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RECYCLED CONCRETE: CHARACTERISTICS, AND SUSTAINABLE DEVELOPMENT

The demolition of old buildings and their replacement with new buildings is a frequent phenomenon in a large part of the world, which leads to the generation of construction waste. Among the construction wastes are concrete, which is the most common method of managing these wastes through their disposal in landfills. On the other hand, the production and use of concrete are increasing rapidly, which leads to an increase in the consumption of natural materials, which are the largest component of concrete. A possible way to solve these problems is to recycle destroyed concrete and produce alternative aggregates for structural concrete. Based on documentary studies, this article aims to introduce recycled concrete and its characteristics with a descriptive-analytical method.

Key words: *recycled concrete, properties of recycled aggregates, properties of recycled concrete, existing obstacles.*

Introduction

The demolition of buildings and their replacement with new buildings have different reasons. Among its main reasons can be mentioned the change of use, deterioration of the structure, change in the fabric of the city, expansion of traffic direction, natural disasters, etc.

The waste resulting from the demolition of buildings is placed in landfills, which causes much environmental pollution. Concrete is one of the construction wastes that can be recycled and reused. Concrete recycling is becoming a popular way to reuse leftover materials from building demolitions.

In addition to reducing environmental pollution, concrete recycling also reduces construction costs. Therefore, in this article, an attempt has been made to investigate the characteristics of recycled concrete as well as its advantages and disadvantages.

Research Methodology

In collecting information, library and documentary methods have been used. In this article, the successful experiences of projects implemented in other countries as well as the research of researchers have been used.

General properties of concrete with recycled materials

After the destruction of concrete, the aggregates contain a certain amount of cement paste. This mortar is the main reason for the low quality of recycled concrete compared to concrete with natural aggregates. The method of producing recycled concrete is different from the method of producing concrete with natural aggregates.

Because recycled aggregates contain cement mortar, they have higher water absorption than natural aggregates.

Therefore, in order to achieve the desired efficiency of recycled concrete, if water-reducing additives are not used, it is necessary to add a smaller amount of water to saturated aggregates compared to natural aggregates [6].

Properties of aggregates

Recycled concrete materials can be prepared from the following:

1. Samples prepared for concrete testing.
2. Destruction of concrete buildings.

In conventional concrete, only the cement paste surrounds the aggregates, but in recycled concrete, the aggregates may contain salt, bricks, tiles, plastics, dust, etc.

Numerous tests have shown that recycled aggregates, after separation from other wastes and sieving, can be used as a substitute for coarse aggregates.

However, checking the quality of recycled aggregates in terms of grain size distribution, friction, and water absorption is particularly important [1].

The size of the aggregates

After sifting the aggregates and separating them, it is necessary to place the aggregates in a crusher to achieve the desired size for making concrete. It is generally accepted that recycled aggregates, both coarse and fine aggregates, are obtained from impurities by crushing them once or twice. In order to achieve the right size, larger aggregates are placed in successive crushers.

The best aggregate size is obtained by using the first crushing and then the second crushing, but from an economic point of view, the first crushing is more suitable. In the initial crushing stage, the size of the grains is reduced to about 50 mm, and on the way to the second stage, electromagnetism is used to remove metal materials. The second crushing step reduces the particle size to about 14–20 mm. Necessary care should be taken during crushing because finer materials are produced than in the initial stage and the concrete crushing stage [2].

Friction

There is little information about the friction between aggregates. In countries such as the United States and the United Kingdom, recycled aggregates are used in road surface layers. However, the studies conducted show promising results about the use of recycled aggregates in sub-base layers in flexible pavements [5].

Absorption

Recycled aggregates have very high water absorption compared to natural aggregates. This high absorption is caused by the porosity caused by the binding of the mortar to the aggregates.

Water absorption in coarse aggregates can be considered to be about 3–12 % of natural aggregates, and these percentages depend on the type of cement used to produce aggregates [4; 8].

Properties of hardened recycled concrete

Compressive strength

Although researchers have reported a reduction in strength in recycled concrete, it should be noted that the amount of strength reduction depends on parameters such as the type of cement used to make recycled concrete, the water per cement ratio, the moisture conditions of recycled aggregates, etc. For example, in the Katz test, it was found that at a high water per cement ratio (between 0,6 and 0,75), the strength of recycled concrete is about 75% of normal concrete [4].

In Rao's test, it was also found that the strength of recycled concrete can be considered equal to that of normal concrete, with the condition that the water-to-cement ratio is higher than 0,55.

Rao also showed that if the water per cement ratio is reduced to 0.4, the strength of recycled concrete will be only about 75 % of that of normal concrete [8].

Apart from the water per cement ratio, the moisture conditions of the aggregates also have a significant effect on the compressive strength [8; 12].

Creep and shrinkage

Recycled concrete has high shrinkage due to the high absorption of its aggregates. Studies show that the shrinkage of recycled concrete on the 90th day is about 0,55 mm/m to 0,80 mm/m. While the acceptable amount of shrinkage in normal concrete is around 0,30 mm/m. Laboratory results for creep are not completely clear; even some studies have shown opposite results. For example, in an experiment, creep in recycled concrete was reported to be about 20 % less than normal concrete after 1 year [1]. It seems that recycled concrete and conventional concrete will be comparable when the simultaneous effects of creep and shrinkage are considered.

Modulus of elasticity

The modulus of elasticity for recycled concrete is reported to be about 50–70 % of normal concrete, depending on the water per cement ratio [7].

Bending and tensile strength

Studies conducted by Rao show a reduction in strength of about 15–20 % in normal concrete. In another study, where only the tensile strength of concrete was investigated, the difference in the tensile strength of recycled and normal concrete at day 28 was reported to be less than 20 % [1]. Studies have shown that the use of admixtures such as microsilica, etc., helps improve the properties of recycled concrete.

Comparison of recycled concrete with concrete with natural aggregates

- increase water absorption;
- increasing the amount of organic impurities (if the concrete is in contact with the ground during its life);
- decrease in compressive strength;
- increase creep;
- decrease the modulus of elasticity;
- specific weight loss;
- reducing friction resistance.

Properties of fresh recycled concrete

Many researchers have reported lower workability for recycled concrete than conventional concrete with the same amount of water. In order to improve efficiency, special measures have been proposed regarding changing the moisture content of recycled aggregates [11]. Recycled concrete

contains more air (about 4 % to 5,5 %) than conventional concrete. This extra air can be attributed to the greater porosity of the aggregates [4].

The density of most concrete made with natural aggregates is 2 400 kg/m^3, while the density of concrete made with recycled aggregates is less than 2 150 kg/m^3. One of the reasons for reducing the density of recycled concrete is the presence of excess air in this type of concrete [11; 4].

Obstacles to using recycled concrete

People's lack of trust in the use of recycled materials due to inappropriate culture as well as the low prices of materials in developing countries are obstacles for recycling operations, and the only thing that can convince manufacturers or owners to recycle waste is imposing Landfill costs. These issues can all hinder the promotion of the use of recycled aggregates in concrete.

Lack of government support

Unfortunately, there is a lack of government support for the development and progress of the recycling industry in developing countries, but the motivation for collecting information, documenting it, and consequently controlling the management of recycled materials can be realized with the existence of a suitable policy in the legal framework.

Lack of knowledge

One of the factors that causes the continuation of landfilling is people's lack of awareness of the benefits of recycling as well as their lack of awareness of the consequences of the absolute use of freshly mined aggregates. To overcome these barriers, we need to raise awareness and disseminate information about the consequences of repeated use of quarry aggregates as well as the characteristics of recycled concrete to stimulate public opinion towards recycled materials. We can also create space for the growth of recycled materials by participating in and pushing the construction industry to use recycled materials in projects.

Lack of appropriate technologies

The methods or technologies for eliminating waste on an economic scale should have high speed and low cost. However, regarding concrete recycling, there are few feasible technologies.

Absence of appropriate codes and standards

Regarding the use of recycled materials, except for RILEM and JIS [9] and what is used in Hong Kong, there are a limited number of standards and codes.

In Hong Kong, for common applications, except for water protection buildings, the use of 100 % recycled aggregates is allowed for low-grade concrete, but for high-grade concrete, only 20 % of the aggregates can be recycled.

In Japan, JIS pursues a program entitled Recycled Concrete with Recycled Aggregates, which promotes the use of recycled concrete.

Expanding the standards related to recycling and reuse of aggregate, in addition to providing specific goals for the producer, also gives the consumer confidence about the quality of concrete.

Conclusion

The production of solid waste is the product of various human activities, which today have changed a lot with the change of lifestyle and comprehensive development compared to the past.

One of the solid waste materials is building waste, which is increasing in volume day by day.

Due to the limitations of natural resources and environmental protection, the most optimal solution is to reuse waste.

The use of recycled grains in concrete is a promising solution to the problem of construction waste management.

LIST OF REFERENCES

1. Ajdukiewicz A., Kliszczewicz A. Influence of recycled aggregates on mechanical properties of HS // HPC. Cement and concrete composites. – 2002. – № 24 (2). – P. 269–279.

2. Corinaldesi V., Giuggiolini M., Moriconi G. Use of rubble from building demolition in mortars // Waste management. – 2002. – № 22 (8). – P. 893–899.

3. Sagoe-Crentsil K.K., Brown T., Taylor A.H. Performance of concrete made with commercially produced coarse recycled concrete aggregate // Cement and concrete research. – 2001. – № 31 (5). – P. 707–712.

4. Katz A. Properties of concrete made with recycled aggregate from partially hydrated old concrete // Cement and concrete research. – 2003. – № 33 (5). – P. 703–711.

5. Khalaf F.M., DeVenny A.S. Recycling of demolished masonry rubble as coarse aggregate in concrete // Journal of materials in civil engineering. – 2004. – № 16 (4). – P. 331–340.

6. Nagataki S., Gokce A., Saeki T., Hisada M. Assessment of recycling process induced damage sensitivity of recycled concrete aggregates // Cement and concrete research. – 2004. – № 34 (6). – P. 965–971.

7. de Oliveira M.B., Vazquez E. The influence of retained moisture in aggregates from recycling on the properties of new hardened concrete // Waste management. – 1996. – № 16 (1-3). – P. 113–117.

8. Rao A. Experimental investigation on use of recycled aggregates in mortar and concrete. Civil Engineering, Department of Engineering, Indian Institute of Technology. – Kanpur, India, 2005.

9. Rilem T.C. 121-DRG. Specifications for concrete with recycled aggregates // Mater. Struct. – 1994. – № 27 (9). – P. 557–559.

10. Günçan N.F. Using waste concrete as aggregate // Cement and concrete research. – 1995. – № 25 (7). – P. 1385–1390.

11. Topcu I.B., Sengel S. Properties of concretes produced with waste concrete aggregate // Cement and concrete research. – 2004. – № 34 (8). – P. 1307–1312.

12. Poon C.S., Shui Z.H., Lam L., Fok H., Kou S.C. Influence of moisture states of natural and recycled aggregates on the slump and compressive strength of concrete // Cement and concrete research. – 2004. – № 34 (1). – P. 31–36.

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ПЕРЕРАБОТАННЫЙ БЕТОН: ХАРАКТЕРИСТИКИ И УСТОЙЧИВОЕ РАЗВИТИЕ

Снос старых зданий и замена их новыми постройками — частое явление в значительной части мира, приводящее к образованию строительного мусора. К строительным отходам относится бетон, который является наиболее распространенным видом отходов на свалках. С другой стороны, производство и использование бетона быстро растут, что приводит и к увеличению потребления натуральных материалов, которые являются самой большой составляющей бетона. Возможным способом решения этих проблем является переработка разрушенного бетона и производство альтернативных заполнителей для конструкционного бетона. Эта статья, основанная на документальных исследованиях, направлена на то, чтобы представить переработанный бетон и его характеристики с помощью описательно-аналитического метода.

Ключевые слова: *рециклобетон, свойства рециклобетона, свойства рециклобетона, существующие препятствия.*