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WORKABILITY OF BANANA FIBERS REINFORCED CONCRETE FOR EASY POURING

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Abstract- Concrete is the most widely used construction material in construction industry. Workability is the property of concrete which is directly related to the strength factors and quality of work. Workability of concrete is determined to ensure ease of handling. Natural Fibers are added in concrete to achieve desired properties and results in reduction of cost and light weight structures. The purpose of this study is to check the workability of specimen having banana fibers of 50 mm length for easing pouring and handling. For the study of workability banana fiber reinforced concrete (BFRC) slump cone test is performed. Banana fiber is added 2.5% by mass of cement content. The value of BFRC slump test is compared with the value obtained by the slump test of plain concrete (PC). The results revealed that by the addition of banana fibers the value of slump decreased. It is concluded that the workability depends upon the ingredients of concrete as well as the additional materials which are used to enhance or achieve desired properties.

Keywords- Banana Fibers, Banana Fibers Reinforced Composites. Slump Test.

1 Introduction

Concrete is the back bone of construction industry [1]. By the passage of time the utilization of concrete is growing day by day. This can be due to increase of urbanization rate in developing countries and even developed countries. Concrete has adverse ecological affects and there is always need to reduce the impacts of concrete on environment. Sustainable material is always needed to reduce the cement content of concrete resulting in reduction of air pollution due to less emission of carbon dioxide (Co_2) in air. Concrete is a brittle material which is stronger in compression phase and weaker in tension [2] [3].The natural fibers have gained popularity for using in concrete due to their eco-friendly nature, economical and good physical properties. The utilization of natural fibers in concrete lead to reduction of workability of concrete [4]. Workability is the property of concrete which is directly related to the strength factors and quality of work. By the addition of fibers the workability is reduced [5]. Banana fiber is lignocellulose natural fiber so by addition of banana fiber (BF) the concrete become less workable. This is due to the increase of water absorption because of presence of banana fiber [6]. Owing to the fact of increased water absorption property of concrete the slump test value is decreased.

Therefore, not only banana fibers, the usage of all agricultural natural fibers may lead to reduction in workability [7]. By the increment of quantity of fibers in concrete the value of slump test performed on fresh concrete is decreased [8] [9] [10]. Slump test is performed both on site and in laboratory for determination of workability of concrete [11] [12]. Workability of concrete is related with the value of slump test. If the slump value is high then the material is considered as more workable and vice versa. Raw materials and additional fibers have great influence on workability. Hence, workability is controlled by these ingredients and water to cement ratio (W/C) in concrete. Less water cement ratio results in reduction of workability i.e. slump cone test value. To overcome this flaw different types of plasticizers and super-plasticizers are used [13]. These admixtures help in increment of workability. Many researchers reported the influence of agricultural natural fiber on properties of concrete when they are used in concrete composites [14]. Jute is also a natural fiber and it is

used by researchers to enhance the mechanical, dynamic and absorption proprieties of concrete. It is also found that by the use of jute natural fibers, there is increases in resistance against the impact loadings [15]. With the popularity of use of admixtures in concrete, it has been observed that the fibers in concrete enhanced the properties when used with admixtures. Admixtures solely may not perform better than the combination of fibers with them [16]. Numerous studies are being conducted by different researchers on the effect of fibers on workability and mechanical properties of concrete [17] [18] [19].

There are a number of studies present on the workability of artificial fibers [20]. But the literature on the workability of agricultural natural fibers is very less. Workability plays a vital role in the hardened properties of concrete. So, there is need to investigate the workability of natural fibers reinforced composites (NFRC). For this purpose banana fiber reinforced composite (BFRC) is casted with 2.5% content of banana fiber by the mass of cement content. Slump cone test is performed to check the workability of BFRC for easy pouring and handling. If the value of workability test is undesirable it may deviate from the required properties of concrete. Lower value of slump means the concrete is less workable and it will cause difficulty in handling and pouring, can lead to decreased in strength. The study will help to understand the workability of PC and BFRC. It will also help to understand the usage of agricultural waste like banana fiber in concrete and its effects towards the workability of fresh concrete but the determination of water absorption is not included in this work.

2 Methodology

2.1 Raw materials.

For the production of PC, Ordinary Portland cement (OPC) and Margalla crush were used along with locally available sand. The max. size of aggregate was taken as 20 mm for production of both PC and BFRC. For the preparation of fiber reinforced composite (FRC), banana fiber was used. Banana fiber used in slump cone test is shown in figure 1. The length of banana fiber was kept fixed as 5 cm (50mm). Tap water of normal temperature was used for the preparation of both PC and BFRC. PC was prepared by the water cement ration (W/C) of 0.6 and 0.7 W/C was used for preparation of BFRC.

Figure 1: Combed banana fibers of 50mm length.

2.2 Mix design and concrete preparation.

For plain concrete preparation, cement, sand and course aggregates ratio for mix design was 1, 2 and 4 respectively. The water to cement ratio (W/C) was 0.6 for PC. Same mix design was executed for the production of BFRC. To the best of the author's knowledge there is no standard present for mixing of BFRC so, layer method was adopted. The W/C was increased to 0.7 for BFRC because of presence of fiber. This increment was also for making it workable and for good compaction because poor compaction may lead to reduction in strength. The addition of water was carried out stepwise to avoid bleeding. All materials were added in a way that they may mixed efficiently. To prepare PC, all materials were added in concrete mixer along with water and mixer was rotated for three minutes. For the preparation of BFRC, one third of the

aggregates were spread in concrete mixer followed by the one third of BF content. Then one third of sand and the same content of cement were placed and spread in mixer. Same procedure was adopted for three layers of each, aggregates, fibers, sand and cement. After the addition of one third water content, concrete mixer was rotated for three minutes. The remaining water was added in increments to make BFRC workable.

2.3 Workability test

Slump test is performed to find out the consistency or workability of concrete. This test is performed both in laboratory and at construction site before pouring of concrete into testing moulds. ASTM standard C 143/C143M-15a states that slump test is the method which provides a procedure to investigate the slump of plastic hydraulic concrete [21]. The slump cone is used in test has top diameter of 100 mm and bottom diameter of 200 mm. The length of temping rod used for compacting is 600 mm and it's both ends are hemispherical with diameter of 16 mm. The first concrete layer is placed in 1/3 volume of cone. Compaction is performed by dropping temping rod at random places in the cone from a height of 25mm. Remaining two layers are also filled and efficiently compacted by earlier described way. By rolling and screeding, surface can be made smooth. Cone is lifted vertically up and placed besides the concrete which is moulded by slump cone. Ensure upside down before placing it besides the moulded concrete. Temping rod is placed over the upper surface of cone in such a way that half of the temping rod length may cover concrete mould. Ruler is use to read the slump value of concrete as shown in figure 2.

Figure 2: Measuring the slump value of BFRC

3 Results and Analysis

3.1 Slump of fresh concretes

The values of slump for plain concrete and BFRC, addition of BF to produce BFRC and W/C are present in table 1. Values of slump for PC and BFRC are 40mm and 10 mm respectively. It can be noticed that there is considerable decrease in the value of slump for BFRC having 2.5% BF. The W/C ratio is increased for BFRC but even after increment of water content there is huge decrease of 75% in value of BFRC. The decrease of slump value for BFRC is may be due to the water absorption of banana fiber. The water absorption of natural banana fibers reduce the water content in other ingredients of concrete. The addition of fiber may reduce the workability of concrete.

Table:1-Water cement ratio (W/C) and slump of PC and BFRC

Mix	BF addition (%)	W/C (ratio)	Slump (mm)
PC	0	0.6	40
BFRC	2.5	0.7	10

3.2 Ease with concrete handlings.

The transportation and pouring of concrete depends upon the workability of concrete. The water cement ratio has great influence on the workability of concrete. If concrete does not meet the required water cement ratio then it results in reduction of slump value. BFRC is less workable as compared to PC as it has less value of slump test. Greater is the slump value, more is the workability and vice versa. PC has more workability i.e. slump value of BFRC is reduced by the addition of natural banana fibers in it. So, as a result of this the handling of BFRC is difficult as compared to PC. This is due to water absorption property of BF. The water provided in concrete during mixing is absorbed by fiber content present in mixture and other ingredients get less amount of water. Due to the reduced content of water in ingredients, it becomes harder and difficulty is faced during its transportation and pouring. The concrete with reduced slump value is also difficult to compact during compaction of concrete in molds.

4 Conclusions

The Plain concrete (PC) and banana fibers reinforced composite (BFRC) are evaluated in terms of workability. For this purpose, slump test is performed on both PC and BFRC. The fiber content by mass of cement and length are kept as 2.5% and 50 mm respectively. By conducting this study following conclusions can be drawn.

- By the addition of banana fiber there is huge decrease in workability of BFRC as compared to PC.
- Workability of BFRC is reduced to 75% as compared with PC.
- Less value of slump leads towards the difficulty of the concrete handling and concrete matrix becomes less workable.
- PC is more convenient to handle and transport as compared to BFRC.

The above mentioned outcomes indicated that the difficulty of handling is caused by less workability. The banana fibers have drawbacks towards the workability of BFRC. More amount of W/C as compared to PC is required to BFRC to make it more workable. Plasticizers and super plasticizers may also be used to enhance workability.

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