kakawate wood ash used as admixture aggregates at age 28 days. The kakawate wood ash were taken from the dirty kitchen of a selected household.

Procedure. Three samples of concrete cylinder were taken on the same mixture of concrete and after 24 hours these specimens were soaked in water and cured for 28 days.

After 28 days the three samples for each mixture were brought to BIP Geotechnical and Materials Testing Engineers, an accredited testing laboratory by the Department of Public Works and Highways, and tested for compressive strength using the Universal Testing Machine. The average compressive strength were computed and used as basis for analysis.

Discussion of Results

Table I shows the strength of concrete with kakawate wood ash used as admixture aggreagates in terms of compression at age 28 days

It is revealed in Table I that the average compressive strength of concrete with *kakawate* wood ash is 5.47 MPa while the minimum ultimate compressive strength at 28 days of 140 kilograms per square centimeter (2,000 lbs. per sq.in.)" or 13.82 MPa.. The compressive strength of concrete with *kakawate* wood ash used as admixture aggregates of 5.47 Mpa is below the allowable compressive strength of 13.82 MPa set by the Philippine National Building Code.

Table 1. Compressive Strength of Concrete with Kakawate Wood Ash at Age 28 days

Specimen	Compressive Strength (@Pa)
	5.18
2	5.66
3	5.58
Average Compressive Strength, MPa	5.47

Conclusions

Based on the findings of the study, the following conclusions was drawn:

1. The compressive strength of concrete with kakawate wood ash using the proportion 80% Portland Cement and 20% Kakawate Wood Ash is below the accepted compressive strength used in designing structures.

Recommendations

In view of the aforementioned findings and conclusions derived from the study, the following are hereby recommended by the researcher.

1. Concrete with kakawate wood ash as admixture aggregates using the proportion 80% Portland Cement and 20% Kakawate Wood Ash is not recommended for building construction since the compressive strength of 5.47 MPa is below the allowable compressive strength of 13.82 MPa as set by the Philippine National Building Code.

2. Parallel studies may be considered to find out the sustainability and practicability of using *kakawate ash* and Portland cement for concrete using different proportions for the construction of low-cost housing projects without sacrificing the strength of the structure.

References

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