Polymer modified mortars – Type, Function, Advantages, Disadvantages

What is Polymer modified mortars?

Polymer modified mortars is formed by mixing the organic polymers as admixture during the preparation of mortar which remains finely dispersed in solid form or emulsified form. The polymer used can be both liquid type as well as the solid fine dusted form.

The polymer helps to enhance the extra property of mortar and attain its highest performance. The property likes adhesion, toughness, bonding strength, and flexural strength to some extent are highly enhanced. Such mortar on drying also gives the high resistance property against fire and chemical attacks.
Moreover, such polymers in mortar even act as superplasticizers i.e. reduces the water as well increases the workability. The polymer-cement content is generally 5%-20% (i.e., 5%-20% of cement mass)

**Types of polymers used**

The polymers are the chemical compounds (especially organic) which have the long chain of the repeating simple compounds or units. Such smallest repeating units are called monomers and the process of forming the polymers my rearrangement in long-chain is called Polymerization.

All polymers available cannot be used to form such mortars. Only some selective which are capable of coordinating its characteristics with cement mortar is chosen. The commonly used polymers are of these types:

1) **Re-Dispersible polymer powder:**

These are the fine dust or powdered form of the polymers which can, later on, reunite to give the solid form of thin plastic film or coatings along with the process of hydration of cement. During the mixing process, the polymers act as a lubricant and do not get agglomerated with cement particles.

Then the as the hydration process exhibits along with the evaporation of the water molecules, the free movement of the fine polymers is restricted. They tend to attach in the capillary pore or void formed by the hydration.
And as the hydration process increases rising the capillary pressure with the removal of moisture, the fine particles now attached together and deform to give thin films over the interface of particles and cement.

The re-dispersible polymer is a German technology invented by Wacker Hemie in 1953 giving the polymer-modified mix of mortar. The Re-Dispersible polymer is further divided into two types according to the process of their mixing.

Polymers like Ethylene-vinyl acetate (EVA) are mixed in dry mix firsts whereas the polymer-like Polyvinyl alcohol powder is mixed in water and then forms a wet mix of mortar. However, the Re-Dispersible polymer is more preferable for a dry mix of mortar such as wall putty, ceramic tile jointing mortar, dry powder interface mortar, self-leveling mortar, etc.

2) Emulsified polymers:

These are the polymers available in emulsified form. The hydrophilic part of polymers attached with water molecules and hydrophobic repels the water, thus the polymers can remain highly dispersed without contacting each other to form the polymer chains.

The common use of emulsified polymer is Latex particles emulsion. the dispersed emulsified latex is mixed in the cement mortar. The mortar then leads to hydration and evaporation, letting the polymers concentrate with the loosing of the water attached to hydrophilic tails.
Then the deformation occurs due to polymerization. There is a mortar, coalescence and interdiffusion occur that lead to the formation of the film. Some of the re-dispersible polymer powder mix in water to form a wet mix also forms the emulsified polymers after they mix into water.

3) Liquid polymers:

Epoxy resins, unsaturated polymer resin, and petroleum-based epoxy are liquid polymers that can be used to provide high-quality polymer mortar. These polymers result in rapid curing and excellent bonding in cement and aggregates. But the especial curing liquids are used. The commonly used Amine functional compounds and carboxylic functional compounds.

Due to low cost, and easily available Unsaturated polyester resins and epoxy resins are mostly used as polymers in concrete.

However, this polymer concrete tends to shrink more. The liquid form of epoxy resin turns into an infusible solid mass film during the process of curing with cross-linkers.

Function of Polymer in mortars

Polymers quickly rearrange to form the thin layer of the protective film in mortar. This traps the moisture of water inside the layer and even on evaporation they remain entrapped which is used for curing purposes.
Thus, they prevent the cracks and also help to fill the capillary pores or voids formed during curing. So, the strength, impermeability, and toughness of the mortar increases. Moreover, this film increases the tensile strength and improves the flexural behavior of mortar.

Polymers also do provide more fluidity in the mix and act as the water reducers. Moreover, some polymers even can increase hydration time, and thus working or initial setting time increases. The polymer is also responsible for proper adhesion between the different substrates.

Application of Polymer modified mortars

- They are more popularly used for repair purposes as they have minimum shrinkage and better ability to bond even in new and smooth surfaces. Thus, they are applicable for overlay purposes as well.
- They are applicable to the cracks and form the bond & strengthen the two crack surfaces. Thus, used for filling honeycomb defects in concrete.
- They are used for waterproofing as the polymer chain forms the thin tough layer of the impermeable protective film.
- They are applicable to grouting purposes too.
- The polymer-modified are suitable for shotcrete purposes especially, for the salt mine galleries and underground work.
- They can be easily applicable to a wet substrate without showing any deficiency in adhesion.
- They are very useful to adhere to the tiles, glass,
Advantages of Polymer modified mortars

- They improve the bonding strength of structure and bonding forces. So, fewer chances of failure of masonry through the mortar joints layer.
- The polymer-modified mortar has better tensile strength, impact resistance, wear resistance, durability.
- Polymer modified mortar are good against the freezing and thawing and also prevents the cracks due to it.
- The water resistible and impermeable layer can be achieved through it.
- They are extremely advantageous for repairing works, filling voids. Cracks and overlay as can easily adhere to any substrate.
- Polymer modified mortar are inert and stable against any chemicals compare to other mortars.

Disadvantages Polymer modified mortars

- They are relatively high cost.
- Their formation process is complex and if the correct ratio of the polymer and cement is not achieved different undesirable complexity may arise.
- The permissible thickness of such mortar is 1 inch – 2 inch, although different polymers are used to increase their performance.
The epoxy resin-based polymer mortar has relatively high shrinkage.

How to prepare Polymer modified mortars?

The mortar and polymer types are chosen according to the exposer condition, external environment, and the place of application. The amount of polymer needed to be added is fixed according to the general thumb rule or the design according to the requirement of its enhancing property features.

The whole process of mixing is carried out in the mechanical rotating mixture which can variable rotating speeds for the better results.

At first, the required water and the polymer for a single batch are rotated in the bowel of the rotating mixture at very
slow speed (140-150 rpm) and after a certain minute, the polymer can be seen well dispersed homogeneous form.

Then slowly the cement is added in the rotating mix. Leaving the mix for a few seconds (30sec - 60 sec) to rotate after complete pouring of cement, the whole sand is added slowly. The mixture is then set up to the medium speed (285- 300 rpm) and then left for a few minutes of mixing. Then the mortar is taken out of the mixing bowl and is ready to work over the substrate.

I hope this article on “Polymer modified mortars” remains helpful for you.

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