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Study of the physical-mechanical characteristics of concrete in a concrete-PET mixture

Estudio de las características físico-mecánicas del concreto en una mezcla de concreto-PET

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Abstract

In the field of construction materials, concrete is today one of the most accepted mixtures of materials by the community. Cement is one of the most used products in the world, although large cities are already full of large buildings, cement is still requested in large works. One of the materials widely used as primary packaging are the thermoplastic polymers of the so-called PET (Polyethylene Terephthalate). These materials are currently very polluting mainly in oceans, seas and rivers. The properties of polymers could be exploited to reinforce the properties of concrete and at the same time reuse the polymer to reduce its contamination on the planet. For this research project the experimental methodology was applied consisting of establishing combinations of concrete-PET materials in different ratio. The results obtained from the different mixtures that were prepared from the Flexural Effort tests, it is observed that both in the mixture containing 0.5% PET and in the one containing 1.0%, the results of Flexural Effort are higher compared with the pure mixture.

Cement, Polymer, Flexion

Resumen

En el ámbito de los materiales para la construcción, el concreto resulta hoy por hoy una de las mezclas de materiales más aceptadas por la comunidad. El cemento es uno de los productos más utilizado en el mundo, a pesar que las grandes ciudades ya están llenas de grandes construcciones, el cemento sigue siendo solicitado en las grandes obras. Uno de los materiales ampliamente utilizado como envase primario son los polímeros termoplásticos de los llamados PET (Polyethylene Terephthalate). Estos materiales, actualmente son muy contaminantes principalmente en océanos, mares y ríos. Las propiedades de los polímeros podrían ser aprovechados para reforzar las propiedades de los concretos y al mismo tiempo reutilizar el polímero para disminuir su contaminación en el planeta. Para este proyecto de investigación se aplicó la metodología experimental consistiendo en establecer combinaciones de los materiales de concreto-PET en diferentes proporciones. Los resultados obtenidos de las diferentes mezclas que se elaboraron de las pruebas de Esfuerzo de flexión, se observa que tanto en la mezcla que contiene 0.5% de PET como en la que contiene 1.0%, los resultados de Esfuerzo a la flexión son más altos comparado con la mezcla pura.

Cemento, Polímero, Flexión

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Introduction

In the field of construction materials, concrete is today one of the most accepted mixtures of materials by the community. Its physical-mechanical properties, the way of preparation, handling and transport, give it more advantages over other materials. In Mexico, due to its geographical condition, it is built using concrete as a highly resistant and load-bearing material.

Cement is one of the most widely used products in the world, despite the fact that large cities are already full of large constructions, cement continues to be requested in large works. According to the latest statistics provided by Index Mundi, in its report Hydraulic Cement: World Production, By Country. This report records a production of 2.31 billion tons of cement.

Hence the importance of studying and improving the properties of materials, in this case concrete or mortar in particular. Additives have been developed that help or contribute to improve the properties of cement such as setting, resistance, etc.

One of the materials widely used as primary packaging are thermoplastic polymers called PET (Polyethylene Terephthalate). These materials are currently very polluting, mainly in oceans, seas and rivers. In Mexico, 800,000 tons of PET are generated per year and only 15% is recycled, according to the president of the Special Commission for Sustainable Development of the Chamber of Deputies, legislator René Fujiwara Montelongo.

The properties of the polymers could be used to reinforce or increase the properties of concrete, which is why a way could be found to relate these materials to obtain a better quality concrete and at the same time reuse the polymer to reduce its contamination. in the planet.

Methodology

For this research project, the experimental methodology was applied, consisting of establishing various combinations of concrete-PET materials in different percentages and taking a concrete sample as a reference without containing any amount of PET.

- Mixtures are made in a 1:2 cement/sand ratio with a 0.625 water/cement ratio, using Portland CPC-30R cement without PET dosing.
- Mixtures are made in a 1:2 cement/sand ratio with a 0.625 water/cement ratio, using Portland CPC-30R cement with PET dosage: Cement/sand/water and 0.5% PET graduated by mesh No. 4.
- Mixtures are made in a 1:2 cement/sand ratio with a 0.625 water/cement ratio, using Portland CPC-30R cement with PET dosage: Cement/sand/water and 1.0% PET graduated by mesh No. 4.
- Mixtures are made in a 1:2 cement/sand ratio with a 0.625 water/cement ratio, using Portland CPC-30R cement with PET dosage: Cement/sand/water and 1.5% PET graduated by mesh No. 4.
- Mixtures are made in a 1:2 cement/sand ratio with a 0.625 water/cement ratio, using Portland CPC-30R cement with PET dosage: Cement/sand/water and 2.0% PET graduated by mesh No. 4.

Physical-mechanical tests of all the mixtures are carried out, highlighting the property of Effort to bending.

Results

As can be seen in table No. 1, the results obtained from the different mixtures that were elaborated and the data of the results of the bending stress tests are shown. These results were also graphed as shown in graph No. 1 for a better analysis of the information.

It is observed that both in the mixture containing 0.5% PET and in the one containing 1.0%, the flexural stress results are higher at 7 and 28 days compared to the pure mixture, that is, without PET content. On the other hand, it is observed that the mixtures containing 1.0 and 1.5% PET have the lowest values at 14 and 28 days compared to those of the pure sample. In graph No. 1 it is possible to appreciate the aforementioned values as in the case of the mixtures of 0.5 and 1.0% above the values of the pure mixture.

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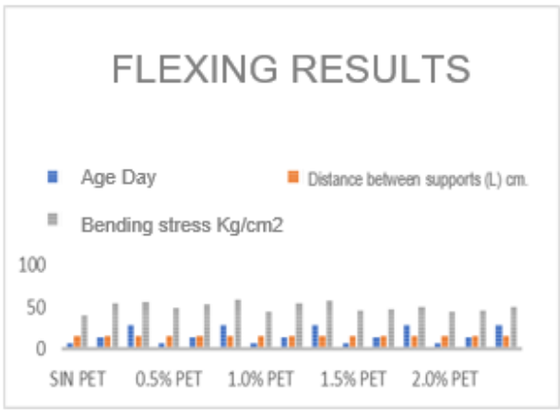
Mixes	Age Day	Load (P) Kg	Distance between supports (L) cm.	Flexibility effort Kg/cm^2
No PET	7	330.5	15	39.6
	14	455.7	15	54.7
	28	465.0	15	55.8
0.5% PET	7	404	15	48.5
	14	444	15	53.27
	28	490.5	15	58.86
1.0% PET	7	369.5	15	44.34
	14	453.5	15	54.42
	28	476.5	15	57.18
1.5% PET	7	379	15	45.48
	14	397	15	47.64
	28	420	15	50.40
2.0% PET	7	367.5	15	44.10
	14	383.5	15	46.02
	28	421	15	50.52

Table 1 Flexibility results table
Source: Own wlaboration

These results allow us to make some conclusions and to continue working on the research project.



Graphic 1 Flexion results
Source: (own elaboration)

Conclusions

After analyzing the results obtained, it is concluded that:

1. It is possible to add the PET polymer to the concrete without affecting its physical-mechanical properties.

2. In the case of the Flexural Effort, the Concrete-PET combination of 0.5-1.0%, the values are higher than the values of normal concrete.

These results open up the possibility of continuing to search for the most appropriate combination and working on other variables such as:

- Modify the particle size of the PET Explore in the thermal part the behavior of the mixture at different temperature values.

- Continue varying the PET-concrete ratio until reaching the optimal ratio.

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