Analysis of the Compressive Strength of Concrete Using Plastic Bags as Admixture

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Abstract

The study was conducted to determine the compressive strength of concrete with used plastic bags at age 28 days using the proportion 1:2:4:1 and the compressive strength of concrete without used plastic bags using the proportion 1:2:4. The result of laboratory testing can be a benchmark on proceeding with other tests to determine further if used plastic bags can be an admixture for concrete. The slump for each specimen was also measured.

The study revealed that the compressive strength of concrete without used plastic bags is fc = 20.41 MPa. On the other hand, the compressive strength of concrete with used plastic bags is fc' = 10.33 MPa. It is to be noted that the compressive strength for concrete commonly used for designing structures ranges from fc' = 17.33 MPa to fc'= 21MPa .Likewise, the National Building Code states that "concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 140 kilograms per square centimeter (2,000 lbs. per sq.in.)" or 13.82 MPa.

It was found out also that the slump of concrete without used plastic bags is 26mm and the slump of concrete with used plastic bags is 30mm.

Based on the result, it can be concluded that concrete with used plastic bags using the proportion 1:2:4:1 cannot be used as an admixture for concrete.

Introduction

Background of the Study

Concrete which **is a** mixture of cement, aggregates (gravel and sand), and water is adaptable to widely varied structural needs; is available practically anywhere; is fire resistant; and can be used by semiskilled workers. It is used for roads, immense buildings and engineering works. The cement is the chemically active element, or matrix; the sand and the stone are the inner elements, or aggregates.

The use of concrete has become in demand in the construction industry which resulted to the increase of prices of its components. The volume occupied by concrete in a structure depends on the proportioning of the cement and aggregates used. With the introduction of another component, like used plastic bags, the volume of concrete will increase, hence, reducing the price of concrete.

Inasmuch as plastics are so durable that they will not rot or decay, great amounts of discarded plastic products accumulate in the environment as waste if not disposed of properly or recycled.

Thus, the researcher conducted this study to determine if used plastic bags can be used as one of the components of concrete which is equal to 13.82 M<PA. The National Building Code states, "Concrete, other than fill, shall have a minimum ultimate compressive strength at 28 days of 140 kilograms per square centimeter (2,000 lbs. per sq.in.)" or 13.82 MP

When these used plastic bags mixed in concrete can reach the desired compressive strength of concrete, the problem on waste disposal can be solved. Aside from being environment friendly, the cost of concrete can be reduced without sacrificing the strength of structure. The concrete with used plastic bags is intended for slab on fill and filler of concrete hollow blocks.

Significance of the Study

Concrete which is a combination of cement and aggregates is the most commonly used construction material 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.

Plastic bags are part and parcel of everyday living. Almost all have plastic bags in their households which are used to store/wrap usable things in daily life.

But most often than not, most used plastic bags are considered waste materials and if not disposed of properly these might have an adverse effect on the environment and to the health of every individual. Since plastic bags do not decompose easily, these cannot be disposed of immediately.

This research was conducted to determine if these used plastic bags when mixed with concrete affects the desired compressive strength of concrete. When these concrete with used plastic bags can reach the allowable compressive strength, waste will not only be eliminated but the cost of concrete will also be reduced.

Objectives

The study aimed to determine the compressive strength of concrete with used plastic bags. It specifically sought answers to the following questions:

1. What is the compressive strength of concrete with used plastic bags as admixture using the proportion of 1:2:4:1?
2. What is the compressive strength of concrete without used plastic bags as admixture using the proportion of I:2:4?
3. What is the slump of concrete with used plastic bags as admixture using the proportion of 1:2:4: I?
4. What is the slump of concrete without used plastic bags as admixture using the proportion of I:2:4?

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) size, and coarse aggregate particles are larger than 6.4 mm (.25in). 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 6.4mm (.25 in) in size, is used. *At* the other extreme, aggregates up to 15cm (6in) or more in diameter are used in large dams. In general, the maximum size 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 8 2006. C 1993-2005. Microsoft Corporation.)

Concrete used without strengthening is termed mass or plain concrete and has the structural properties of stone-great strength under compressive forces and almost none under tensile forces. F. Joseph Monier, a French inventor, found that the tensile weakness could be overcome if steel rods were embedded in a concrete member. The new composite material.was called reinforced concrete, or ferroconcrete. It was patented in 1857 and a private house in Port, Chester, New York first demonstrated (1857) its use in the United States. It is now rivaled in popularity as a structural material only by steel. Concrete reinforced with polypropylene fibers instead of steel yields equivalent strength with a fraction of the thickness. Reinforced concrete was improved by the development of pre-stressed concrete- that is, concrete containing cables that are placed under tension opposite to the expected compression load before or after the concrete hardens. Another improvement, thin-shell construction, takes advantage of the inherent structural strength of certain geometric shapes, such as hemispherical and elliptical domes; in thin-shell construction great distances are spanned with very little materials. The perfecting of reinforced concrete has profoundly influenced structural building techniques and architectural form (Encyclopedia Encyclopedia).

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. (ACI 3 18M-11).

Plastic can cover many synthetic or semisynthetic polymerization products. They are composed of organic condensation or addition polymers and may contain other substances to improve performance or economics. There are few natural polymers generally considered to be "plastics". Plastics can be formed into objects or films or fibers. Their name is derived from the fact that many are malleable, having the property of plasticity.

Plastic can be classified in many ways, but most commonly by their polymer backbone (polyvinyl chloride, polyethylene, polymethyl methacrylate and other acrylics, silicones, polyurethanes, etc.). . Other classifications include thermoplastic, thermoset, elastomer, engineering plastic, addition or condensation or polyadditiuon (depending on polymerization method used), and glass transition temperature or T.

Plastics are durable and degrade very slowly. In some cases, burning plastic can release toxic fumes. Also, the manufacturing of plastics often creates large quantities of chemical pollutants. #3 – PVC (polyvinyl chloride), commonly used to package foods and liquids, ubiquitous in children's toys and teethers, plumbing and building materials, and in everything from cosmetics to shower curtains, contain numerous toxic chemicals called adipates and phthalates ("plasticizers") which are used to soften brittle PVC into a more flexible form.

In the 1990s, plastic recycling programs were common in the United States and elsewhere. Thermoplastics can be remelted and reused and thermoset plastics can be ground up and used as filler though the purity of the material tends to degrade with each reuse cycle. There are methods by which plastics can be broken back down to a feedstock state. (Wikepedia.org).

Scope and Limitation of the Study

The scope of the study covered the testing of strength of a concrete with plastic bags at age 28 days using the proportion 1:2:4:1 (1 bag cement, 2 boxes sand, 4 boxes gravel and 1 kl used plastic bags) and concrete without used plastic bags at age 28 days using the proportion 1:2:4 (1 bag cement, 2 boxes sand, 4 boxes gravel) in terms of compression and slump: .Note: 1 bag cement is equal to 40 kgs Portland Cement, 1 box is equal to 1 cu.ft. and used plastic bags are cut is small strips.

Methodology

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

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 used plastic bags at age 28 days and three pieces concrete cylinder without used plastic bags at age 28 days.

Procedure. Each concrete mixture for each proportion were sampled for the slump test. Three samples were taken for each mixture to determine the slump and the average was used as basis for analysis.

Three samples of concrete cylinder were taken from the same mixture of concrete. 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 Saint Louis University Material Testing Laboratory, 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.

Results and Discussion

Slump test were taken on the fresh concrete to determine the consistency or state of fluidity of the freshly mixed concrete.

The degree of consistency of concrete is shown on Table 1. Consistency is described as the **degree** of wetness or slump of the concrete. Concrete should be correctly proportioned to produce workability required for a particular structure. Concrete is said to be workable when it is properly proportioned for transport and placed without segregation. For example, **a** fairly thick or stiff concrete may be used for pavement for it can be vibrated and tamped. On the other hand, concrete for thin wall and small column structure may be compacted with a minimum vibration (Fajardo, 1993).

Table 1. Recommended slump for various construction structures

Types of Construction	Maximum Cm	Minimum cm
Reinforced foundation, wall and footing	13	5
Plain footing, caissons and sub-structure walls	10	2.5
Slabs, beams and reinforced wall	15	7.5
Building columns	15	7.5
Pavement	7	5
Ieay mass construction	7	*2.5*

On the other hand the average slump as shown on Table 2 is 26mm for concrete without used plastic bags and 30mm for concrete with used plastic bags. Both specimens are within the acceptable slumps from 25mm to 75mm as shown on Table 1.

Table 2. Slump of concrete with used plastic bags and concrete without used plastic bags

Specimen	Slump (mm)	
	Concrete without used plastic bags (1:2:4)	**Concrete with used plastic bags (1:2:4:1)**
1	27	29
2	25	30
3	26	31
Average Slump (mm)	26	30

Table 3 shows the strength of concrete with used plastic bags and concrete without used plastic bags in terms of compression at age 28 days.

It can be seen from the table that the average compressive strength of concrete without used plastic bags is 20.41 MPa. The average compressive strength of concrete with plastic bags is 10.33 MPa. Since concrete other than fill should have a minimum ultimate compressive strength at 28 days of 140 kilograms per square centimeter (2,000 lbs. per sq.in)" or 13.82 MPa, the concrete with used plastic bags using 1:2:4:1 did not pass the required compressive strength.

Table 3, Compressive.strength of concrete with used plastic bags and concrete without used plastic bags at age 28 days

Specimen	Compressive Strength MPa	
	Concrete without used plastic bags (1:2:4)	Concrete with used plastic bags (1:2:4:1)
1	21.22	9.5
2	19.5	10.5
3	20.5	11.0
Average Compressive Strength, MPa	2041	10.33

Conclusions

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

1. The slump of concrete with used plastic bags as admixture using the proportion 1:2:4:1 which is 30 mm is within the limits recommended for plain footing, caissons and sub-structure walls and heavy mass construction.
2. The slump of concrete without used plastic bags as admixture using the proportion of 1:2:4 which is 26 mm is also within the limits recommended for plain footing, caissons and sub-structure walls and heavy mass construction.
3. The compressive strength of concrete with used plastic bags using the proportion 1:2:4:1 is below the accepted compressive strength used in designing structures.
4. Plastic bags cannot be used as admixture for concrete using the proportion 1:2:4:1. The additional materials, **i.e.** plastic bags, affect the strength of concrete.

Recommendations

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

1. The consistency or slump for concrete with used plastic bags using the proportion 1:2:4:1 can be used for slab on fill because it is within the limits recommended for such structure.
2. Concrete with used plastic bags using the proportion 1:2:4:1 cannot be used for building construction because it did not reach the minimum requirement of compressive strength set by the National Building Code which is equal to 13.82 MPa.
3. Plastic bags should be properly disposed of and when these plastic bags are mixed with concrete, they should be removed.
4. Parallel studies can be conducted to determine the strength of concrete with used plastic bags using various proportions of cement and cut plastic bags and reducing the size of cut plastic bags into smaller strips.

References

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