1. Introduction

1.1 General Introduction:

Concrete is a composite product produced by mixing cement, aggregates and water and sometimes admixture if needed, It made by composed of coarse aggregate bonded together with a fluid cement which hardens over time (Zongjin, 2011).

The word concrete comes from the Latin word “concretus” (meaning compact or condensed) derivation (Con – together) (Crete – to grow) and its history can be charted from 5000 BC (The Roman Pantheon, 2013).

Fames concrete structures such as Hoover dam, the Panama Canal and the roman pantheon. The earliest large scale user of concrete technology were the ancient roman, and concrete is widely used in the roman empire (Moore and Davi, 1999). Today concrete is the most widely used man made material measured by tonnage (The Roman Pantheon, 2013).

Figure (1): Roman pantheon dome and opus caementicium and smeaton tower (The Roman Pantheon, 2013).

Concrete is a very important construction material, impacting heavily on gross domestic products of many nations: a $30 billion business for ready- mix concrete production industry per year in the United States. It is therefore imperative that this important material in the world construction industry must also be endued with the best possible properties. Concrete has occupied an important place among construction materials and is widely used in all types of engineering structures ranging from a small building to heavy structures, ever since concrete has been accepted as a material.

Engineers have been trying to improve its quality, strength, durability, etc, against adverse conditions. The aim of the engineers is to make the concrete not only everlasting but also an economical material of construction in comparison to other material as such as steel as timber.

Concrete is a brittle material which is strong in compression but very weak in tension. This weakness in the concrete makes it to crack under small loads, at the tensile end. These cracks gradually propagate to the compression end of the member and finally, the member breaks.

Cracking of concrete is perhaps its major disadvantage which results mainly from its low tensile strength and low tensile strain capacity, where concrete is considered as a brittle material and locks ductility. In general, concrete cracks when there are tensile stresses exceeding in magnitude its tensile strength.

Deterioration of concrete structures due to steel corrosion is a matter of considerable concern since the repairing of these structures proved to be a costly process. Repair and rehabilitation of the civil structures needs an enduring repair material. The ideal durable repair material should have low shrinkage, good thermal expansion, substantial modulus of elasticity, high tensile strength, improved fatigue and impact resistance. Reinforcing the concrete structures with fibers such as polypropylene is one of the possible ways to provide all the criteria of the durable repair material. This type of reinforcement is called Fiber Reinforcement of Concrete Structures. There is an increasing worldwide interest in utilizing fiber reinforced concrete structures for civil infrastructure applications. In the recent years, there is great development in the area of admixtures and now a day, the Fiber admixtures like propylene fiber, used to enhance performance characteristics of concrete by reducing crack. It is need of time to design and construct the structures which will have greater durability and strength and which have led to develop concept of high performance concrete. The major intension in developing high performance concrete is to have adequate resistance to aggressive environments and to make the structure impermeable.

The concept of using fibers to improve the characteristics of construction materials is very old. Early applications include addition of straw to mud bricks, horse hair to reinforce plaster and asbestos to reinforce pottery. Use of continuous reinforcement in concrete (reinforced concrete) increases strength and ductility, but requires careful placement and labor skill. Alternatively, introduction of fibers in discrete form in plain or reinforced concrete may provide a better solution. The modern development of fiber reinforced concrete (FRC) started in the early sixties (Ramualdi and Batson, 1983).

Fiber reinforced concrete (FRC) is Portland cement concrete reinforced with more or less randomly distributed fibers. In FRC, thousands of small fibers are dispersed and distributed randomly in the concrete during mixing, and thus improve concrete properties in all directions. FRC is cement- based composite material that has been developed in recent years. It has been successfully used in construction with its excellent flexural-tensile strength, resistance to spitting, impact resistance and excellent permeability and frost resistance. It is an effective way to increase toughness, shock resistance and resistance to plastic shrinkage cracking of the mortar. Fiber is a small piece of reinforcing material possessing certain characteristics properties. They can be circular, triangular or flat in cross-section. The fire is often described by a convenient parameter called ―aspect ratio‖. The aspect ratio of the fiber is the ratio of its length to its diameter.

The principle reason for incorporating fibers into a cement matrix is to increase the toughness and tensile strength and improve the cracking deformation characteristics of the resultant composite. For FRC to be a viable construction material, it must be able to compete economically with existing reinforcing system (Amit, 2013).

Fiber reinforced concrete (FRC) is concrete made primarily of hydraulic cements, aggregates, and discrete reinforcing fibers. Fibers suitable for reinforcing concrete have been produced from steel, glass, and organic polymers (synthetic fibers) (James *et al.,* 2002).

Addition of fibers to concrete makes it a homogeneous and isotropic material. When concrete cracks, the randomly oriented fibers start functioning, arrest crack formation and propagation, and thus improve strength and ductility. The failure modes of FRC are either bond failure between fiber and matrix or material failure (Faisal, 1990).

Fiber is discrete material having some characteristic properties. The fiber material can be anything. But not all will be effective and economical. Some fibers that are most commonly used are:

- Steel Fibers:

  Straight, crimped, twisted, hooked, ringed, and paddled ends. Diameter range from 0.25 to 0.76mm.

- Glass Fibers:

  Straight diameter ranges from 0.005 to 0.015mm (may be bonded together to form elements with diameters of 0.13 to 1.3mm).

- Natural Organic and Mineral Fibers:

  Wood, asbestos, cotton, bamboo, and rockwool. They come in wide range of sizes.

- Polypropylene Fibers and other Synthetic Fiber:

  Plain, twisted, fibrillated, and with buttoned ends.

  Kevlar, nylon, and polyester. Diameter ranges from 0.02 to 0.38mm (Faisal, 1990).

Synthetic fibers are man-made fibers resulting from research and development in the petrochemical and textile industries. SNFRC utilizes fibers derived from organic polymers which are available in a variety of formulations. Fiber types that have been tried in portland cement concrete based matrices are: acrylic, aramid, carbon, nylon, polyester, polyethylene and polypropylene (James *et al*., 2002).

Polypropylene (PP) is athermo plastic polymer used in a wide variety of applications such as textiles (rope and carpets), packaging, labelling, stationary, containers, automotive parts and banknotes. Polypropylene fiber derive from synthetic hydrocarbon polymer through extrusion processes of hot drawing the material through a die. In the production process and based on the properties required, copolymerization among the monomers is necessary for the desired properties to be achieved (Sabu and Visakh, 2011). It is adopted because of its tensile and flexural strength capability of arresting plastic shrinkage cracks. It has been established that the addition of randomly distributed polypropylene fibers to brittle cement based materials can increase their fracture toughness, ductility and impact resistance (Saeed *et al.,* 2006).

Figure (2): Polypropylene fiber.

Only a few of the possible hundreds of fiber types have been found suitable for commercial applications. This research deals specifically with the concrete reinforced with the 'polypropylene fibers' in this research, several experiments on concrete using propylene Fiber have been conducted aiming to reduce the concrete problems at its fresh and hardened stages.

1.2 Problem definition and scope of research

- Worldwide, concrete is a very important construction material. It is therefore imperative that this material that is so important in the world construction industry must also be endued with the best possible properties. The employment of fibers in the concrete will improve the strength and compensate for the apparently declining strength of reinforced concrete building constructions

- The use of PpFRC in the local construction industry is limited. The purpose of this work is to develop evidence of the engineering properties of PPFRC in which indigenous polypropylene fibers are used. This includes the properties of PPFRC such as workability in fresh state, free shrinkage and other mechanical properties in hardened state.

- The scope of this research covers the study of available literature about the application of Propylene Fiber in production of concrete, especially in developing countries with similar environmental conditions like Sudan.

This research therefore studies the effects of micro synthetic polypropylene fiber in improving concrete strength. The results of this work will be useful for the local construction industry and could be used for developing specification guidelines for the use of PPPFC in Sudan construction.

1.3 Research Questions and Hypothesis :

After were read about Polypropylene Fiber , we obtain that we have many questions , manly , if we add Polypropylene Fiber to local concrete grade 25 N/mm^2, Then can be obtain concrete with :

- Good performance .
- Increases both Compressive and Flexure strength.
- Enhanced the Failure mode .

and above properties or not ?

Also we hypothesis that , if the adding of Polypropylene Fiber to concrete and make it hard to handling or it become very less in workability , in then we will use super plasticizer .

1.4 Research objectives:

1.4.1 General objectives:

The main objective of this research is to study the possibility of using PPFRC in the Sudanese construction industry, namely; in producing structural and nonstructural concretes. To achieve this main objective the research has to go through different stages, within each stage there is specific objective would be achieved.

1.4.2 Specific objectives:

1. To study the concrete admixtures in general and FRC in particular specially PpFRC on the properties of both fresh and hardened concrete.
2. To explore the properties of polypropylene fibers in specific environments to which the commercial FRCs are exposed.
3. To increase resistance of cracking, without changing the mix composition.
4. To develop concrete early age strength.
5. To increase strength and improve durability.
6. To select optimum ratio of propylene to produce concrete suitable for structural purposes.

1.5 Research methodology

Stage (1): Consulting References (books, papers, thesis, Research reports, ASTM standard British standard and ACI reports).

Stage (2): Laboratory testing as follows:

- Testing of raw material (fine, coarse aggregate and cement) which include the following tests: sieve analysis, specific gravity consistency, initial setting time, final setting time …etc.
- Mix design of grade of concrete (25 MPa).
- Addition of four percentages of PP (0.0, 0.10, 0.15 , 0.20 , 0.25 and 0.30 % of cement content of each grade of concrete.
- Testing of fresh and hardened concrete which include: slump test, compressive strength, flexural strength.

Stage (3): analysis of test results, compression and discussion of results.

Stage (4): Writing and preparation of thesis.

1.6 Research organization

This research contains five chapters:

Chapter one: General introduction, research problem, and objectives…etc

Chapter two: Literature review.

Chapter three: Experimental program of Low volume PpFRC

Chapter four: presentation of Results and discussions.

Chapter five: Conclusion and recommendations.

References.

Appendices.