

A Summary of Self-Leveling Mortar

Mortar is one of the building materials appeared earlier in the history of architecture. In the long course of development, mortar has always been widely used in the important parts of building. Mortar is a construction material prepared according to a certain proportion from cementing materials, fine aggregate, admixtures, and water, as well as other additives added as required. It plays the role of bonding, padding, and transferring stress in the building. Mortar, as a big family, is different in its nature, varieties and uses. In terms of its classification, according to the differences in the cementing materials, mortar can be divided into lime mortar, cement mortar and mixed mortar; according to its uses, it mainly includes masonry mortar, plastering mortar, decorative mortar, waterproof mortar, thermal insulation mortar, corrosion-resistant mortar, radiation protection mortar; while according to the bulk density, mortar can be divided into heavy mortar, light mortar and so on. However, these are all the properties and characteristics the general traditional mortar has, and with the development and progress of society, increasingly unable to meet the requirements of people.



Since the reform and opening up, China's building materials industry has made great progress. But with the improvement of people's living standards, the requirements and demand for the quality of construction materials are also increasing. This requires us not only to improve the building materials in the quality, but also to improve the effects in the functionality, performance, and decoration of materials. Cement mortar, as a traditional building material, has played a great role in housing construction, met people's living needs and requirements on the housing use performance in the past, and has also been in line with the characteristics of the times then in the construction technology and process. Mortar in the construction process is a labor-intensive job. Since its scientific and technological content is not high, in the course of its work, there will inevitably be many shortcomings and problems that are difficult to avoid. With the progress of technology, and people's increasing needs of material and cultural life, people have great improvement and requirements on the using standard and comfort level of housing. The traditional cement mortar has been difficult to meet the requirements. And it exists the quality requirements of flatness itself, so it is difficult to create a good prerequisite for the subsequent

projects. As far as the construction unit is concerned, since it is to lower construction costs, shorten the project cycle and achieve better construction quality, the construction of cement mortar cannot meet its requirements. It requires the mortar with better fluidity, and the study of self-leveling mortar can solve this problem. Therefore, the study on the fluidity of mortar contributes to the research and development of self-leveling mortar.

The study of mortar fluidity focuses on the study of self-leveling mortar. Self-leveling mortar has the following advantages:

1. Improve the project quality, and shorten the project cycle. Because of its good fluidity, the self-leveling property has become the biggest characteristic of self-leveling mortar. After pouring by mixing well into the paste, it can freely flow to form a horizontal plane under the action of its own weight and self-stress, overcoming the common quality defects difficult to control by the flatness of ordinary cement. The mortar with good fluidity also has the following features: (1) stable in quality; (2) high in construction efficiency; (3) convenient for construction management; (4) fully protected in the aspects such as the uniformity, density, strength, flatness and cracks of building floors.

2. Promote the progress of construction technology and boost the modernization of construction industry. With the improvement of construction levels, modern buildings not only require higher building functional quality, but also require buildings to be oriented to modernization. The positive development of new building materials with better performance is one of the important conditions to promote the progress of construction technology and the only way to boost the modernization of construction materials. And the study on the fluidity of mortar is one of the meaningful topics.

3. Improve the working, living and learning environments; adapt to the continuous improvement of people's living standards. People's pursuit of a good living environment is to pursue the beautiful, comfortable working, learning and living environment. This requires to improve the housing standards, improve the use function, decoration, and decorative quality of housing, and increase the related facilities. And these all correspondingly require the various kinds of new materials to meet the requirement.

From this, the necessity to develop the self-leveling mortar can be seen, but this requires that we should strengthen the research on the fluidity. The research on the mortar performance started earlier abroad, and there also are quite a lot of researches on it, but the researches on the fluidity of mortar focus on the influencing factors of fluidity.

The study on the fluidity of mortar started late in China, starting mainly from the raw materials composed of mortar, identifying the admixtures related to this characteristic, and proceeding with the study from the properties of the material itself (physical and chemical properties), as well as the reactions and results produced in compounding with other materials. The research is committed to the effects of its fundamental factors on it. As the research on the fluidity of mortar, there exists the following influencing factors: the type and amount of cementing materials, the amount of water used, thickness degree of fine aggregate, grain shape and gradation, stirring time, the dosage and type of admixtures. To this end, we have adopted the experimental method to theoretically demonstrate, identify the rule of various factors influencing the fluidity of mortar

and propose the ways to improve the fluidity of mortar:

The experiment on the fluidity of mortar is essentially to improve and enhance the fluidity of ordinary mortar by adding admixtures and auxiliary materials, thus developing the self-leveling mortar that meets the requirements of the construction process and user's use. The research contents focus on: 1) the effect of the kinds of water-reducing agents on the fluidity of mortar; 2) the effect of gradation on the fluidity of mortar; 3) the study on the rheological properties of mortar. Therefore, in this experiment, not only the effects of different gradations and different types of water-reducing agents have been selected for testing, but also are the effects of different mixing ratios tested. According to the existing instruments and equipment in the laboratory, the following three technical indicators have been mainly selected for testing: (1) consistency; (2) degree of expansion (degree of fluidity); (3) strength.

The following analysis can be used as a basis for the influencing factors of mortar fluidity:

1. Effects of Water-Cement Ratio

If the adhesive-sand ratio remains unchanged, the increase in the water-cement ratio and the decrease in the cohesion degree of cement flocculent structure will result in the decrease in both the plastic viscosity and yield stress inside the liquid. Meanwhile, the amount of water used will increase; the component of solid volume will reduce; and the viscosity of mortar will decrease. This is because the cement and sand grains in the mortar, by the point contact, produce cohesion. The cohesion size depends on the particle shape, size and the number of solids. The rapid decrease of cohesive force with the increase in the amount of water used. Thus, as the water-cement ratio is increased, the yield stress of mortar will be reduced.

2. Effects of Water-Reducing Agents

Cement stirred with water will produce the flocculent structure, which is wrapped with a lot of mixing water, reducing the fluidity of mortar. Adding water-reducing agent can make the wrapped water in it released, and increase the fluidity of mortar. The water-reducing agent is a surfactant. After adding, the hydrophobic groups of water-reducing agent are bound to be adsorbed onto the surface of cement particles, while the hydrophilic groups will point to the aqueous solution and form the adsorbed film. This oriented adsorption makes the charges with the same symbol on the surface of cement particles produce electric repulsion, and makes the flocculent structure of cement formed in the early stage of adding water dispersed and disintegrated, therefore, releasing the free water in the flocculent structure and improving the fluidity. Meanwhile, the water-reducing agent oriented adsorbed on the surface of cement particles will make the surface of cement particles wetted and form a stable solvated water film on the particle surface, preventing the direct contact between the cement particles and playing a lubricating role. Due to the adsorption and dispersion, wetting and lubricating roles played by the water-reducing agent, the fluidity of cement paste is promoted to increase. Therefore, adding water-reducing agents into the mortar, both the plastic viscosity and yield stress are reduced.

3. Effects of Sand Gradation

The effects of sand on the plastic viscosity and yield stress of mortar are manifested in the surface features and particle size distribution of sand grains. If the surface is rough and there are multiple edge angles, when the sand grains are in contact, the frictional resistance will increase and the rheological parameters will also increase; for small and fine particles, the specific surface

area is large, and the amount of cement slurry used for lubricating the mortar surface and filling the voids will be increased (represented by the total amount of cement slurry). If the total amount of cement slurry is certain, reducing the specific surface area and the porosity of sand, the thickness of lubricating film will correspondingly be increased. The decrease in the probability of contact with sand grains can increase the fluidity of mortar.

As can be seen according to the above mechanism, the improvement of fluidity can be achieved by using a reasonable mixing ratio, and then mixing with superplasticizers (also can be compounded by fly ash) to make its plasticity-retaining time increased. The mortar thus obtained does not need vibrating or plastering, can be self-leveling, and can be used for pumping construction.

In conclusion, proceeding from the most fundamental factor affecting the fluidity of mortar is an effective method to study and improve the fluidity of mortar, and develop the self-leveling mortar.