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# Green Curb - An Alternative Method to Produce Road Curb Using Old Tire

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**Abstract.** Green curb was introduced to be an alternative material for a traditional road curb. This green curb is having a different concrete mix but the dimension and other requirement with respect to JKR requirement is still the same. The coarse aggregate will be replaced with crumb rubber (CR) that was extracted from vehicle tires after been shredded to the specified size from 15-20 mm as coarse aggregate. Testing such as slump test, compressive strength test and rebound hammer test was conducted to obtain the results. From the results, the slump test shows a high workability and decrease in compressive strength as the percentage of CR increase. The total weight of road curb is reduced by almost 8% compared to the control specimen. This 20% CR mixtures shows good result among other mixtures. The percentage of CR used are 20%, this particular percentage has good workability, satisfy the concrete grade 25 as required by JKR guideline (JKR/SPJ/1988).

## 1. Introduction

Concrete is made of cement, aggregates and water. Concrete is one of the widely used construction materials around the world. Day by day, the demand for natural resource like aggregates increase rapidly as the construction industry activity grows. This will cause a depletion of resources in the future and it is decreasing at an alarming rate stated by [1]. Therefore an alternative materials was introduced to overcome the problem arise.

In Malaysia, there are about 57,391 tons of tires generated every year and only 40% of it will be dispose correctly stated by [2]. The increase of vehicles owner corresponds to the number of tires they use. When they replacing the old tires, after wear and tear, these tires will be dump at the landfills as waste. For some reason, many of us did not know the correct way to dispose the used tires. To make thing worse, some of us even burn these tires as a method of disposal. This method of tire disposal gave a lot of negative impact to environment and dangerous to human health as the toxic gases released is dangerous.

In this research, the aim was to replace the coarse aggregates in concrete with CR. However, it is proposed that the alternative concrete to be used for non critical element such as road curb. Concrete curbs is commonly used as a safety barriers, dividers and at road shoulders. It provides the necessary protection to the pavement and road users. Thus, it does not require the same properties like beams, slabs or columns.

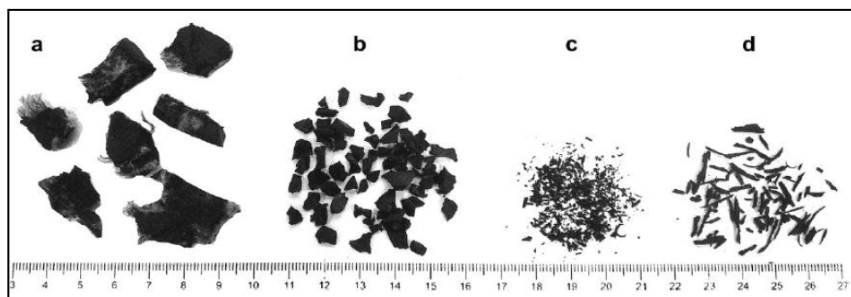


The curbs are more to aesthetic and safety purpose for road and road users, and from JKR guideline, the concrete grade requirement is only G20 / G25 concrete. The curbs have to provide safety features as well as protecting the road users and itself. The curbs tend to be damaged after impact of vehicles. So the curbs should have properties that will absorb the energy during impact and thus reduces the damage. It must also have the characteristics to resist from cracking and deterioration due to environmental effects. The ease of doing construction work, for example for the workers to move the curbs with ease, they should be easy to handle, not too heavy and easy to construct.

## 2. Methodology

### 2.1. Materials

In this research, the crumb rubber was supplied by Yong Fong Rubber Industries Sdn Bhd located at Klang Selangor. Classification of rubber aggregate is crumb where the properties is accordance to [3]. The first type is slit tires where the tire is cut into two sections, the second type is shredded/chipped tires where the particle size is 300-400mm long and 100-230mm wide, the third type is granular 0.15 – 19mm, and last type is crumb rubber 0.075-4.75mm. The nominal size for crumb rubber is between 0.075mm and 4.75mm (No. 200 sieve and No. 4 sieve). Figure 1 shows the CR size. Figure 2 shows the processes involved in producing crumb rubber.



**Figure 1.** Classification of rubber aggregates; (a) chipped, (b) crumb, (c) granular, (d) fibre [3].



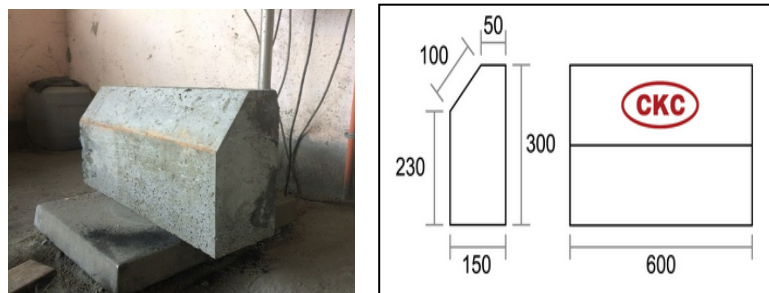
**Figure 2.** (a) tyre (b) shredding machine (c) crumb rubber.

### 2.2. Mix proportions

Concrete mixes were prepared using partial replacement method by adding crumb rubber as coarse aggregate ranging from 0% to 30%. When the concrete mix showed the desired workability and uniform crumb rubber distribution, it was placed in a mould and vibrated on a shaking table. The specimens were stored in curing room. For the concrete G25, the ratio of cement to sand to aggregate is 1:1:2.

### 2.3. Curb Size

The curb was produce as similar to the product sold on the market. The size is 600mm x 300mm x 150mm. Figure 3 show the road curb that has been cast in the laboratory.



**Figure 3.** Road curb product and its dimension.

#### 2.4. Testing

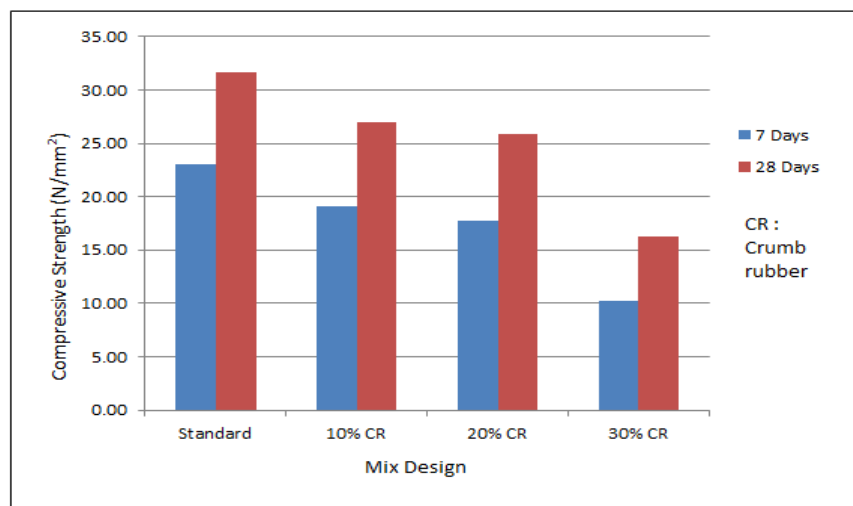
The compressive strength and slump test were accordance to ASTM C109 Standard Test Methods for Compressive Strength [4] and ASTM C143 Standard Test Methods for Slump [5], respectively.

### 3. Results and Discussions

The result obtained was from laboratory testing on 7 days, and 28 days. The results of concrete curb containing crumb rubber was analysed to assess the performance.

#### 3.1. Compressive Strength Test

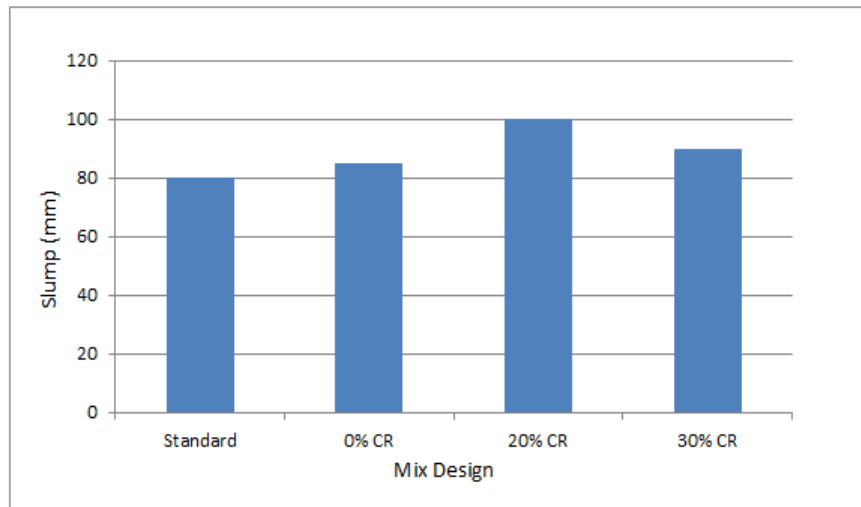
Figure 4 shows the results of compressive strength for concrete mix at 7 and 28 days. The strength is decreasing when CR were added to the mix. However, the optimum replacement is 20% where it is above the specified compressive strength of 25 N/mm<sup>2</sup> by JKR guideline [6].



**Figure 4.** Compressive strength of concrete mix

#### 3.2. Slump Test Value

Figure 5 shows the results of slump test for concrete mix. The slump results show an increasing pattern when CR were added to the mix. The slump indicates the workability of mix and the results is a little bit high but still acceptable.



**Figure 5.** Slump test value of concrete mix

### 3.3. Weight Differences

Figure 4 shows the results of compressive strength for concrete mix at 7 and 28 days. The strength is decreasing when CR were added to the mix. However, the optimum replacement is 20% where it is above the specified compressive strength of 25 N/mm<sup>2</sup> by JKR guideline [6].

**Table 1.** Road curb weight.

Concrete Mix	Weight (kg)
Standard	2.3
20% Crumb Rubber	2.12
Differences	8%

From Table 1, it shows about 8% differences between the standard curb and curb with 20% CR. This differences will definitely help to reduce the burden and makes things easier to handle or carry the curb on site.

### 4. Conclusion

As for conclusion, the slump test shows a high workability and decrease in compressive strength as the percentage of CR increase. The total weight of road curb is reduced by 8% compared to the standard curb. This 20% CR mixtures shows good result among other mixtures. The percentage of CR used are 20%, this particular percentage has good workability, satisfy the concrete grade 25 as required by JKR guideline (JKR/SPJ/1988).

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