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Review on Properties of Recycled Construction Waste Concrete Aggregate

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Abstract: *Recycled construction waste aggregate is to solve the damage caused by construction waste to the natural environment. Through crushing, screening and other processes, the construction waste aggregate is made into reusable coarse aggregate or fine aggregate, and then replaced by natural gravel or natural sand and stone in different replacement rates and applied to the recycled aggregate in concrete. In this paper, three main physical properties of waste concrete, the old ceramic tile, broken ceramic, crushed clay brick and waste glass aggregate are summarized, which are water absorption rate, apparent density and crushing index of recycled building waste aggregate. The crushed clay brick and broken ceramic aggregate have the highest water absorption rate and low in apparent density and high in crushing index. Waste concrete mixture has excessive water absorption, low apparent density and excessive crushing index, whilst damaged ceramic tile combination has low water absorption, low apparent density and low crushing index.*

Keywords: *Construction waste, recycled aggregate, waste concrete*

1. Introduction

Since the 1990s, due to the rapid development of the domestic economy, the pace of urbanization has also followed. According to the survey, domestic construction waste generates 41 million tons every year. On the one hand, many people do not pay much attention to the protection of total natural resources, with the concept of "inexhaustible, inexhaustible", resulting in the consumption of a large number of natural resources. On the other hand, after rebuilding, renovating and demolishing all kinds of buildings, a lot of waste concrete, crushed clay brick, broken ceramic tile, broken ceramic and waste glass aggregate will be left, aggregate has a brilliant affect on the sustainability of concrete shape and ecological surroundings. Therefore, the problem of building waste recycling is placed in front of human beings. In order to remedy the issues of environmental air pollution and sustainable improvement of development industry, it is crucial to recycle development waste [1-2].

In order to enhance the recycling rate of building waste aggregate, after suited processing and treatment, it can now not solely decrease the air pollution of waste concrete to the environment, however additionally guard natural resources well, which is of remarkable magnitude to the sustainable improvement of society. So that a sustainable improvement of recycled building waste combination greater conducive to environmental protection [3]. Therefore, it is vital to recognize the features of waste aggregate. This paper mainly introduces the main characteristics of different construction waste aggregate.

2. Physical Properties of construction waste aggregate

Construction waste aggregate is a kind of renewable resources, with “Recycling”as the basic principle. In addition to the recycled construction waste aggregate [4-5], there are many other construction waste aggregate, such as crushed clay brick [6], broken ceramic tile and ceramic [7], waste glass [8] and so on. Compared with natural aggregate, construction waste aggregate has the physical characteristics of low apparent density and high water absorption due to the attachment of old mortar.

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2.1. Water absorption

Water absorption is one of the important indicators for evaluating the performance of waste recycled aggregates from buildings. The water absorption of aggregate is related to the particle size of aggregate, the kind of waste aggregate and the surface hole. For recycled building waste aggregate, the porosity is high and the water absorption is high. The larger the apparent density of aggregate, the denser the material, the weaker the water absorption capacity; The smaller the aggregate particle size, the larger the specific surface area of the same mass of aggregate, the more surface holes, the stronger the water absorption capacity [9]. The water absorption rate of waste glass aggregate is low, which is only 0.12%-0.66% [10-12]. And Discard Ceramic Tile's ceramic tile aggregate has half for Glaze, oneself bibulous is little, bibulous range is in 0.19%-0.84% commonly [13-14]. Due to the difference of manufacturing technology, the water absorption rate of broken ceramic aggregate is between 1.4% and 7.2%, which is much higher than that of ceramic tile [15-16]. The surface of waste recycled concrete aggregate is rough and includes a lot of historical mortar, so that its water absorption price is massive and range from 2.56% to 11.5% [5,6]. The water absorption of overwhelmed clay brick is greater than that of waste concrete aggregate, which is 11.14%-15.8%, due to the fact the apparent density of beaten clay brick combination is small and the porosity is excessive [4,17].

2.2. Apparent density

The apparent density of building waste recycled aggregate is related to material properties and particle size. The apparent density of reclaimed fine aggregate was lower than that of reclaimed coarse aggregate. Some researchers have also found that the apparent density of recycled waste concrete is much lower than that of natural aggregate, because many old cement mortars with a lower density than aggregate are attached to the waste concrete aggregate [4,10]. The apparent density of the crushed clay brick aggregate is only 1875kg/m^3 because of its high water absorption and high porosity. The apparent density of broken ceramic tile is 2278kg/m^3-2401kg/m^3, which is higher than that of broken ceramic aggregate[18]. Due to the particularity of waste glass aggregate, few researchers have explored the apparent density of glass aggregate. However, a few scholars have found that the apparent density of glass aggregate is about 2300kg/m^3[12].

2.3. Crushing Index

The compressive strength, flexural strength, static elastic modulus and strength loss rate of recycled concrete decrease with the increase of recycled aggregate crushing index. The crushing index can show the ability of the construction waste aggregate to resist crushing, and the strength of the recycled aggregate can also be obtained indirectly. The higher the percentage of fragmentation indicators, the lower the crushing resistance and aggregate strength of the aggregate [15]. The crushing index is not only related to the density of aggregate, but also to the water absorbing capacity and appearance shape of aggregate. The natural aggregate has low porosity and high hardness, so the crushing index is lower and the crushing index increases with it. The crushing index of waste concrete is generally between 15% and 31% [4,19], while the crushing index of recycled brick aggregate is more than 30% [6]. The crushing index of abandoned ceramic aggregate is generally 11.9%-14.6%, in contrast, the crushing index of abandoned ceramic aggregate reaches 34.62% [14].

3. Conclusion

In summary, a large number of research results show that waste concrete aggregate, broken ceramic tile, broken ceramic, crushed clay brick, waste glass aggregate and other materials can be used for recycled concrete aggregate. The conclusion is as follows:

(1) Compared with natural aggregate, waste concrete aggregate has higher water absorbing capacity, lower apparent density and higher crushing index. This is due to the waste concrete aggregate containing a large number of old mortar, resulting in high porosity.

(2) The water absorbing capacity, apparent density and crushing index of broken ceramic tile aggregate are lower than those of natural aggregate. The glaze of ceramic tile aggregate is smooth, general bibulous little, density is bigger also.

(3) Ceramic aggregate and crushed clay brick are more porous, with high water absorbing capacity, low apparent density and high crushing index.

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(4) Waste glass aggregate itself has a waterproof role, because of its special material, glass aggregate with low water absorbing capacity, low apparent density and other characteristics.

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