CHAPTER TWO

LITERATURE REVIEW

2.1 Historical Background

The earliest known published reference to the use of small amounts of organic material to increase the fluidity of cement containing composition was made in 1932 .where polymerized naphthalene formaldehyde sulphonate salts were claimed as useful in this role. This was followed during the mids 1930s to early 1940s by numerous disclosures regarding the use of lignosulphonate and improved composition. In recent years, construction agencies in North America, Great Britain and other countries have evinced great interest in the use of superplasticizers, superfluidifiers, siper water reducers or high range water reducers.

The superplastisizers (SP) are referred to as high range water reducing admixture by ASTMC494, which mainly disperses the water in concrete matrix. This property is some time called as dispersion-fluidification property of concrete admixture. The superplasticizers are classified in the following four major groups;

- Sulphonated Nephthalene Formaldehyde Condense (SNF).
- Sulphonated Melamine Formaldehyde Condense (SMF).
- Modified Lignosulphonates (MLS).
- Others.

Today superplasticizers are used in all important projects across the world in high rise buildings, prestressed concrete, slender components with congested and densely packed reinforcement, beams and slabs pre-cast elements and long slender columns.

The superplasticizer affects the various properties of concrete both in fresh and hardened.

- Reduction in interfacial tension.
- Multilayered adsorption of Organic molecule.
- Release of water trapped amongst the cement particles.
- Retarding effect of cement hydration.
- Change in morphology of hydrated cement.

The workability of concrete is mainly governed by the max size, shape, texture and grading of the aggregates. For a given value of water cement ratio, there is one value of coarse/fine ratio for given material that gives the highest workability .developed a miniature slump test for the cement paste which requires small amount of paste and less testing time. The high workability of SP concrete is however lost in the early 30 minutes due to formation of hydrates.

The compressive strengths of SP concrete are usually higher than the corresponding strengths of the reference mixes. When SP is used, a water reducer up to 32-33% can be achieve this fact leads to the increase in the compressive strength of SP concrete. Most recently new generations of SP have been developed to give ultra high strength concrete producing concrete with compressive strength of 15000 psi and more and very high early strength at 2 to 4 hours.

In water reduced SP concrete no undue segregation and bleeding of concrete occurs due to decrease in water cement ratio. If there are sufficient fine aggregates in the concrete, the segregation in high workability SP concrete can also be controlled ,There are three possible ways in which superplasticized concrete can be produced High workability concrete, Concrete with low water/ cement ratio, Concrete with reduced cement content. [3]

2.2 Effects of Superplasticizers on Properties of Concrete:

Demonstrated the effect of superplasticizers on workability and strength of concrete.One control mix was prepared using ordinary Portland cement Type-1,

Fine aggregates confirming to the gradation of ASTM-136, and Lime crushed stone of size1/2 in coarse aggregates.

To investigate the effect of SP on workability, slump tests were carried out for concrete mixes of ages 3, 7, and 28 days. The effect of SP on compressive strength of concrete was investigated by preparing and testing concrete cubes [6 cm*6cm*6 cm] at ages of 3,7,28 days.

To check the effect of water reduction on SP added to concrete, the water content was gradually increased, at a constant workability, keeping all other ingredients of the mix as constants. Increasing the dosages of the SP was used to compensate for the lost in workability. Workability was kept constant by the method of successive trials;

In the last trial, workability was kept constant both; cement content and water content were reduced keeping water/cement ratio and workability as constant. The results have shown that slump increased with increasing SP but with some exceptions for some ratios. On the other hand, the compressive strength increased with increase of SP ratios except when adding 0.8 % of SP-as largest value of this study- the compressive strength decreased.

From the results obtained, it can be concluded that the properties of concrete in fresh and hardened stages have been improved with the addition of both types of superplasticizer for all nominal mixes of concrete. [3]

Studied the Effect of Superplasticizer (Polycarboxylic Ether) on the Compressive Strength of Concrete using different water cement ratios. The superplasticizer was used as an admixture added to the concrete at ratios of 0%, 2%, 2.5% and 3.5% by weight of cement and varying water cement ratios of 0.4, 0.45, 0.50 and 0.55. Sixty-four (64) concrete cubes were cast and cured for 7, 14, 21 and 28 days respectively. At the end of each hydration period, the cubes were crushed and their compressive strength was determined. The compressive strength of 0- 3.5% level

of superplasticizer at water cement ratio of 0.4 – 0.55 ranged from 11.38 – 18.04N/mm^2 at 7days curing, while the compressive strength at the same percentage level of superplasticizer and water-cement ratio at 14 days curing ranged from 12.78–18.80N/mm^2. The compressive strength of 0-3.5% level of superplasticizer at water cement ratio of 0.4 – 0.55 ranged from 14.00 – 21.90N/mm^2 and 15.00 – 23.10N/mm^2 for 21 and 28 days curing respectively. The slump test of 0-3.5% level of superplasticizer at 0.4 – 0.55 water-cement ratio ranged from 10-90mm. [4]

Presented a research paper on the Effects of Superplasticizing Admixture on Properties of Concrete. The objectives of this study were to determine the optimum dosage of concrete superplasticizer for normal concrete, and to investigate the effect of superplasticizer on properties of concrete focusing on characteristic strength of 30 N/mm^2 at 28 days. One control mix was prepared using ordinary Portland cement, 20 mm granite coarse aggregate, and sea sand. In addition, four mixes were prepared using different ratios of admixture dosage. The result obtained showed that the slump increase with increasing admixture dosage, and over dosage of these admixtures lead to high slump loss. Whereas the compressive strength was observed to increase with increase of superplasticizer dosages to certain limit beyond which the compressive strength reduces with increasing the dosage. Finally, the paper concluded that superplasticizer has significant effect on both properties of fresh and hardened concrete. [5]

Presented a research paper on the Effects of Superplasticizing and Retarding Admixtures on Properties of Concrete. The objectives of this study were to determine the optimum dosage of concrete retarder and superplasticizer for normal concrete and to investigate the effect of superplasticizer and retarders on properties of concrete. This study focused on normal strength concrete with characteristic strength of 30 MPa at 28 days of age, which used Ordinary Portland Cement

(OPC) as binder, 20 mm granite coarse aggregate and sea sand.In addition, four mixes were prepared using different ratios of admixture dosage. The results obtained showed that slump loss was reduced by using the chemical admixtures. workability of concrete was increased by adding superplasticizer and retarder. However, very high dosages of both admixtures tends to impair the cohesiveness of concrete.Compressive strength was improved by SP for all ages. On the other hand, retarder resulted in lower compressive strengths compared with control mix at early ages, even its ultimate strength was higher than the desired characteristic strength.

The paper concluded that superplasticizer and retarder had significant effects on both properties of fresh and hardened concrete. [6]

Demonstrated the effect of Re-Dosing Superplasticizer to Regain Slump on Concrete aiming to determine the variation of contribution of superplasticizer and also its effect due to re-dosing to the compressive strength of concrete was investigated in the study. One control mix was prepared using Ordinary Portland cement. M-sand of fineness modulus 2.96 and crushed stone passing through a 20mm sieve. The results obtained showed that:

- In stipulated elapsed time, the slump loss was less for those mixes having a higher initial dose of superplasticizer.
- The properties of hardened concrete such as compressive strength of superplasticized concrete was found to be higher than those of control mix for that superplasticizers improved the strength of concrete by improving the workability of concrete leading to denser and less porous structure.
- Large increase in slump of superplasticized concrete was maintained for several hours by the addition of second and third dosage. [7]

Studied the Effect of Superplasticizer on Fresh and Hardened Properties of Self-Compacting Concrete Containing Fly Ash. The objective of this study was to

evaluate the performance of self-compacting concrete containing 10% percent cement replacement with fly ash, in addition to varying dose of superplasticizer. The materials used for study were cement, fly ash, superplasticizer, fine and coarse aggregates.

The results obtained showed that from the slump and compaction factor tests, it was observed that concrete containing fly ash and superplasticizer yields good workable and marginally accelerate and increase the compressive strength of self-compacting concrete. [8]