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ADMIXTURES CANNOT WATERPROOF BUILDING ENVELOPE BUT CAN GIVE GOOD WORKABILITY.

Admixtures are actually no substitute to waterproofing of buildings but definitely provide so many beneficial effects. Admixtures are ingredients in the form of powder or liquid, added to the concrete matrix during mixing.

Chemical admixtures include accelerators, retarders, water reducers, superplasticizers etc. Here we will confine ourselves to waterproofing compounds and plasticizers/superplasticizers.

According to one estimate the worldwide annual consumption of superplasticisers is approximately 500 million liter. Many important characteristics of concrete are influenced by the ratio of water to cement used in the mixture. By reducing the amount of water, the cement paste will have higher density, which results in higher paste quality. An increase in paste quality will yield higher compressive and flexural strength, lower permeability, increase resistance to weathering, improve the bond of concrete and reinforcement reduce the volume change from drying and wetting, and reduce shrinkage cracking tendencies.

To understand about the water cement ratio it would be important to appreciate the first chemical reaction, which takes place once the water is added to the cement. The major constituent of cement is tricalcium silicateC_3S.

In the first stage, as soon as C_3S comes into contact with water it releases calcium and hydroxyl ions into the solution. In the second stage, the dissolution continues and pH reaches a high value of 12.5. Not much silica dissolution occurs at this stage. After a certain critical value of calcium and hydroxide ions is reached, there is a rapid crystallization of CH and C-S-H followed by a rapid reaction.

The emergence of Steel reinforced structures was a great break through and the reinforcement works like a backbone of the building.

A common person frequently asks a question what is durability, is his construction durable.

Chemical admixtures like plasticizers have definitely a role to play and they have indeed conferred several beneficial effects in reducing the water cement ratio and giving a better concrete. Although it still depends on the skill of the mason. ***If we look into the mechanism of these superplasticizers then they are several unresolved questions.*** The use of admixtures is generally ***based on trial -and-error*** because of an incomplete understanding of their mechanism of action. One approach is to study the interactions that occur between the admixtures and the hydrating cement components. The ***admixtures may remain in a free state as a solid or solution*** may interact at the surface or chemically combine with the constituents of cement or cement paste. The type and extent of interaction may influence the physico-chemical and mechanical properties of concrete such as water demand, hydration kinetics, composition of products, setting times, microstructure, strength, and durability.

Superplasticizer molecules can ***interfere with the nucleation and growth of the hydration*** products, thus retarding the formation of connective gel between the hydration particles; this will help in maintaining fluidity (slump) for longer period. Also, depending upon their chemical composition, superplasticizer molecules may ***become embedded, or intercalated, in the hydration*** products, leading to new organo-mineral hydrates. In the case of these chemical mechanisms, the relationship, between the molecular properties of the superplasticizers and effects observed are only partially understood.

In addition the effectiveness of ***admixtures depends on different concrete mixes, quality of water, quality of cement and other components which if remained unchecked can become counter productive.***

However these problems are resolved to great extent ***by polycarboxylate and acrylate based*** admixture which are slightly expensive but have less problems. These admixtures are based on ***new chemistry because they work on the basis of steric hindrance,*** which being a physical characteristics do not interfere with chemical reactions. We are one of the few companies and perhaps first Indian company to introduce these products.

Inspite of some benefits that ***we get from admixtures*** they are not capable of giving waterproofing to the structure and protecting reinforcement from malignancy and corrosion.

To prevent all possible water intrusion causes, a ***building must be enveloped from top to bottom*** with waterproof materials. These waterproof systems must then interact integrally to prevent water infiltration. Should any one of these systems fail or not act integrally with all other envelope systems, leakage will occur.

Even with continual technological advances in materials, water continues to create unnecessary problems. This is most often due to an envelope's inability to act as an integrated system preventing water and pollutant infiltration. All too often several systems are designed into a building, chosen independently and acting independently rather than cohesively. ***The combination of roofing, waterproofing, dampproofing, and flashing systems that acts cohesively as a barrier, protecting interior areas from water and weather intrusion. These systems envelope a building from top to bottom, from below grade to the roof.***

In addition waterproofing applications are not complete unless the ***surface is prepared either in existing buildings or structures***. Leakage into structural components can damage structural portions and facades of a building envelope. In these cases actual repairs to a structure or its components is required before application of remedial materials. This type of repair ***is referred to as restoration. Restoration is the process of returning a building or its components*** to the original or near-original condition after wear or damage has occurred.

Let us first go into the basic question.

What is durability?

The environment has a vital impact on the life of every structure. While foundations have to withstand the action of water and chemicals in the soil, superstructures are subjected to weathering action and attach by harmful chemicals present in the atmosphere.

In order for a construction to perform its structural function, it is required not only to be strong but also to be durable. It is important that the structure retains its original form, quality and serviceability throughout its lifetime. This is an aspect of durability that is desired in construction. Durability assumes even greater significance for concrete structures in coastal regions where it is subject to harsh and frequent onslaughts of weather.

What are the socio-economic implications of durability?

Durability has economic implications. It has been found that about 40 percent of the total resources of the construction industry are applied to repairs and maintenance. Replacement costs of parts, or of the entire structure increases the lifecycle costs, rather than the initial costs. With no controls exercised on the various repair materials and practices, it often leads to repeated repairs and uncontrolled costs. Maintenance and lifecycle costs escalate. This is another reason why building-in strength and durability features into construction is of primary importance.

Ecologically, also there is a need to conserve natural resources by making materials last longer.

According to A. M. Neville ***"Often, instead of using a special cement, it is possible to change some of the properties of the cement in hand by the use of a suitable additive. A great number of proprietary products is available: their effects are described by the manufacturers but eh full details of the action of many of these additives, known as admixtures, are yet to be determined, and the performance of any one admixture should be carefully checked before it is used.***

An important feature of the majority of admixtures for concrete is that they are used primarily on the basis of experience or ad hoc tests: theoretical information on a scientific basis is generally not available to permit a reliable quantitative prediction of behaviour in concrete under the various possible circumstances. This is due to the marketing of admixtures largely as proprietary products."

<u>Superplasticizers</u>

It is common practice to use superplasticizers like

- Sulfonated melamine-formaldehyde condensates (SMF)
- Sulfonated naphthalene-formaldehyde condensates (SNF)
- Modified Lignosulfonates (MLS)

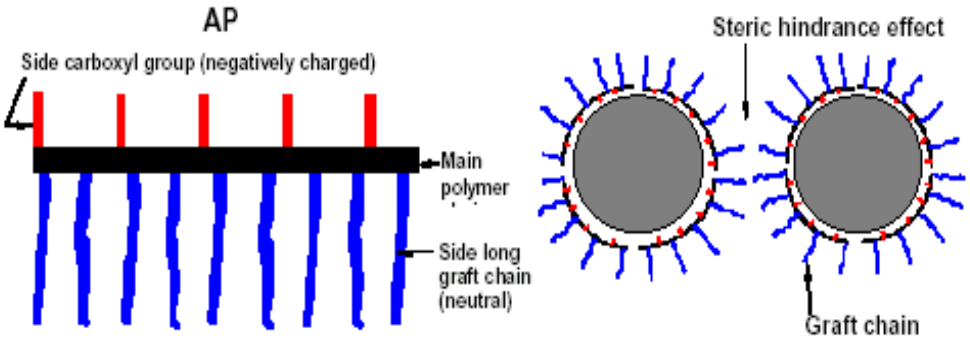
Admixtures confer several beneficial effects on concrete including reduction in water requirements, increased workability, controlled setting, accelerated hardening, improved strength, better durability, desired coloration and volume changes. The use of admixtures is generally based on trial –and-error because of an incomplete understanding of their mechanism of action.

Inspite of the large usage of the above superplasticizers there are some problems. For example, superplasticizer molecules can interfere with the nucleation and growth of the hydration products, thus retarding the formation of connective gel between the hydration particles; this will help in maintaining fluidity (slump) for longer period. Also, depending upon their chemical composition, superplasticizers molecules may become embedded, or intercalated, in the hydration products, leading to new organo-mineral hydrates. In the case of this chemical: mechanisms, the relationship, between the molecular properties of the superplasticizers and effects observed are only partially understood.

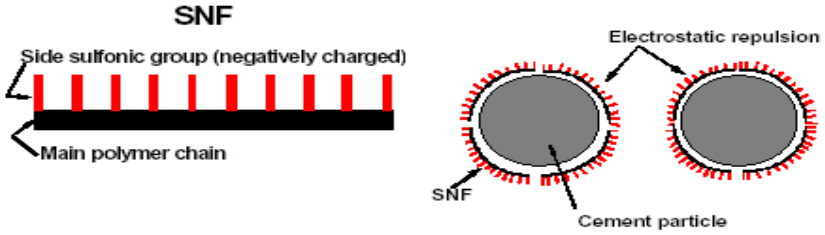
The retarders in superplasticizers work on the following mechanism:

- The mechanism of set retarders is based on absorption. The large admixture anions and molecules are absorbed on the surface of cement particles, which hinders further reactions between cement and water i.e. retards setting. Later as a result of the reaction between the organic salts and C3A for cement, the former- are removed from liquid phase of system, thus eliminating further retardation.

- The principal role on mechanism of water reductions and set retardation of admixtures are usually composed of long-chain organic molecules and that are hydrophobic (not wetting at one end and hydrophilic (readily wet) at the other. Such molecules tend to become concentrated and form a film at the interface between two immiscible phases, such as cement and water, and alter the physio-chemical forces acting at this interface.



Error! ***Schematic picture of acrylic polymer (AP) and the related steric hindrance effect on the dispersion of cement particles***



Error! ***Schematic picture of sulfonated polymer (SNF) and the related electrostatic repulsion effect on the dispersion of cement particles.***

The above diagram would show that when other admixtures are used they react with cement and can produce undesirable products.

In this series we have developed Protekta RR6, Polycarboxylate based, and Protekta SPR4, Protekta KR-2, Acrylate based which do not produce any side or undesirable products.

Protekta RR6

New generation Superplasticizer which does not interact with cement and work on unique mechanism. Protekta RR6 is specially designed Polycarboxylate based latest admixture for Ready Mix Concrete or for Green concrete.

USES

- Polycarboxylate based superplasticizers
- Increases the Compressive Strength of the Concrete upto ***42.0Mpa***
- Reduces Water Absorption 78%
- Setting time is within permissible limit of ISI Standards.
- Long retention of the slump
- Improved surface finish

APPLICATION

The excellent dispersion properties of this admixture both for ready mix and site mix concrete allow the production of very high, early and high strength concrete with minimal voids.

- High workability without segregation or bleeding
- Less vibration required
- Can be placed and compacted in congested reinforcement
- Improved surface finish

Protekta SPR-4

Specially designed latest admixture for Ready Mix Concrete or for Green concrete. Traditional superplasticizers and water reducers like salts of Lignosulfonic acids, Hydroxicarboxylic acids and the traditional superplasticizers based on Sulfonated Naphthalene Formaldehyde polymers or Melamine Formaldehyde polymers. Provide good workability to fresh mixtures but cannot maintain it for long periods. The workability decreases dramatically within 30 minutes. The original workability is normally restored by adding fresh water to the concrete and this type of retempered concrete loses its mechanical strength and durability.

Protekta SPR-4 is a water-soluble co-polymer.

USES

- Offers very high workability and low air entraining effects.
- The cementitious composition can retain good workability over a long period of time combined with low or without air entrainment.
- These acrylic polymers are very effective in reducing water: cement ratio giving high grade concrete increasing compressive strength and giving very high workability thus keeping the mixture without slump loss over a long period of time.
- Reduces water absorption by 72%.

Protekta KR-2

Protekta Emulsion KR2 is a solvent-free aqueous silicone ester emulsion. It is designed to be used as an admixture during the in-plant manufacture of low slump cement containing blocks paving products, and **as Admixture in RMC, Freshly made concrete and MORTAR FOR PLASTER**

1. When Protekta Emulsion KR2 is incorporated into low slump cementitious products such as imitation stone blocks and pavers, the permeability to water and the occurrence of unsightly efflorescence is dramatically reduced. Additionally, the 28day compressive strength and transverse breaking load strength is increased by up to 50%. The use of EMULSION KR-2 enhances the intrinsic quality of cementitious products by increasing the compressive strength and reducing the damage caused by water uptake and efflorescence.

2. When incorporated in concrete/or mortar, it reduces the water absorption by 85-90%

USES

- Reduces water absorption by over 85-90%
- EMULSION KR-2 is permanently bonded to the substrate and cannot be washed out.
- Does not leave an oily residue on the product.
- Easy to use. Can be used in existing processes.
- The degree of water resistance can be varied by changing the rate of addition.
- No hazardous solvents emitted during use.
- Non flammable and non corrosive
- Cost effective.

WATERPROOFING COMPOUNDS

Waterproofing is a complex phenomenon. The best way to waterproof any concrete structure is to take adequate measures at the time of construction. Most of the waterproofing compounds available in Indian market are based on stearates and oleates. Metal soaps are good water repellent agents for masonry but decrease the water vapour permeability due to a blocking of masonry capillaries. Organic polymers may form a film covering the masonry surface, resulting in some blocking of the masonry pores and this results in an effect on the water vapour permeability of the substrate.

Permanent bonding between masonry capillaries and impregnants results in long term durability. Most organic polymers and metal soaps are considered to physically adsorb on masonry with little chemical bonding due to the absence of functional groups within the molecules.

Both types of admixtures increase resistance to water penetration either by acting as pore fillers or by creating a hydrophobic coating within the pores, or by combining both effects. Materials which produce hydrophobic coating (Fatty acids, wax, and bituminous emulsions) function as follows. Normally, concrete *wets* because the pressure needed for wetting is low due to the surface tension forces which pull the water into the pores. When waterproofing admixtures such as stearates are used, insoluble calcium stearates produced by the reaction of soap with $Ca(OH)_2$, coats the surfaces of the pore.

Workability

Workability of concrete is improved when water reducers are incorporated in the mixture at a given water content. The increase in workability, generally measured by slump test. For example, the effect of a water reducer on workability (at a given water content) is higher at a higher slump or a higher water content; the addition of the same amount of water reducer causes an increase in slump of about 30mm in a plain concrete mix at 20mm slump and of 80mm in a plain mix at 70 mm. The effectiveness of water reducers on workability decreases in the same order as that found for water reduction. For a given slump, the admixture-treated concrete with reduced water is generally more workable.

Therefore we suggest and conclude by saying that there is no doubt that admixtures can be useful but it is important that while selecting admixture you should be very judicious and not use wrong products on the pretext of cost effectiveness because there is nothing more important than the durability of building.

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