

# Study on Partial Replacement of Cement with Flyash and Addition of Bananafibre in Concrete

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**Abstract**— Concrete is one of the materials that are widely used in construction all around the world. This material is widely used because it has several benefits such as more durable, energy-efficient, low maintenance, affordability, fire-resistance, excellent thermal mass and also versatility. My research is conducted to determine the properties of concrete, compressive strength, flexural strength and tensile strength of concrete, to produce good cementitious material by using banana fiber. Agriculture waste material can help to increase the strength of concrete. The source of natural fiber are found in plant and they are readily environmental friendly and cheap. In addition, natural fiber ash has an excellent potential to improve the performance of concrete. In my study, compressive strength test was conducted to know the strength of concrete with three different temperatures. Banana trunk is cut layer by layer and burn in furnace with four different percentage compositions of banana fiber and fly ash. A total of 12 cubes with 150 mm x 150 mm x 150mm were used to determine the strength of concrete using banana fiber ash. All this specimens is cure for 7, 28 and 90 days using water curing method. 0.5% to 2% of banana fiber ash is added with fly ash 0-20% by weight. The materials use in my study is banana fiber ash, sand, cement, coarse aggregate, and water. The result analysis shows, the mix with 10% replacement of cement with fly ash achieved the maximum value of splitting tensile strength of 2.4 and 3.2 N/mm<sup>2</sup> corresponding to 28 and 90 days of curing periods respectively. It was also concluded that specimen containing 10% replacement of cement with fly ash recorded increase in compressive strength of 27 N/mm<sup>2</sup> & 29 N/mm<sup>2</sup> over the control specimen at 28 and 90 days of curing respectively. Specimens with 10% and 20% replacement of cement with fly ash achieved higher flexural strength than the plain concrete.

**Keywords:** Replacement of Cement, Flyash, Concrete

## I. INTRODUCTION

### A. General

Concrete is one of the material that are widely used in construction all around the world. It is used to build tunnels, buildings, apartments, bridges, schools, rigid roads & more. This material is widely used because it has several benefits such as more durable, energy-efficient, low maintenance, affordability, fire-resistance, excellent thermal mass and also versatility. Concrete is consists of four different type of ingredients, that are course aggregate, fine aggregate, Portland cement, and also water. But concrete has its own disadvantages due to considerable brittleness, which results in poor fracture toughness, poor resistance to crack propagation, and low impact strength. New developments continue in the application of concrete materials. There are many researchers used natural fiber as cementitious material

to increase the concrete strength. The investigation has been carried out using several natural fibers such as, bamboo, jute, banana, hemp and also rice husk. Nowadays, many studies had been done to utilize the natural waste as cementitious material replacing small amount of Ordinary Portland Cement (OPC). For example, rice husk which have reactive pozzolanic properties (Elizabeth, 2013). In my research, banana fiber ash was used as cementitious material to produced high strength concrete. Banana fiber ash has its own properties that can be found in stem itself. It has low density, appropriate stiffness, high disposability, and renewable. (Mukhopadhyay, 2008). Fibers are broadly classified into man-made and natural fibers. Man-made fibers are made from synthetic materials like steel and natural polymers while natural fibers originate from vegetable, animal and mineral sources. Presently, the use of natural fibers in composites is preferred over manmade fibers due to their numerous advantages, which include light weight, high strength to weight ratio, corrosion resistance and other advantages such as biodegradability, low cost and wide spread availability. According to Rawi&khafagy many investigations have already been carried out on various mechanical properties and physical performance of concrete materials using natural fibers from coconut husk, sisal, hemp, sugar cane biogases, bamboo, jute, wood and other vegetable fibers and these investigations showed encouraging commercial prospects of these new materials for application in low cost housing construction. It is interesting to note that natural fibers such as jute, coir, banana, sisal, etc are abundantly available in developing countries like India, Sri Lanka, and some of the African countries but are not optimally utilized. At present these fibers are used in a conventional manner for the production of yarns, ropes, mats, and matting as well as in making articles like wall hangings, table mats, handbags, and purses. Most of all plant fibers are hydrophilic in nature with a moisture content of 8.13% due to the presence of cellulose in cell structure. The most important one is lignin. The lignin content of plant fibers influences its structure, properties, and morphology. Another important characteristic of plant fiber is the degree of polymerization. Joseph et al. stated that basset fibers like flax, jute, hemp, knead, and ramie have the highest degree of polymerization approximately about 1000. With the increase of ash production, the biggest challenge for disposal ponds is to provide sufficient capacity and maintain overall stability. To accommodate the problem, many options are available, including:

- Construction of new facilities, which pose a significant cost.
- Expansion of existing facilities, which require stabilization of larger masses of fly ash
- Construction of containment spill berms, which may pose a significant cost; and

- Installation of treatment facilities and application of dry placement methods,
- Which may be expensive but allow fly ash to be placed in larger embankments?

## II. OBJECTIVES

- The general objective of this study is to investigate the compressive strength of concrete banana fiber as cementitious to produce high strength concrete with different temperature. The specific objectives of this study were:
- To measure the compressive strength of concrete using banana fiber ash as waste agriculture with various temperature.
- To measure the chemical properties of banana fiber ash burning with different temperatures as cement replacement.

## III. LITERATURE REVIEW

The purpose of this chapter is to study and analyze the previous study that has been done earlier through journals, articles, research papers and also thesis. This chapter will review more detail regarding banana fiber ash, its advantages and analyze more valuable information.

### A. Introduction to Concrete

Concrete is widely used in construction industry such as high rise building, bridge, houses, and others due to its durability. The concrete behavior is strong and durable and also produces environmental friendly structure. To obtain environmental friendly concrete, recycling by product such as fly ash is more economical (Naik, 2008)

### B. Concrete Materials

Concrete is the composite material that is compose by mixing several raw materials such as water, cement, course aggregate, fine aggregate and sometimes admixture. This raw material can be found naturally on earth and have several advantages. According to R.Srinivasan, (2010), the major material used in construction through the world is ordinary Portland cement (OPC). 80 to 90 percent of the total production comes from OPC. OPC was made up from five different raw materials.

### C. Natural Agriculture Waste

There are two processes to dispose agriculture waste materials. Usually this material was disposed into landfill or by open burning. These processes were harmful for our environment because it can lead to air pollution and global warming Girisha, C. et al.,(2012).

### D. Advantages of Natural Fibre

Natural fiber ash has its own advantages and disadvantages. The importance of this natural fiber ash is that it has low density, appropriate stiffness, high disposability, and renewable. Furthermore, this natural fiber is easy to recycle and biodegradable Samrat Mukhopadhyay, (2008).

### E. Properties of Banana Fiber Ash

According to Rodrigo C.K et al., (2014), banana fiber ash can be use to produce concrete and mortar which can be classified

to have cementitious properties. He used banana leaf as part of component material instead of using banana trunk. Almost 95 million tons of banana waste was produce since 2012

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