HARDNESS COMPRESSION RELIABILITY FOR CONCRETE BRICKS INFUSED WITH LOW- DENSITY PLASTIC PARTICLES

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ABSTRACT

In this paper we will present a world while environment crisis due to the high contamination levels in sanitary landfills and how by recovering plastic materials as particles and infusing them, we manufacture new and stronger construction concrete bricks. The main objective in this research paper is to determine an appropriate supply formulation for plastic infused bricks greater than or equal to 64 kgf/cm^2. This was according to the NMX-C-036-ONNCCE-2004 standard specification. In the test where the total hardness compression reliability was computed, we could notice that it exceeded hardness of 64 kgf/cm^2 and strength of 90 kgf/cm^2. To verify the research hypothesis we sampled a value according to the t- distribution using Minitab 16 where P was within 0.027. As such, we accepted the maintained hypothesis.

Keywords: Environment crisis, sanitary landfills, plastic, construction bricks, reliability.

1. INTRODUCTION

Plastics are, nowadays, the most used and manufactured products. However, it is also one of the most polluting sources to soil and marine environments due to the hard plastic mineralization (Allsopp et al. 2007).
On one hand, researches about the plastic problem are focused on reusable and degradation alternatives such as different types of plastics with pro-oxidants or biodegrade polymers that allow their complete mineralization (Burgess-Cassler et al. 1991; Scott 1990; Johnson et al. 1993). Bacteria, actinomycetales and fungus (Lee et al. 1990), capable of biodegrading polymers or helping to determine a suitable environment for this, are currently taking a special role (Bonhommea et al. 2003; Orhan et al. 2004). On the other hand, organisms capable of synthesize biodegradable polymers to create new plastics are being researched (Martins & Marconato 2006) as well as organisms with an extracellular enzymes production able to change physical and chemical properties in a polymer (Burgess-Cassler et al. 1991; Pometto et al. 1992; Iman and Gould 1990; Ishigaki et al. 2000).
At the present time, gadgets, clothes and miscellaneous are easily broken and have a short life spam. Mass industrialization, production and distribution generate more products and thus, waste. The constant growing of some products' markets demanded the disposal of the same, so the economic growth in the 21st Century was propelled by garbage. Christine Frederick uses the term 'planned obsolescence' to describe the American economic growth source through planning or designing products with a limited useful life. This was just the beginning of the 'use and throw-away' culture. Plastic is then adapted to this culture change aimed towards waste perfectly. What is more, thanks to the plastic low prices, it was possible to design throwaway products. Every year, there are more and more plastic made products. They had changed our routines: throwing away the dishes and cutlery instead of washing them and avoiding unpleasant housework like washing diapers. Plastic has made possible to do less and less making easier every day's life. What is more, it had had a major part in the prevention of transmitted diseases making possible to have a better hygiene (Strasser, 1999).

According to Carpintero (2003) and the argument about dematerialization, plastics can be considered as a good that improves the financial assets' efficiency. There is energy efficiency through the manufacture of lighter goods. That is, plastic industry requires less effort to transport soda in plastic bottles than those in glass bottles. Although, what they perceived as saving resources becomes an environmental problem when those bottles become garbage and glass made bottles can be reused. This is an efficiency corruption as a cheap product can be so easily disposed of. Plastic contributes to a more practical and efficient life, but that does not mean a material and energy saving. Now, plastic contributes to improve the comfort and the social well-being even when the amount of waste becomes in an environment challenge.

2. METHODOLOGY

2.1 The technical specifications showed below are from the current NMX-C-404-ONNCCE-2005 standard specification. This will help us to determine what the resistance to hardness compression reliability is that we pretend to make equal or exceed during the cylinders test (Chart 1).

Chart 1. Mechanical properties under the standard specification

Compresion Resistence (f*p), kgf/cm^2	NMX-C-036-ONNCCE-2004	Over gross area
Up to 28 days		64.0 kgf/cm^2
Water absorption Up to 24 hours %	NMX-C-037-ONNCCE-2005	12 % max.
Inicial, g/min		5 g/min
Volumetric density, kgf/cm^2 min.		1930 kgf/cm^2

Extracted from: NMX-C-404-ONNCCE-2005.

2.2 Concrete ratio for 4 samples from raw material and supplies (Chart 2).

Sample	Concrete	Sand	Gravel	Water	Plastic
A	1.500 kg	3 kg	3 kg	1.500 L	100 Grs
B	1.500 kg	3 kg	3 kg	1.500 L	150 Grs
C	1.500 kg	3 kg	3 kg	1.500 L	180 Grs
D	1.500 kg	3 kg	3 kg	1.500 L	200 Grs

Extracted from: IMCyC (Concrete ratio), 2010.

2.3 Curing concrete specimens

2.3.1 Wet curing of concrete should be done as soon as the specimens are taken from the cilinders. That is 48 hours after making it (Figure 1).

Figure 1. Specimen taken from the cylinder.

2.3.2 Specimens are submerged into water and let them rest for 14 days to determine the resistance as the standard specification NMX-C-404-ONNCCE-2005 refers (chair 1).

Chart 1. Curing of concrete

test time	allowable tolerance
24 hours	± 0.30 hours
3 days	± 2 hours
7 days	± 6 hours
14 days	± 12 hours
28 days	± 24 hours

2.3.3 The specimens are taken from the water 14 days later and are left to drain for 48 hours. Although, they should not be under the sun as it takes water away through evaporation (Figure 2).

Figure 2. Specimens drain.

It is important to notice that security equipment like glasses, mask and gloves are an important part to prepare the foundation of the concrete specimens to test them.

2.3.4 After the specimens drain we got the following samples (Figure 3).

Figure 3. Samples for foundation preparation.

2.3.5 Place into the smelter the appropriate quantity of sulfur mortar according to the specimens to prepare their foundation. The sulfur must be totally dry (Figure 4).

Figure 4. Dry sulfur

2.3.6 Heat the sulfur morter to a 140 +/- 10 °C temperature. Stir it constantly (Figure 5).

Figure 5. Heated sulfur at 140º C.

2.3.7 Oil lightly the foundation preparation plate and verify that they are dry. This is to avoid vapor or foam bubbles inside the layers bigger than 6mm (figure 6).

Figure 6. Specimens' dry base.

2.3.8 Empty the sulfur morter over the plate for the foundation and place the specimen’s base over it. It should be in contact with the sulfur morter. Use a guide bar to centered it and let it there enough time to allow the sulfur to cool. To remove the foundation base shake the plate gently. Repeat the same steps for the other side of the specimen (Figure 7).

Figure 7. Specimens places in the base foundation.

2.3.9 Use a metal square to verify that the foundation surface is flat and that the thickness is 0,05 mm and that there are not deformation larger than 0,05 mm using the feeler gauge (Figure 8).

Figure 8. Flat samples.

2.3.10 Perpendicularity: Make sure that the foundation plates are perpendicular to the cylinder specimen in more than 0.5º (3mm in 30 mm). To accomplish this, place the metal square over the foundation plate and using a Vernier, measure the perpendicular deformation in the specimen’s shaft (Figure 9).

Gap no larger than 3 mm in 300 mm.

Figure 9. Samples perpendicular deformation.

2.3.11 Foundation plate's thickness: Using the Vernier, measure the sulfur plate's thickness. Make sure that it is 3 to 5 mm thick (Figure 10).

Figure 10. Sulfur plate's thickness

2.3.12 finally, we got the samples needed (Figure 11).

Figure 11. Samples with sulfur foundation

3. RESULTS

3.1 Hypothesis. The average resistance to compression is 64.0 kgf/cm^2. The additive increased resistance to compression through $\propto$=0.05.

$$H_0: \mu = 64.0\ kgf/cm^2$$

$$H_1: \mu \geq 64.0\ kgf/cm^2$$

In the following chart we show you the concrete charges during the test.

Chart 2. Breach Concrete Charge in each sample

Sample	Breach Concrete Charge
A	14000 Kgf
B	16500 Kgf
C	22000 Kgf
D	17000 Kgf

Data from quick compression test are specified in the next table.

Chart 3. Compression test data

Sample	Breach concrete charge *R*	Total deformation $\propto$	Constant deformation ε	Breach concrete charge strain *f'c*
A	14000 Kgf	$3.961\text{x}10^{-4}$	$1.320\text{x}10^{-5}$	80 kgf/cm^2
B	16500 Kgf	$6.668\text{x}10^{-4}$	$2.222\text{x}10^{-5}$	94 kgf/cm^2
C	22000 Kgf	$6.224\text{x}10^{-4}$	$2.074\text{x}10^{-5}$	125 kgf/cm^2
D	17000 Kgf	$6.810\text{x}10^{-4}$	$2.060\text{x}10^{-5}$	97 kgf/cm^2

3.2 Estimated total deformation of the concrete samples

$$\propto = \frac{PL}{AE}$$

Where:

P= Breach concrete charge
L= Sample's length
A= simple base's area
$\varepsilon = Elastic\ modulus\ of\ Concrete\ (adimensional)$.

3.3 Estimated constant deformation of the concrete samples.

Where:

$\propto = Total\ deformation.$
L=*Sample’s length.*

$$\varepsilon = \frac{\propto}{L}$$

3.4 Estimated strain of the concrete breach deformation according to the NMX-C-404-ONNCCE-2005 standard specification. Here it is established that the result of the concrete breach deformation should be rounded to the next number.

Where:

P=Axial charge applied to the rectangular prism (kgf).
A= Sample’s base (cm^2).

$$f_c = \frac{P}{A}$$

3.5 Hypothesis testing. The average resistance to compression is 64.0 kgf/cm^2. The additive made possible to enhance the compression resistance through $\propto$=0.05

$$H_0: \mu = 64.0\ kgf/cm^2$$

$$H_1: \mu \geq 64.0\ kgf/cm^2$$

To test the alternative hypothesis these data were introduced to Minitab 16 (Chart 4).

Chart 4. Introduced data to Minitab 16

↓	C1 Strength
1	80
2	94
3	125
4	97

The results from Minitab were those showed in Chart 5.

Chart 5. Results from Minitab 16

Variable	N	Mean	Desv. Est.	Standard error of the mean	95 % lower limit	T	P
Strength	4	99.00	18.85	9.43	76.82	3.08	0.027

For effects of this paper, the P value will be the only data we will be interested. So, P is 0.027. As this result goes beyond the required alpha, the alternative hypothesis will be accepted. Thereby plastic helped to enhance the compression resistance shall be accepted.

4. CONCLUSIONS

Sanitary land fields have become a problem due to the high amounts of waste placed there every day. Particularly, there are about 500 thousand millions of plastic bags and around a billion of them become into smaller and more toxic petropolymers every day. Those petropolymers pollute the soil and water and they can also be part of the food chain. The last past is catastrophic for flora. The results obtained from this research and the will to help to decrease polyethylene bags that pollute our ecosystem drew us to the conclusion that compacted plastic bags can be mixed with concrete to enhance resistance higher than 64 kgf/cm^2 to elaborate concrete bricks for buildings purposes. It is important to notice that the strength from the compression tests was higher that what was mentioned in the NMX-C-404-ONNCCE-2005 standard specification. This concrete mixed with plastic is also satisfactory to build sidewalks. In is also worth to mention that with the implementation of this project, plastic bags pollution will be narrowed and it will also allow building houses without an economical raise to construction materials.

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