

Construction Method of the New Thermal Insulation Material Foam Concrete

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Abstract. With the continuous expansion of application of the concrete structure materials in construction engineering, different types, different properties of concrete materials also have been developed in application, in which foam concrete is the more representative. Foam concrete is stirred with cement (425 above), fine sand as the base material, adding foaming agent, expansive agent, additives, and even waterproof agent and mixed by special mixer. It has millions of tiny independent. It is uniform distribution with closed pore structure. Light weight, good thermal insulation performance, sound insulation, fire resistance, good pump performance, good water resistance, strong water resistance, strong impact energy absorption performance, and low price. It can be widely used in foamed concrete block, foamed concrete lightweight wall panel, roof thermal insulation making slop, the ground insulation cushion, foundation pit filling, the wall pouring and other projects. This paper expounds the new type of insulation foam material mixed coagulation characteristics and the composition of the material, finally explains the foam concrete construction method and process, which shall be the reference to relevant personage.

Introduction

In recent years, foam concrete gradually becomes the preferred material in building roof insulation and making slop. Compared with the polyethylene (benzene board), cement perlite and other insulation materials, it has unmatched insulation performance with the advantages of simple operation, high degree of mechanization, festival, labor and others. The foam concrete wall is lightweight concrete made of Portland cement, which takes ordinary portland cement as inorganic binder, fly ash as admixture, sand as aggregate, and mixed with organic foaming agent. After the on-site spot and pouring, foamed concrete is used on the spot, and it is used as the self supporting wall of the building, which changes the current method of precast block masonry wall. Especially along with the our country pays more and more attention to the construction of energy-saving work, the exploration and research on the theory and practice of foam concrete draw great attention both at home and abroad, in order to make full use of the good properties of foam concrete and to unceasingly expand its application domain in architectural engineering. The development and application of foam concrete do not only accelerate the project progress, improve the quality of the project, increase the earthquake resistance of buildings, but also decreases the total costs of the project, achieves the effect of saving energy and reducing consumption and promotes the development of high-rise buildings.

This paper briefly introduces integral cast-in-situ foamed concrete wall construction process, emphatically explains the main construction method and key points in foam concrete mixing, planting bar technology, template installation, demolition, wall repair and maintenance, and points out that the method reduces working procedure, shortens the time limit for the project and achieves the expected results.

Characteristics of Foam Concrete

Foam concrete is also called cement foam. It is the lightweight porous concrete product. It is made of the foam prepared by foam agent water solution which is added into the slurry which is made of cement based materials, aggregate, admixture, admixture and water, which is mixed, poured and naturally cured. It has the following advantages:

1. Has compressive strength and aging resistance

Traditional chemical thermal insulation materials can achieve thermal insulation effect, but its compressive strength and anti-aging performance have been unable to meet the requirements. Lightweight foam cement can completely solve this problem, and it is the substitutes of the traditional thermal insulation materials.

2. Has a better light weight

The density can reach $200 \sim 1600 \text{ kg/m}^3$, which effectively reduces the building load.

3. Has good sound insulation

The sound insulation of lightweight foam cement is 5 to 8 times higher than that of the ordinary cement, which has solved the problem of the noise in the living space.

4. Has good high temperature resistance

The applicable temperature of foam cement can reach above 250 to 300°C , and benzene board will be softened at more than 75°C and occur chemical reactions.

5. Improve the stability and life of insulation layer

The insulating layer of foam cement has high stability and anti-aging performance, which effectively ensures the indoor ground smooth without cracking, and the life is $5 \sim 10$ times longer than that of benzene board and 5 times longer of that of the perlite particles.

6. Has good environmental protection performance

All the additives of foamed cement are plant fiber protein and animal protein which are non-toxic harmless. Benzene board, perlite particles and other chemical heat insulation materials will produce harmful toxic gases at high temperature.

7. Has good thermal insulation

The thermal insulation coefficient is 0.08 W/m.k which is 20 to 30 times that of ordinary cement.

The Main Raw Materials of Foam Concrete

Cementing Materials. The cementing material for the production of foam concrete can be Portland cement, double quick hardening cement, gypsum, magnesite cement, ash volcano, etc. For the needs of solid bubble of foam concrete, cementing materials are required to be condensated as soon as possible. In production, double quick hardening cement and magnesite cement shall be used, but the costs is high.

Aggregate. The aggregate which is commonly used in foam concrete has a wide source, mainly including the industrial waste lightweight aggregate, such as fly ash haydite, spontaneous combustion of coal gangue, expansion slag beads, cinder and light sand; the natural lightweight aggregate, such as pumice, scoria and light sand; the artificial lightweight aggregate, such as shale, clay pottery grain, expanded perlite light sand, emblem of glazed hollow bead; the enhanced aggregates, such as plant fiber, glass fiber and so on.

Foaming Agent. Foaming agent can be divided into three kinds, such as plant, animal and compound. The plant foaming agent has low costs, but its foam strength is not high, the bubble is not uniform; Due to the use of animal protein as the main raw material, although the foam strength and evenness are better than those of the plant foaming agent, but shelf life of the animal foaming agent is very short, special in the hot summer, the peak period of construction, its drawbacks do not only affect the progress of the whole project, but also is a huge waste of materials and increases the costs of the lightweight concrete in production; The composite foaming agent has the advantages of the plant and animal foaming agent, which can make up the deficiency of both. In fact, the composite foaming agent is a good choice in the actual construction.

Foam Concrete Construction Technology

Construction process flow chart is shown in Fig. 1.

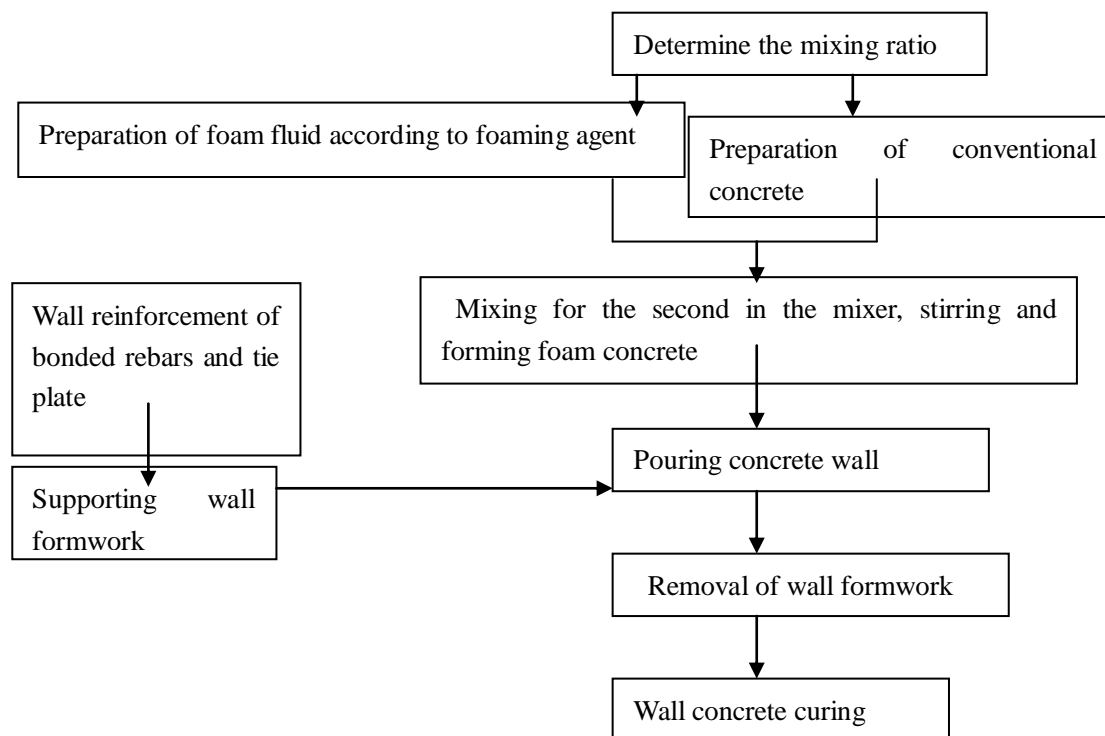


Figure 1. Construction process flow chart

1. Preparation of cementitious materials

Cementitious materials can be made of cement, gypsum or magnesite, in which cement is mainly used. Because the foam shall be mixed into the cementing material slurry, the production of foam concrete shall be firstly prepared cementing material slurry. The foam preparation (foam) and the cementing material slurry system can be done at the same time. Before the preparation of slurry, the cementitious materials, fillers (fly ash) and lightweight aggregate (perlite and polystyrene particles, etc.) shall be measured and be fed into the mixer by the screw conveyor while mixing. At the same time, the water shall be fed into the mixer from the side of the metering pump.

2. Preparation of foam

At the same time of the preparation of cementitious materials, the foam has been made by the foaming machine and has been ready to be added into the mixer and to be mixed with the slurry. Before making the foam, the foaming agent shall be added into the water to be diluted, and the original foaming agent cannot be directly added to the foaming machine.

3. After the preparation of the mixing foam of the foam and the cementitious materials and the cementitious slurry, the foam shall be fed into the mixer by mechanical or artificial, be evenly mixed with the cementitious slurry in the mixer and be made into foam slurry.

4. Unloading and conveying

The foam slurry shall be discharged from the mixer and be directly flowed into the storage tank of pump truck. Start the delivery pump on the pump truck to deliver the foam to the construction site for pouring or to the mould for casting and molding. For the small-scale construction where the delivery cannot be done, small casting, manual feed pouring or on-site pouring can be used.

5. Curing

On-site pouring all uses natural curing. Mould products can be carried out curing in the early stage after pouring and be carried out the later curing, such as heat and moisture preservation, after the mould is taken off when the release intensity is achieved. Mould products can also be carried out steam curing, if there are conditions, steam pressure can also be used.

6. Post cutting process

If the small mould or special-shaped mould are used, after the mould releases, the production is finished. It is no need cutting. The products are only needed to be renovated a little bit. But if large mould is used, the products are larger. The products can be cut into required size after the final coagulation, after which the later curing can be done. Some products are needed other cut after the release mould.

The wall reinforcement are all post construction, thus planting technology is essential. Before the construction of large area planting, make the sample planting, conduct a random sample on site and carry out anti pulling force test to the anchorage reinforcement of the manufactures. If the anchorage reinforcement passes the test, it can be used in large area planting. The performance and selection parameters of anchorage steel bar are shown in Table 1.

Table 1 Anchorage performance and selection parameters of steel bar (Anchorage depth $\geq 12d$ but not less than 100 mm) mm

Bar diameter	6.5	8	10	12	14
Anchor hole diameter	10	12	14	16	18
Anchorage length	100	100	120	150	170

Conclusion

This method is suitable for frame structure, shear wall structure and infill wall; suitable for the civil buildings with the seismic fortification intensity of and below 8 degrees; suitable for the buildings with high environmental protection, energy saving, high noise effect; suitable for the buildings with short construction period .

1. Light weight (1/3 of clay brick, 1/4 of concrete), fast construction, can reduce the costs of construction and project capital turnover cycle, compared with the traditional masonry process, can save costs of 15%.

2. Non combustion body with good fire performance.

3. The drying shrinkage value is 0.5 mm / m, deformation is small, which effectively solves the common problem of masonry cracking. The overall performance is good with high strength which is quakeproof without the collapse risk.

4. Strong grip nails, which solves the problem that light partition wall cannot hang heavy things.

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