

The Study Of Polyvinyl Alcohol Fiber Reinforced Cement Stabilized Macadam

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ABSTRACT

As a new material, the researches on polyvinyl alcohol fiber cement stabilized macadam are also less. This article studies the effect of different volume fraction of fiber length on the compressive strength and splitting tensile strength of cement stabilized macadam. To promote polyvinyl alcohol fiber cement stabilized macadam's application, it has theoretical significance and engineering application value.

Keywords –cement, polyvinyl alcohol fiber, engineering application, compressive strength.

I. Introduction

Polyvinyl alcohol fiber cement stabilized macadam is a new material that composed of polyvinyl alcohol fiber and cement stabilized macadam. The raw material of polyvinyl alcohol fiber is polyvinyl alcohol and through a special process formed. In 1980s, Japan first developed polyvinyl alcohol fiber that can be used for roadbed base. In the late 1980s, China successively developed polyvinyl alcohol fiber too. The features of polyvinyl alcohol fibers are hydrophilic, high elastic modulus, high specific surface area and have good compatibility with cement. However, the researches on the polyvinyl alcohol fiber cement stabilized macadam are still rare, this limits its application and promotion. Therefore, expanding the researches on the polyvinyl alcohol fiber cement stabilized macadam is necessary. In this article, we mainly study the mechanical properties of polyvinyl alcohol fiber cement stabilized macadam of different lengths and different contents of polyvinyl alcohol fiber.

II. Test generalization

The cement used in the test is 32.5 ordinary portland cement of Anhui Huaihai United Cement Factory; the polyvinyl alcohol fiber is made of Shanghai Kaifu Industrial Development Limited Liability Company, its cross-sectional area is $1.52 \times 10^{-4} \text{mm}^2$, its tensile strength is 1600Mpa and elastic modulus is $3.5 \times 10^4 \text{Mpa}$. There are five gravel particle size: 1# (19-31.5mm)、2# (9.5-19mm)、3# (4.75-9.5mm)、4# (2.36-4.75mm)、5# (0-2.36mm) . According to the test results, the target proportion of cement stabilized macadam is 1# : 2# : 3# : 4# : 5# : =12:30:23:6:29, the dose of cement is 4.0%.

The formula of cylinder compressive strength is

$$f_{cu} = \frac{F_{\max}}{A}$$

Explanation: f_{cu} — cylinder compressive strength(Mpa);

F_{\max} —maximum load (KN) ;

A—Bearing area (mm^2) .

The formula of splitting tensile strength is

$$f_{ts} = \frac{2F_{\max}}{\pi A} = 0.637 \frac{F_{\max}}{A}$$

Explanation: f_{ts} — splitting tensile strength (MPa) ;

F_{\max} —maximum load (KN) ;

A—Bearing area (mm^2)

III. Test results and analysis

2.1 The compressive strength of polyvinyl alcohol fiber cement stabilized macadam

The length of polyvinyl alcohol fiber in polyvinyl alcohol fiber cement stabilized macadam is 0mm, 12mm, 18mm, 24mm, 30mm, each length fiber has three volume fraction : 0.6Kg/m³、0.9 Kg/m³、1.2 Kg/m³. The specimen size of cylinder is diameter of 150mm, height 150mm, and curing period is 7 d. According to the test results, when the length of the fiber is 0mm, the compressive strength of specimens is 4.91Mpa; when the length of the fiber is 12mm and the volume fraction is 0.6Kg/m³、0.9 Kg/m³、1.2 Kg/m³, the compressive strength of specimens is 5.

84 MPa、 5.39MPa、 5.44MPa; when the length of the fiber is 18mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2 Kg/m³, the compressive strength of specimens is 5.36 MPa、 5.21MPa、 4.76MPa; when the length of the fiber is 24mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2 Kg/m³, the compressive strength of specimens is 5.29 MPa、 5.17 MPa、 5.37MPa; when the length of the fiber is 30mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2 Kg/m³, the compressive strength of specimens is 5.12 MPa、 4.88MPa、 4.62MPa. Thus, when the length of the fiber is constant, the compressive strength of the specimen is decreased with the increase of fiber volume fraction.

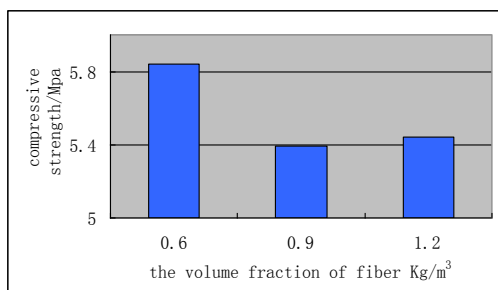


Figure 1:the compressive strength when the fiber length is 12mm

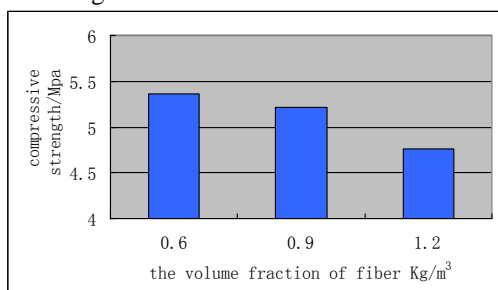


Figure 2:the compressive strength when the fiber length is 18mm

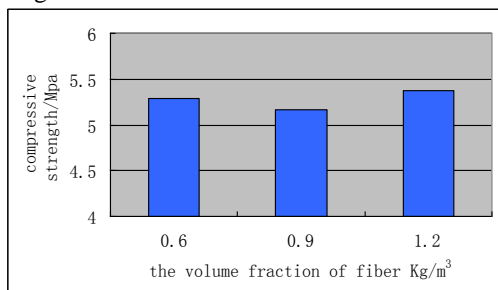


Figure 3:the compressive strength when the fiber length is 24mm

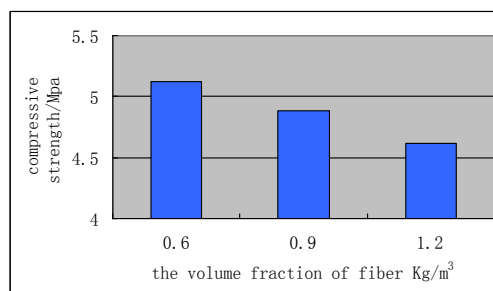


Figure 4:the compressive strength when the fiber length is 30mm

2.2 The splitting tensile strength of polyvinyl alcohol fiber cement stabilized macadam

The length of polyvinyl alcohol fiber in polyvinyl alcohol fiber cement stabilized macadam is 0mm、 12mm、 18mm、 24mm、 30mm, each length fiber has three volume fraction : 0.6Kg/m³、 0.9 Kg/m³、 1.2 Kg/m³. The specimen size of cylinder is diameter of 150mm, height 150mm, and curing period is 7 d. According to the test results, when the length of the fiber is 0mm, the splitting tensile strength of specimens is 0.272Mpa; when the length of the fiber is 12 mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2 Kg/m³, the splitting tensile strength of specimens is 0.279 MPa、 0.287MPa、 0.224MPa; when the length of the fiber is 18mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2Kg/m³, the splitting tensile strength of specimens is 0.260 MPa、 0.229MPa、 0.287MPa ;when the length of the fiber is 24mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2Kg/m³, the splitting tensile strength of specimens is 0.264 MPa、 0.254MPa、 0.285MPa; when the length of the fiber is 30mm and the volume fraction is 0.6Kg/m³、 0.9 Kg/m³、 1.2Kg/m³, the splitting tensile strength of specimens is 0.234 MPa、 0.249MPa、 0.244MPa.

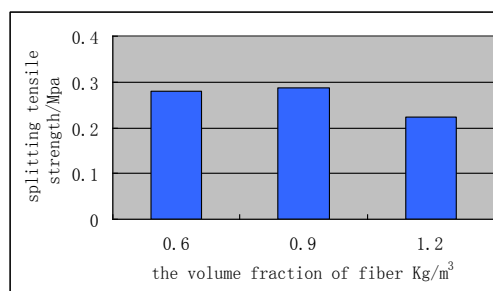


Figure 5:the splitting tensile strength when the fiber length is 12mm

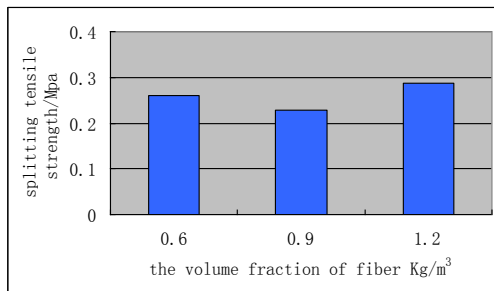


Figure 6:the splitting tensile strength when the fiber length is 18mm

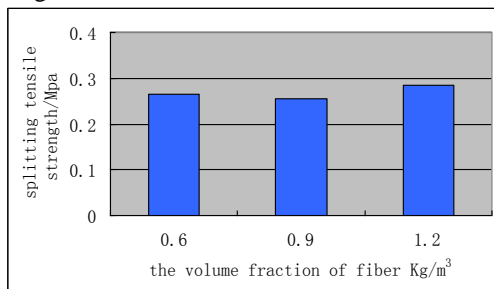


Figure 7:the splitting tensile strength when the fiber length is 24mm

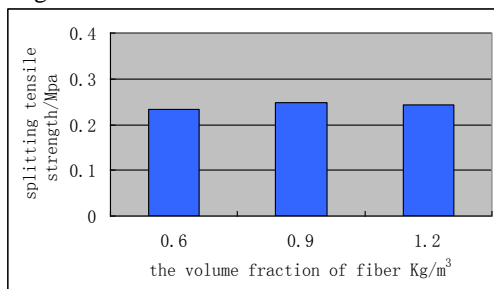


Figure 8:the splitting tensile strength when the fiber length is 30mm

IV. Conclusion

(1) The incorporation of polyvinyl alcohol fiber can be have a good increase of compressive strength of cement stabilized macadam, when the length of the fiber is 12mm and the volume fraction is 0.6 Kg/m³, the compressive strength of cement stabilized macadam is largest.

(2) The variation between polyvinyl alcohol fiber and the splitting tensile strength of cement stabilized macadam is not obvious. When the length of the fiber is 12mm and the volume fraction is 0.9Kg/m³, and the length of the fiber is 18mm and the volume fraction is 1.2Kg/m³, the splitting tensile strength of cement stabilized macadam is largest.

(3) Due to time constraints , this article only has a preliminary study of the basic mechanical properties of polyvinyl alcohol fiber cement stabilized macadam. In the next phase, we should have a more systematic research program to improve the impact of polyvinyl alcohol fiber on cement stabilized macadam.

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