Effect of Admixture on Properties of Concrete

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Abstract - *This research indicates the Effect of Admixture on Properties of Concrete. Concrete is a man or a machine-made construction material that has more usage in the construction field, it is necessary to make construction secure and safe for making high strength concrete the admixture Silica fume is a good choice to make the compressive strength of concrete very high but for having a high strength concrete. Chemical Admixtures interact with hydrated cementitious materials and are divided into three categories of Admixtures with physical, chemical, and physical-chemical performance. Admixtures with a physical function are chemical Admixtures that do not have a direct effect on the cement dewatering reaction process, although they may affect its process and rate. These Admixtures generally show their effect and function before the initial setting of concrete and their effect does not continue after setting in hardened and hardened concrete. These Admixtures include water reducers, aerobes, gas generators, foaming agents, aerators, anti-scouring agents, pumping facilitators, colorants, and bonding agents. Admixtures with chemical function either affect the process and reaction process of pre-setting cement dewatering or alter the microstructure of dewatering products before and after setting. Therefore, in addition to the pre-set time, the reaction of chemical Admixtures may continue in the hardest stages of concrete. Reinforced concrete is brittle and has less tensile strength. In order to reduce the weakness of fragility, thin and short filaments that are randomly distributed in all directions in concrete are a very suitable method (these thin filaments are called fibers). The main reason for using fibers in concrete is to increase the hardness and tensile strength, improve crack control and deformation.*

Key Words: Admixture, Concrete, Silica Fume (SF), Fly Ash (FA), Grade 43 Portland cement (PC)

1. INTRODUCTION

The production of cement, the main adhesive in concrete, was started in England in 1756 by John Smeaton, who was responsible for building the foundation of the Eddystone tower, and finally Portland cement in 1824 on the same island. The name was registered in the UK by Joseph Aspdin. The people of our country also became acquainted with the consumption of cement since 1312 with the construction of the Ray Cement Factory, and with the development of the country's industries, today about 26 to 30 million tons of cement are produced per year. With the knowledge of engineers on how to use cement in civil works, this material found its place in our country. One of the fastest-growing methods of construction in the world today is concrete buildings. After the Islamic Revolution, due to the lack of beams as a result of sanctions and the expansion of construction in the country, the use of concrete grew greatly. In addition, concrete buildings have advantages over steel buildings, such as greater resistance to fire and atmospheric factors (corrosion), ease of preparation of concrete due to the abundance of concrete materials, and insulation against heat and sound, which is the development of the day. In addition, it provides this type of building. One of the important disadvantages of concrete buildings is the very high weight of the building, which is directly related to the amount of earthquake damage to the building. If we can make the separating blades and panels of lightweight concrete, the weight of the building and as a result, the destruction of the building by the earthquake will be greatly reduced. However, the low strength of lightweight concrete has been an important factor in limiting the scope of application of this type of concrete and taking advantage of it.

2. METHODOLOGY

The use of micro silica in the manufacture of lightweight concrete has increased the strength of lightweight concrete and reduced this limitation. In this research, while explaining concrete and the effect of water on concrete strength, more about light concrete and methods of increasing its strength using micro silica, mechanical properties, and also its applications are discussed. At first, it may be thought that the main building material is a viscous material resulting from the hydration of cement and water and that aggregates are cheap and filler materials of this adhesive. The second possibility is that coarse aggregates are considered as masonry joined by mortar and this mortar is cement slurry and fine aggregates. The third possibility is that concrete is considered as a material of two different phases, namely hydrated cement and stone grains. Therefore, the properties of concrete depend on the properties of each of the phases and the interface between the two phases. Each of the second and third theories has limitations and can be used to express the behavior of concrete. But in the first theory, these issues do not exist.

If it is thought that cement can be produced cheaper than aggregates, the question arises whether cement and water can be used alone as a building material (concrete)? The answer will definitely be no, due to the high-volume changes in the cement paste. The shrinkage of pure cement paste is approximately 10 times that of concrete with 250 kg of cement per cubic meter. The same is true for creep and drop. In addition, the high heat generated by consuming large amounts of cement, especially in hot climates, will cause cracks. It also makes aggregates more resistant to chemical attack than cement paste, although the cement paste is also relatively stable in these corrosive environments. Therefore, regardless of the price of stone materials in concrete will be very useful.

3. CONCRETE COMPONENTS AND THEIR PROPERTIES

- Cement: makes up about 7 to 15% of the volume of concrete
- Water: makes up about 14 to 21 percent of the concrete volume
- Rock aggregates (sand): make up about 60 to 75% of the concrete volume
- Air: In airless concrete, the amount of air volume is between 0.5 to 30% and in aerated concrete, the amount of air volume is between 4 to 8%.
- Admixtures: These are chemicals that are added to the mixture in small amounts and as a percentage of the weight of cement to create the desired properties in concrete.

4. THE ROLE OF CEMENT IN CONCRETE

Any adhesive is called cement. However, the adhesive of stone materials in concrete is called cement, whose role is simply to stick the grains together and alone does not affect the strength and load-bearing capacity.

Table -1: Cement components

63%	Cao
20%	Sio
6%	3o2Al
3%	3o2Fe
1.5%	Mgo

5.CHEMICAL IN CEMENT

Tricalcium silicate: (3Cao-Sio2) abbreviated (C3S), Calcium silicate: (2Cao-Sio2) abbreviated (C2S), Tricalcium aluminate: 3Cao-Al2o3) with the abbreviation (C3A), Aluminophyte tetra calcium: (4Cao-Al2o3-Fe2o3) abbreviated (C4AF)

6. TYPES OF STANDARD CEMENT (PORLAND)

- Type I cement, ordinary cement, this type of cement is used in normal weather conditions and where there is no form in terms of sulfate (Uses: All concrete works such as street tables - mortars - coatings and .....
- Type II cement, medium cement, this type of cement is partially retardant and also partially resistant to the attack of sulfates. Uses: (For concreting in hot environments and bulk concreting and ...
- Type III quick-setting cement this, type of cement has the basic components of type I cement, but is finely ground and therefore has a faster setting. Uses: Manufacture of precast concrete parts, use in cold weather, in workshops that use slippery molds.
- Type IV cement, quick setting cement, this type of cement is a retarder and has less C3s and C3A and has more C2S. Uses: In bulk concreting, in hot environment temperature above 40 degrees, concreting in successive layers Note: Consumption of this cement in hot weather prevents cold connection.
- Type five cement, anti-sulfate cement, this type of cement is suitable for use in concreting that is exposed to sulfate attack.

If we can make the separating blades and panels from lightweight concrete, the weight of the building and as a result the destruction of the building by the earthquake will be greatly reduced. However, the low strength of lightweight concrete has been an important factor in limiting the scope of application of this type of concrete and taking advantage of it.

7. USE OF WATER IN CONCRETE

The place of water use in concrete is very sensitive in terms of hydration. Lack of proper use of water will lead to the following problems:

- Cement setting time is delayed, concrete is delayed
- Decreases the final strength of concrete (sometimes reduces the strength by up to 30%)
- Causes corrosion and gradual deterioration of rebars.
- On the surface of the final dried concrete, it creates stains that are especially important in concretes whose surface is placed in the façade.

8. CHARACTERISTICS OF WATER CONSUMPTION IN CONCRETE

- Not acidic and alkaline (PH between 6 to 8).

- The percentage of carbonates is less than 0.1%.

- The percentage of solids (suspended particles) in it is less than 0.1%.

- The percentage of chlorides should be less than 0.05%.

- The percentage of sulfates should be less than 0.1%.

- The sum of calcium and magnesium carbonate in water used in concrete is not considered harmful if it is up to 0.4%.

- The total salts of manganese, tin, zinc, lead should not be more than 0.5%.

- Iron salts in concrete water do not affect the strength of concrete up to 4%.

- One of the most unsuitable water impurities in concrete is sodium sulfide, which has a maximum vapor content of 1%.

- The use of seawater due to the presence of salts of chlorides, sulfates, etc., which reduces the strength by up to 15%, and on the other hand, the chlorine in seawater causes corrosion of rebars over time and its use in reinforced concrete is not allowed. .

- Stone grains (sand)

9. PROPERTIES OF SAND USED IN CONCRETE

1- The seeds should be completely clean and free of mud and chemical impurities.

2- The grains must be resistant to abrasion and stress.

Note: Silica aggregates have a hardness of 7 to 8 and are the most resistant aggregates used in concrete. Limestone grains have a hardness of 3 to 4 which are used in making concrete.

3. The seeds must be resistant to frost, which depends on the following 3 factors.

A- Porosity: The higher the porosity of the grains, the lower the resistance to frost.

B. Impermeability: The higher the grain permeability, the lower the frost resistance.

C- Tensile strength: The higher the tensile strength, the greater the resistance to frost.

4. The seeds must be resistant to weathering.

In terms of final strength of concrete, concrete that is made with angled grains will be more durable due to the possibility of better aggregation of grains with each other and the friction of the best of them. It is recommended to use this type of grain in cases where very high resistance is desired (above 350 to 400 Kg / cm2), but in normal work where less resistance is the criterion, round and irregular grains can be used.

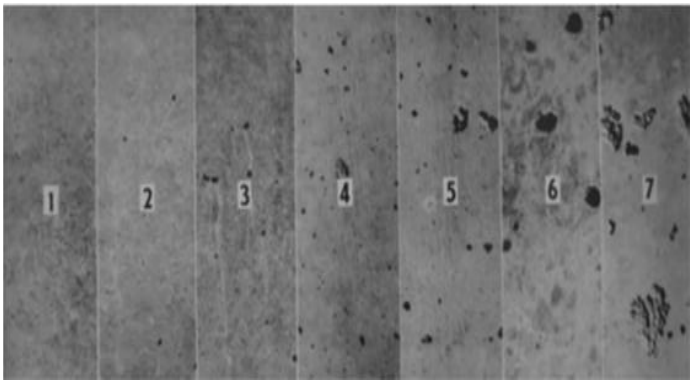

Figure 1. Deferent type of Concrete

10. PROPERTIES OF CONCRETE

- Concrete is mainly composed of two parts

- Stone materials: About 60 to 75% of the concrete volume consists of stone materials.

- Cement paste: About 25 to 40 percent of the concrete volume is filled with cement paste. From 25 to 40 percent of cement paste is 17 to 15 percent cement and 14 to 21 percent water.

- Water content in cement paste (W / C)

- W represents water and C represents the weight of cement, so that a low W / C ratio can be selected.

- This rate is about 0.4 to 0.6 percent.

- Characteristics of using less water to cement ratio

- Increase the compressive and tensile strength of concrete.

- Increase the sealing property in concrete.

- Reduced water absorption.

- Better bonding between cardboard layers in concreting.

- Increased adhesion between rebar and concrete.

- Increased resistance to adverse weather conditions.

- Reduce drop rate, creep rate and reduce the possibility of water dropping concrete.

- Reduce the possibility of grain separation.
- Concrete performance (slump)

Figure 2. Concrete Slump

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11. PROBLEM THAT MAY OCCUR IN FRESH CONCRETE

1- Watering:

It seems that after concreting and polishing the concrete surface, a thin layer of water impregnated with cement appears on the concrete surface. The most important reason is excessive slump. Another reason, such as excessive vibration and inadequate granulation, increase the likelihood of concrete melting.

2- Separation of seeds:

The most important reason for grain separation is high and excessive slump. Other reasons such as excessive vibration, moving the concrete in the form with a shovel or vibrator, pouring concrete from a height, improper storage of grains, and lack of uniform and correct granulation in concrete, lead to separation of grains and concrete from the compressive and flexural strength will be weak and will not reach the desired level.

12. FACTORS AFFECTING CONCRETE STRENGTH

Grain quality: Concrete made of silica grains has a higher strength than concrete made of limestone. Grain content: The more grains are used in concrete, the stronger and more durable the concrete. Amount of cement: The higher the amount of cement, the higher the strength of concrete. Water to cement ratio (W / C): The lower this ratio (about 3.4 to 0.4), the higher the strength of the concrete made. Concrete life: 7-day strength in ordinary concrete is 70% 28-day strength, 28-day strength of concrete, which is about 90 to 95% of the final strength.

Note: The useful life of concrete buildings is usually in the range of 50 to 100 years. Concrete differentiation in terms of density (specific gravity).

1.1. Deferent Types of Concrete added Admixtures

1.2. Ordinary concrete

Concretes that are made with ordinary cements of type (I) to type (V) have a specific weight of 2200 to 2500 kg per cubic meter, which is due to the difference in grain material and concrete density.

1.3. Light weight Concrete

It is concrete whose specific weight is 1.2 to 1.3 times the specific weight of ordinary concrete, which is made of natural or broken aggregates. The specific weight of this type of concrete is approximately 800 Kg / m3, which is used for facades, partition walls, roofs and basically where there is no resistance. Classification of lightweight concrete according to their type of application.

A- Lightweight structural concretes:

This type of concrete has a specific mass between 1400 to 1900 kg / m3 and its minimum compressive strength is equal to 17 N / mm2. Aggregates that are used according to ASTM-C330 standard for lightweight structural concrete are: (1 - Shale, clay and slate 2- Roasting process 3- Expandable slags 1.**4.- Pumice (mineral and industrial)**

1.5. The main advantages of this type of concrete:

- Reduce the cost of heating or cooling.
- Reduce sound transmission between floors and building space.
- Meanwhile, non-structural lightweight concretes are divided into two groups based on their building composition.

A- Foam concrete: during their construction by creating foam, air bubbles in the cement paste or in the cement mortar, aggregates are created. Specific mass (Kg / m3).

B- Concrete with light grains: which are made using perlite or vermiculite or expandable polyester fibers. The specific gravity of this mixture (Kg / m3 960 to 240).

1.6.- Roasted fly ash)

B- Semi-structural lightweight concrete:

This type of concrete has a compressive strength between 7 to 17 Newtons per square millimeter and their specific gravity is 800 to 1200 Kg / m3. Semi-structural concretes are made with aggregates such as perlite, polystyrene fibers and foam floors.

C- Non-structural light concrete:

This concrete is used for filling and thermal insulation purposes and light separators (separating blades and sound insulation in the floor). It has a specific gravity of less than 3800 Kg / m and despite its low specific gravity, its compressive strength can be up to 7 N / m2.

1.7. Heavy concrete

In making this type of concrete, instead of sand, steel chips, cast iron or barium sulfate are used. This concrete is used to prevent X-ray, Y-radiation, etc., and is mainly used for structures related to nuclear facilities or wherever radioactive radiation is possible. The specific gravity of heavy concrete is about 1.5 to 2.5 times the equivalent of the specific gravity of ordinary concrete (6400 Kg / m3).

1.8. Pre-stressed concrete

This type of concrete was founded using high-strength steel as well as good quality concrete. Woven concrete applications can be used in the construction of bridges and offshore structures (such as ports, offshore terminals, fixed and floating oil docks) and, most importantly, nuclear power plants. Lack of cracks in structures made of pre-stressed concrete prevents water and moisture from easily penetrating into it and causing corrosion and rust by reaching the steel.

1.9. Fiber concrete

Reinforced concrete is brittle and has less tensile strength. In order to reduce the weakness of fragility, thin and short filaments that are randomly distributed in all directions in concrete are a very suitable method (these thin filaments are called fibers). The main reason for using fibers in concrete is to increase the hardness and tensile strength, improve crack control and deformation.

Applications of fiber concrete:

- Remote control of highways - roads and airports.
- Bridges and docks.
- On the surface of refractory walls of furnaces (petrochemical industries, steel, cement factories).
- Floors of factories, bus stops, gas stations and industrial halls.
- Explosion-proof structures.
- Parts related to tunneling and mine drilling.
- Protective walls, shelters and hangars.

1.10. Sulfur concrete

Today, this type of concrete, which has many advantages such as resistance to acids and corrosive substances, the ability to melt and reuse, has good flexural and compressive strength, has been considered the use of sulfur concrete in areas where there is a high risk of corrosion Recommended. Sulfur concrete is made by hot mixing of sulfur and mineral aggregates (like the asphalt production method) and is a thermoplastic material (free of water and cement). The best weight ratio for preparing sulfur concrete is 20% sulfur, 32% fine-grained, 48% coarse-grained and 5% silica powder.

Figure 3. Types of concrete

1.11. Polymer concrete

Polymers are used to produce three types of concrete:

A - Concrete with injection polymer (PIC):

It has compressive, tensile and impact resistances as well as a very high modulus of elasticity and is more resistant to freezing, thawing and abrasion by chemical attacks.

B- Polymer concrete (PC)

Methacrylate and styrene methyl monomers and epoxy resins are used to make this type of concrete.

C. Portland Cement Polymer Concrete (PPCC)

Made by adding a polymer or monomer to fresh concrete, rubber, acrylic and acetate vinyl are examples of materials used with an anti-foaming agent.

1.12. Shotcrete Concrete

This type of concrete is used for repairing existing structures as well as works that do not require formwork or complex shapes with low thickness. It is generally used for the inner lining of tunnels, tanks and prestressed concrete tanks, and other uses for stabilizing sloping rock cliffs, covering steel plates to create a fire shield.

1.13. Self-compaction concrete

Liquid concrete that is compacted under its own weight and has extremely high performance and can be used in sections with high reinforcement without the use of vibrators is called self-compacting concrete (s.c.c). This concrete, in addition to having high performance, non-separation of particles forming concrete in the fresh state, has low permeability, high durability and high strength in the hardened state. Its applications, especially in the production of ready-mixed concrete and prefabricated parts, have been considered by the construction industry.

1.14. Rolled concrete (RCC)

It is concrete that is compacted by the movement of the roller when the concrete is not yet hardened. The slip of this type of concrete is zero so that it can withstand the weight of the compacting roller.

Benefits and applications

- In the construction of roads, freeways, runways and hangars, floors of warehouses, industrial roads, mines, stadiums, racetracks, ports and docks, etc.
- Withstand heavy traffic load, especially on slopes
- Stiffness and no deformation against the loads and shocks caused by the fall of hard objects
- Long-term durability compared to bitumen asphalt in the tropics
- Early operation
- Long-term durability of the concrete surface in areas with freezing and cold cycles of garlic
- Save fuel consumption and remove contaminants during cooking and transporting asphalt
- Resistant to spills of petroleum products, hydrocarbons and acids.

1.15. High performance concrete (HPC)

This type of concrete, which is called (super concrete) has one of the following strength properties:Its 4-hour compressive strength must be equal to or greater than 175 Kg / cm2 (initial early resistance). Its compressive strength after 24 hours should be equal to or greater than 2350 Kg / cm (initial strength of concrete). The 28-day compressive strength must be equal to or greater than 700 Kg / cm2The ratio of water to cement is less than 35%.

2. Concrete Admixtures

It should be noted that concreting in the air has its own problems and difficulties. One of these problems in cold weather is the problem of concrete freezing, in which the water in the concrete freezes and prevents hydration operations. In general, it should be noted that low temperatures cause hydration to occur at a slower rate. In this way, the whole process of concreting and obtaining concrete strength faces many problems. The result can be a reduction in the durability and strength of the concrete, which makes the structure unsuitable for the use of what it is designed for. In the long run, cracks may appear in the concrete or the concrete may form in the form of laminates, which are not structural engineers at all. To solve this problem, various ideas have been proposed, the most important of which is the use of antifreeze. Antifreezes make hydration work well and also in cold weather can reach a suitable and desirable concrete so as not to reduce the strength of the structure and can be used easily and without any problems from the existing structure. For a full explanation, I must say that another name for shotcrete is spray concrete, and as its name implies, this concrete is sprayed on the desired surface. It should be noted that this type of concrete is used to repair existing structures as well as work that does not require formwork or complex shapes with low thickness.

It is commonly used for the inner lining of tunnels, tanks and prestressed concrete tanks, and other uses for stabilizing sloping rock cliffs include covering steel plates to create fire shields. You may be wondering what the purpose of shotcrete is and what can be done with ordinary concrete! It should be noted that the purpose of making shotcrete is to make our final product have high strength and very low permeability. One of the main characteristics of concrete that is always mentioned is its high ductility (although you may not have imagined that concrete is so flexible, of course, this is before the concrete hardens) and in fact shotcrete is one of the best uses. Our properties are unique to concrete. To answer this question, it must be stated in which structure concrete is used. In buildings, in all structural elements of the structure, such as beams and beams, structural foundations and shear walls, etc., the use of rebars or reinforcement is mandatory because rebars against the behavior of concrete structures against Improves lateral loads and gravity loads. As you know, concrete has a very weak action against tensile, so the use of rebar in the tensile areas of the structure is a basic requirement, and in addition, according to the structural designer, the use of concrete in the compressive parts of the structure also causes the performance of the structure will improve. Rebars are an integral part of concrete structures, it should be noted that in some cases concrete will not need reinforcement. Like when we use concrete except for leveling under the foundation. As a result, the use of reinforced concrete, ie concrete with reinforcement, is mandatory in all parts of buildings. Yes, it can be done, but it must be said that the opinion of the executor is very important and you cannot add any amount of water to the concrete. Water should be mixed with cement in a certain amount and should not be more or less than the allowable limit, which is called the ratio of water to cement. If more or less water is added to the concrete, it will change the strength (decrease in strength) of the concrete and the concrete will become too fluid, which will lose its structural and load-bearing performance, therefore the ratio Water to cement is very important and must be observed. If we want the concrete to be smoother, we should not use water and instead it is better to use concrete Admixtures. Addition of materials other than Portland cement, aggregates, and water, in the form of powder (round) or liquid (watery), as one of the constituents of concrete and to improve the properties of concrete, shortly before mixing, during mixing or before it is added from pouring. In other words, Admixtures are components of concrete other than hydraulic cement, water, aggregates and fibers that are added to concrete to improve the properties of fresh and hardened concrete and mortar. Concrete admixtures are divided into two groups: chemical and mineral Admixtures. Chemical Admixtures are obtained by processing, mixing, or blending organic and inorganic materials in a chemical process and in powder or liquid forms and in small amounts, usually up to 5% by weight of cementitious material at the time of fabrication and mixing or just before pouring concrete. Mixtures are added. Mineral Admixtures, which are either naturally occurring or industrial by-products, are divided into three categories: inert materials, pozzolans, and cementitious materials [1], and to improve the properties of cementitious mixtures in general consumption amounts of more than 5%. The weight of the cement is added to the concrete during mixing. The scope of this publication (article) includes chemical Admixtures in concrete and the study of mineral Admixtures is entrusted to other publications of the Iranian Concrete Association.

2.1 Interaction of concrete and chemical Admixtures

Chemical Admixtures interact with hydrated cementitious materials and are divided into three categories of Admixtures with physical, chemical, and physico-chemical performance. Admixtures with a physical function are chemical Admixtures that do not have a direct effect on the cement dewatering reaction process, although they may affect its process and rate. These Admixtures generally show their effect and function before the initial setting of concrete and their effect does not continue after setting in hardened and hardened concrete. These Admixtures include water reducers, aerobes, gas generators, foaming agents, aerators, anti-scouring agents, pumping facilitators, colorants, and bonding agents. Admixtures with chemical function either affect the process and reaction process of pre-setting cement dewatering or alter the microstructure of dewatering products before and after setting. Therefore, in addition to the pre-setting time, the reaction of chemical Admixtures may continue in the hardening stages of concrete.

Slow retardants, retarders, quick hardeners, expanders, dehydration reaction controllers, and inhibitors are among the Admixtures with chemical function. Physico-chemical Admixtures Although they do not interfere with the chemical reaction process of cement dewatering, they control some of the chemical reactions or physical behaviors of hardened concrete in the future by injecting special chemicals into the concrete. Corrosion inhibitors, silica alkaline reaction expansion reducers, sealants, permeation reducers, fungicides, microbicides, and insecticides fall into this category of Admixtures.

2.2 Classification of chemical Admixtures

Chemical Admixtures are divided into seven general categories based on the type of effect and the main function they have in concrete.

2.3. Water reducers

Reducing Admixtures are used to increase the fluidity of concrete in a given amount of water, or to reduce the amount of water consumed by maintaining fluidity, or both, and include lubricants, superplasticizers, and transducers.

2.4. Air content

It is an additive that, during mixing, creates a homogeneous structure of discontinuous microbubbles in concrete, mortar, or cement paste, improving efficiency (workability) and increasing reliability against freezing and thawing cycles.

2.5. Slow down

Retarders delay the setting of concrete by slowing down the dewatering process of the cement and include retarders and retarders.

2.6. Accelerators (accelerators)

Accelerators accelerate, harden, or both accelerate the cement dewatering process. Accelerators include accelerators, stimulators, and accelerators.

2.7. Expanders

Expanders are used to increase the volume of fresh concrete (mortar), compensate for shrinkage of hardened concrete (mortar), or create controlled expansion in hardened concrete (mortar). These Admixtures include shrinkage compensators, gas generators, and foaming agents.

2.8. Sustainers

Fasteners improve the reliability of hardened concrete by reducing the penetration of harmful agents, monitoring rebars, or controlling harmful reactions. Permeation reducers, sealants, corrosion inhibitors, and silica alkaline reaction expansion reducers are included in this category of Admixtures.

2.9. Special add-ons

Special Admixtures are a group of chemical Admixtures with special and limited use. Antifreezes, colorants, aerators, pumping facilitators, anti-scourers, dehydration reaction controllers, latexes, and thickeners are examples of special Admixtures.

2.1O. Function of chemical Admixtures

Each additive is defined and grouped according to its main function. The main function of an additive is the main expected effect it has on concrete and indicates the performance of its additive index. An ancillary function is the effect or effects that the additive has on the concrete on a smaller scale than the main function. Some Admixtures may be multi-purpose and affect several properties of fresh or hardened concrete. For example, damping water reducers, in addition to reducing the amount of water, also slow down the concrete. Tip 1-1- Some Admixtures may have side effects. For example, the main function of water-reducing Admixtures is to reduce the water content of concrete, but they may also have side effects of slowing or aerobic. Side effect is an unwanted and, in some cases, even undesirable effect that the additive has on the properties of concrete and it should be remembered that it is different from the sub-function. Tip 1-2 - The increasing expansion of Admixtures and their effective applications may lead to the emergence of new Admixtures that do not fit into this weekly categorization. In such cases, the role of regulations, instructions and special technical specifications issued by manufacturers or reputable international scientific societies have a special place for the evaluation and acceptance of these Admixtures and are a criterion for measuring this type of material.

2.11. Reasons and benefits of using chemical Admixtures

Concrete must be homogeneous, efficient, payable, durable, reliable, and low permeability. In many cases, these characteristics can be achieved by selecting the appropriate materials and mixing ratios and applying the methods and using the appropriate equipment and experienced people. The use of chemical Admixtures, along with their numerous benefits, will make it possible and easier to achieve these properties.

Figure 4. Admixture

In this regard, the most important reasons and benefits of using chemical Admixtures can be categorized as follows.

3. Effect of Concrete Admixtures

3.1. Reduce construction costs

The use of Admixtures can lead to various savings and in addition to offsetting the costs of purchasing Admixtures, it can also bring economic benefits. Reducing construction costs is divided into three categories: direct, indirect, and covert savings. Direct savings are part of the cost reduction that can be easily calculated and measured. These savings include reducing the amount of cement and water, increasing the productivity of manpower, reducing execution time, facilitating and increasing the efficiency of concrete operations, enabling the use of available aggregates and materials, facilitating the transfer and pouring of concrete, speeding up the opening And ease in many other executive cases. Indirect savings include reducing the cost of improving concrete quality, increasing mechanical strength, ensuring uniformity of production, reducing problems and shortcomings during execution, reducing or eliminating rework, improving the appearance and reducing repairs of concrete surfaces, and countless other things. Hidden savings include reduced investment costs. These include reducing the depreciation of equipment and machinery, reducing the volume and dimensions of structural members, the possibility of various designs, optimal use of land by designing taller structures, and the possibility of eliminating the facade. Each of the add-ons may provide only one or more economic benefits that should be considered when calculating the cost savings.

3.2. Adjustment and improvement of concrete properties

Although many desired properties of concrete can be achieved by choosing the right materials and mixing ratio, adjusting and achieving some properties of fresh and hardened concrete using Admixtures is more efficient, economical, and more effective than any other method. With the use of chemical Admixtures, the properties of fresh concrete can be adjusted in accordance with the performance and environmental conditions, and the properties of hardened concrete can be modified in accordance with the technical criteria and operating conditions. Properties of fresh concrete that can be adjusted using chemical Admixtures include: Increase efficiency without additional water consumption, Reduce water consumption without reducing efficiency, Accelerate or slow down initial and final setting, Expand to compensate for shrinkage, Reduce water drop Maintain consistency, reduce grain separation, improve pumping, correct slump loss, and control exotherm at an early age. Properties of hardened concrete that can be modified or improved by the use of chemical Admixtures include: Acceleration or delay in the process of gaining strength, Increased mechanical strength, Improved reliability, Reduced permeability, Expansion control and Alkaline reaction damage Increase adhesion to steel, improve adhesion of new concrete to existing concrete, produce concrete or colored mortar, and control rebar corrosion.

3.3. Ability to run in difficult conditions

Some chemical Admixtures allow the implementation and continuation of concreting operations, while maintaining the required quality, in adverse weather conditions. For example, with the use of retardant lubricants, concrete can be transported over long distances or pumped over long distances; Aggregates and anti-scouring make underwater concreting operations easier; Quick heaters allow concreting in cold weather; And with the help of decongestants, concrete can be applied in low access points, such as turbine water supply pipelines in hydroelectric power plants, without the need for vibration (self-compacting concrete).

3.4. Overcoming sudden events

During concreting operations, there is a possibility of sudden and unforeseen events such as clogged pump pipes, mold collapse, sudden drop in temperature, etc. Some of these events can be overcome with the help of chemical Admixtures. An example of this is the use of dewatering control materials to prevent clogging and reuse of built-in concrete in cases where there are interruptions.

3.5. Coordination with environmental and occupational health issues

Reducing noise pollution, increasing the safety and productivity of labor (manpower), reducing heat from friction of equipment and machinery, not throwing away and using the remaining concrete in the machinery for the next shift (additive to control the need for water) The end of each shift and the failure to drain the washing water in the environment (non-stick additive), are among the items of environmental friendliness that can be achieved with the help of chemical Admixtures.

3.6. Achieving special properties

Some properties of concrete, no matter how careful the choice of materials and proportions of concrete components, can not be achieved except with the use of Admixtures. Among these unique properties and properties that can only be achieved with the use of chemical Admixtures are aerobics, foaming, self-compaction, acceleration, pre-hardening, deceleration, and expansion.

3.7. Contribute to sustainable development

Reducing cement consumption on the one hand by saving on the consumption of natural resources (raw materials) and on the other hand by reducing greenhouse gases from cement production, in order to help preserve the environment and sustainable development. Achieving early resistance by using Admixtures and eliminating the need for evaporation in the process of manufacturing prefabricated parts, called "energy-free", leads to energy savings and contributes to sustainable development. Improving the reliability of concrete structures during operation, which is achieved due to the use of Admixtures, will also contribute to sustainable development by increasing the useful life of the structure. Note 1-3-Regardless of all the above, it should be remembered that no Admixtures of any type and amount can be considered as a substitute for the design of concrete and proper execution of concrete.

3.8. Specifications of chemical Admixtures

Consumable Admixtures must meet the needs and criteria of concrete regulations and national standards of Iran and valid international standards such as AASHTO, ASTM, BS, DIN, EN. These sources describe in detail the technical specifications, minimum consumption expectations, and how each additive is effective, and are a very good guide for using Admixtures. In addition to these standards, manufacturers of these Admixtures always provide accurate technical specifications of their products and the range of consumption and their effect on concrete, which in some cases can be helpful.

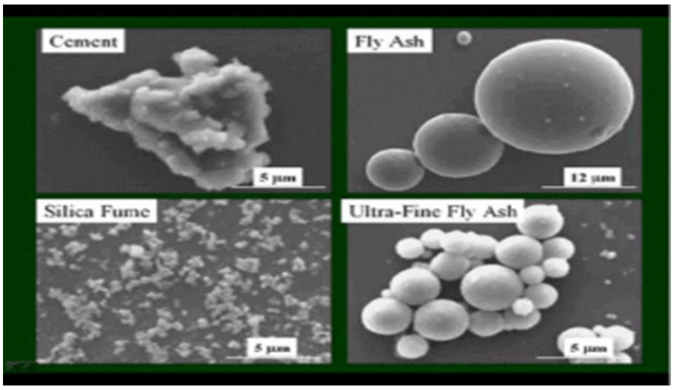

Figure 5. Size of materials

Although the technical specifications provided by the manufacturers include the range of consumption proposed, but the amount of additive consumption should be determined based on the results obtained with the materials used in the workshop.

3.9. Evaluation of Admixtures

Since the composition and properties of cementitious materials, water and aggregates as well as their mixing ratio have a significant effect on the performance of Admixtures, the evaluation of each additive should be based on the results obtained with the materials used in the workshop. In evaluating an additive, its effect on the volume of the mixture must be considered. If the addition of the additive changes the volumetric yield of the mix, as often happens, the change in the properties of the concrete will not be due to the direct effects of the additive alone and may also be due to a change in the proportion of concrete components. In such cases, Admixtures such as cement, aggregates and water should be considered as one of the components of concrete in the mixing plan. If more than one additive is used in concrete, they may affect each other's performance. For example, in concrete with aerobic Admixtures, the use of lubricant can increase aerobic efficiency, while some decongestants reduce its efficiency. In evaluating Admixtures, their interaction on each other's performance should be considered. Environmental factors such as temperature and humidity have a significant effect on the behavior of concrete and the performance of Admixtures. Admixtures that are known to work at normal temperatures may have very different functions at very high or very low temperatures. The performance of each additive should be evaluated under the expected environmental conditions at run time and not be limited to laboratory results performed at standard temperatures. In evaluating the performance of Admixtures, operating conditions such as how and when to mix, how and when to transport, temperature of fresh concrete, how to pour and spread concrete, how to compact and polish concrete, and the method of processing should be considered because each of these can Affect additive function. For example, excessive mixing reduces the efficiency of aerobes.

The time and manner of adding Admixtures to the concrete mix also affect their performance, which should be considered in their evaluation. For example, if water-reducing Admixtures are added to the dry mix of cement and aggregate, their efficiency will be greatly reduced, whereas if they are added to the concrete after adding a portion of mixing water and cement paste, they will perform better. Economics of each additive should be considered in the cost of preparation, transportation, maintenance and addition along with the economic savings that the additive brings with it in the execution of concrete operations. Although the function and the main effect of an additive on the properties of fresh and hardened concrete is usually the main criterion for evaluation and selection of Admixtures, but the side advantages of each product are significant concrete producers, contractors, executors and employers and is of particular importance. These advantages include properties such as efficiency (workability), ease of pumping and molding, surface polishing, early resistance, faster use of molds, appearance of concrete surfaces and elimination or reduction of vibration time. For quality control of Admixtures, in addition On the uniformity of appearance, the uniformity of their performance on concrete should also be evaluated.

3.10. Considerations in the use of Admixtures

Admixtures must comply with Iranian national standards or other valid international regulations. In addition, the instructions and recommendations provided by the additive manufacturer must be carefully considered. The effects of an additive should be evaluated as far as possible using the intended materials in the workshop. This issue becomes especially important when:

- The additive has not been used before with the desired materials or their combination;
- Use of special types of cementitious materials;
- Consume more than one type of additive;

Mixing and concreting should be done at temperatures outside the range usually recommended for concreting. In addition, the use of Admixtures may require modifications to the concrete mixing design, such as changes in the type or amount of cement, changes in the type or aggregation of aggregates, or modifications to the mixing ratio. By adjusting the amount of water and cementitious materials and modifying the type and duration of mixing, the effects of some Admixtures are dramatically improved.

Many Admixtures affect more than one property of concrete and may even adversely affect the desired properties. Admixtures that improve the properties of fresh concrete may cause premature hardening or excessive slowing of the concrete and cause problems. By examining the effect of Admixtures on the cementitious materials used, the causes of abnormal setting behaviors can be understood. Premature hardening often occurs due to a change in the reaction process between the existing tricalcium, aluminate, and sulfate ions. Excessive retardation can be due to delayed calcium silicate dehydration due to overuse of the additive or decrease in ambient temperature. Another important consideration in the use of Admixtures is the limitation of the allowable amount of chlorine ions in concrete. These restrictions are given in the Iranian Concrete Regulations. These limitations are usually expressed as the maximum percentage of chlorine ions relative to the mass (weight) of the cement, although sometimes the amount of "water-soluble" chlorine ions in concrete is also measured. Regardless of how this limit is set, the consumer should know the amount of chlorine ions in the additive so that when determining the type and amount of additive consumption, he does not exceed the limits set for the amount of chlorine ions. Tip 1-6 - The user should be aware that even assuming that chlorine ions are not present in the structure of a chemical additive, there is always the possibility of chlorine ions entering through the water used to produce the liquid additive, as Admixtures are often made with water that contains Small but measurable amounts of chlorine ions. Therefore, caution should be exercised when dealing with terms such as "chlorine free".

13. CONCLUSION

- Admixtures are chemicals that are added to the mixture in small amounts and as a percentage of the weight of cement to create the desired properties in concrete.

- W represents water and C represents the weight of cement, so that a low W / C ratio can be selected.

- Tricalcium silicate: (3Cao-Sio2) abbreviated (C3S), Calcium silicate: (2Cao-Sio2) abbreviated (C2S), Tricalcium aluminate: 3Cao-Al2o3) with the abbreviation (C3A), Aluminophyte tetracalcium: (4Cao-Al2o3-Fe2o3) abbreviated (C4AF).

- The main reason for using fibers in concrete is to increase the hardness and tensile strength, improve crack control and deformation.

- The use of seawater due to the presence of salts of chlorides, sulfates, etc., which reduces the strength by up to 15%, and on the other hand, the chlorine in seawater causes corrosion of rebars over time and its use in reinforced concrete is not allowed. .

- Silica aggregates have a hardness of 7 to 8 and are the most resistant aggregates used in concrete. Limestone grains have a hardness of 3 to 4 which are used in making concrete.

- It seems that after concreting and polishing the concrete surface, a thin layer of water impregnated with cement appears on the concrete surface. The most important reason is excessive slump. Another reason, such as excessive vibration and inadequate granulation, increase the likelihood of concrete melting.

- Reinforced concrete is brittle and has less tensile strength. In order to reduce the weakness of fragility, thin and short filaments that are randomly distributed in all directions in concrete are a very suitable method (these thin filaments are called fibers).

- Foam concrete during their construction by creating foam, air bubbles in the cement paste or in the cement mortar, aggregates are created. Specific mass (Kg / m3).

- Concrete with light grains which are made using perlite or vermiculite or expandable polyester fibers. The specific gravity of this mixture (Kg / m3 960 to 240).

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