Discussion on the application of fiberglass reinforced plastics in building energy saving

Li sheng Chen
Teaching And Research Office For Architecture, The Tourism College of Changchun University, Changchun City, 130000, China
525802150@qq.com

Abstract. In this paper, it introduces the advantages of applying fiberglass reinforced plastics in detail and puts forward the practical application on building pipelines, building doors and windows and roof heat-preservation according to the current status of the use of fiberglass reinforced plastics in building energy saving. Due to the large energy consumption in China, the technicians use advanced technology to transform fiberglass reinforced plastics for the convenience of the improvement of energy efficiency, easing the energy shortage.

1. Introduction
FRP, which is also called fibreglass reinforced plastics, is a kind of structure composite material with synthetic resin as the matrix and fiber as the skeleton.

With the rapid development of economy and the quality improvement of people's life, the consumption and demand of energy have also increased substantially. While the increase in energy consumption has blocked the economic development to a large extent and has also resulted in a series of problems. Therefore, a lot of construction enterprises have launched the strategy of energy conservation and emission reduction. During the process of improving energy status, the fiberglass reinforced plastics are widely applied to building energy saving due to the unique performance.

2. Advantages of applying fibreglass reinforced plastics

2.1. Material advantages
Fibreglass reinforced plastics have the advantages of resistance to humidity, no weathering, thermal insulation and sound absorption, no rust, no radioactive elements, anti-aging, flame retardance and good temperature characteristics. It can be used in both humid and warm south and dry and cold north. It can also be applied to all kinds of buildings both indoor and outdoor [1].

2.2. Advantages of material performance

2.2.1. Light weight and high tensile.
Before applying fibreglass reinforced plastics, particle-board and plastic steel are used(as shown in Table 1). Compared with these two materials, FRP has stronger chemical properties. Its density is between 1.5-2.0, which is a light weight material. The fibreglass reinforced plastics have a strong level. Its anti-fatigue performance and tensile strength are larger. Its strength will not be lower than carbon steel, and the strength of part of FRP in compression, bending and stretching is more than 500Mpa. Therefore, the construction personnel can apply such materials in buildings.
Table 1. Mechanical properties of FRP composites and comparison with other common materials.

| Materials               | Density g/cm³ | Tensile strength /MPa | Tensile modulus /GPa | Specific tensile strength | Bending strength /MPa |
|-------------------------|---------------|------------------------|----------------------|---------------------------|-----------------------|
| Fibreglass reinforced plastics | 1.9           | 560                    | 28                   | 0.28                      | 700                   |
| Particle-board          | 1.57          | 11.15                  | 0.6-2.4              | 0.0045-0.0096             | 15-24                 |
| Medium carbon steel     | 0.78          | 373.46                 | 196-206              | 0.05-0.06                 | 0.05-0.06             |

2.2.2. Strong plasticity.
FRP material has strong artistic design, whose RIM, winding and molding are all strong in plasticity and designability. Different types of raw materials can be selected for design according to various environments, and then different types of FRP products can be manufactured to meet engineering needs. For example, products that are made in resin materials by technicians will be flame retardant, fireproof or stretchable [2].

2.2.3. Strong corrosion resistance and thermal performance.
Fibreglass reinforced plastics have strong corrosion resistance and thermal performance. The resin material inside the material can effectively improve its corrosion resistance. And its expansion coefficient is similar to glass material. Within a certain temperature range, its thermal performance is relatively stable and its coefficient of thermal conductivity is relatively low.

2.2.4. Strong environment-friendly performance.
With the introduction of energy conservation and emission reduction, environmental performance is crucial for the application of materials. The environment-friendly performance of fibreglass reinforced plastics is fabulous and the production energy consumption is relatively low because there is no need for secondary processing in making the material, and it can be formed at one time, which can effectively reduce its production consumption. At the same time, its requirements in temperature are not strict, so it can not only reduce energy consumption, but is more suitable for the construction industry due to its environment-friendly performance.

2.3. Advantages of material installation
FRP is light with flexible shape design. It can be shaped into various shapes such as circle, arc, wave, etc., so it is convenient to install; in addition, FRP has good comprehensive performance. Generally, it can be used for more than 50 years without any maintenance. Even if maintenance is needed, the part of FRP can be repaired on the basis of not damaging the overall structure of the building.

3. Practical application of fiberglass reinforced plastics in building energy saving

3.1. Building pipeline
With the wide application of FRP materials, it has been used in building pipelines instead of concrete or metal pipes. FRP material has some advantages in pipelines. First of all, it is excellent in corrosion resistance because its interior is composed of glass and resin fibers. Use safety is ensured at normal temperature. However, the corrosion resistance of concrete or metal pipes is poor, and in order to maintain their normal operation, anti-corrosion technology and additional costs must be added, influencing the effect of energy saving. In the meantime, the heat resistance of FRP material is excellent. Generally speaking, it can be used normally when the temperature around the pipe is between 40-70°C. Technicians can also add high-temperature materials to the interior of the material during its manufacture so that its adaptability to temperature can be significantly improved. However, concrete pipes are prone to be influenced by the temperature, and cracks will appear when in the open air, which seriously threatens the security of buildings.
Table 2 indicates that the density of FRP material is not large, and the thermal conductivity is low. So compared to concrete or metal pipes, it has lower energy consumption. At last, the cost of applying FRP material is low. It uses low-power pump power, and its water pressure is relatively low, which can reduce costs on the basis of energy conservation and emission reduction. Specifically, when the construction personnel use fiberglass reinforced plastic pipes, the delivery time of the water pump is shorter and the operating cost can be appropriately reduced; due to its better material performance, its maintenance cost is also at a lower level. Therefore, the technicians can carry out construction projects with the help of FRP pipes [3].

| Section steel         | Density | Coefficient of thermal expansion | Thermal conductivity | Combustion performance |
|-----------------------|---------|----------------------------------|----------------------|------------------------|
| Aluminum alloy        | 2.7 g/cm³ | 21*10⁻⁶/℃                     | 203.5 W/(m k)        | Nonflammable           |
| Plastic steel         | 1.4 g/cm³ | 85*10⁻⁶/℃                     | 0.43 W/(m k)         | Combustible            |
| Fiberglass reinforced plastic | 1.9 g/cm³ | 1.9 g/cm³                     | 0.3 W/(m k)          | Difficult flammability |

3.2. Building doors and windows

3.2.1. Performance comparison of aluminum alloy, plastic steel and fiberglass reinforced plastic.
The doors and windows of buildings can function as decoration, ventilation and daylighting. It will cause a large amount of energy water in the process of building doors and windows due to the large energy consumption[4]. It is extremely important for the thermal insulation performance of doors and windows. The construction personnel can use fiberglass reinforced plastic doors and windows whose matrix contained is polymer resin. And the overall structure of the glass fiber is strong as well. Compared with traditional plastic-steel windows and aluminum alloy doors and windows, such doors and windows can not only keep heat and save energy, but also have strong corrosion resistance. (table 3)

| Items                      | Aluminum alloy windows | Plastic steel windows | Fiberglass reinforced plastic windows |
|---------------------------|------------------------|-----------------------|---------------------------------------|
| Wind load resistance /Pa  | 2500-350, III-Iclass   | 1500-250, V-IIIclass  | 3500, Iclass                          |
| Water tightness /Pa       | 150-350, IV-II         | 50-150, V-VI          | 150-350, IV-II                       |
| Sound insulation          | Fair                   | Excellent             | Excellent                             |
| Air tightness             | III class              | Iclass                | Iclass                               |
| Service life time         | 20 years               | 15 years              | 30 years                             |
| Heat preservation         | Bad                    | Good                  | Good                                 |

3.2.2. Advantages of energy saving effect of FRP material.
Specifically, FRP doors and windows can improve the energy saving effect in three aspects:
• Its thermal stability is strong. FRP is a composite polymeric material with a small coefficient of thermal expansion and high strength, so when the temperature of the external environment rises, it will not change obviously, avoiding the occurrence of hidden danger such as cracks. (as shown in Fig. 1)
• FRP doors and windows have low thermal conductivity. Based on its relatively high value of thermal resistance, it can block the heat on the glass, which is an excellent insulation material. At the same time, this kind of doors and windows have strong tightness. The construction personnel will use rubber to seal their gaps during assembly, and coupled with its own high tightness, the phenomenon of heat exchange between doors and windows is stopped [5-6].
• When air convection does not occur, the internal spacing of the glass will increase, so as to reduce the heat transfer coefficient and improve the thermal insulation performance. Due to
the good thermal insulation performance of fiberglass reinforced plastic doors and windows and according to professional calculation, when the thermal conductivity of aluminum alloy is reduced by 0.3, the additional cost will increase by 20%, thus the thermal conductivity of doors and windows is of great importance. The application of fiberglass reinforced plastics makes it possible to effectively achieve energy conservation and emission reduction in architectural projects [7].

Figure 1. Internal material of fiberglass reinforced plastics.

3.3. Roof heat preservation
For the roof heat preservation inside building engineering, the fiberglass reinforced plastics are still necessary. We can't develop roofing environmental protection and energy saving only on the roofing surface. Based on its surface black and white reflectivity, the construction personnel need to take the heat preservation of the roof system into account. The use of energy-saving materials to carry out heat preservation work in areas with severe cold weather will really improve the roofing system. The choice of heat preservation material is the key to perfect the heat preservation effect of the roof and its internal R value determines the heat preservation effect. Time changes and the R value of some materials changes as well. At the same time, the size of different materials will also have an impact on its insulation strength and stability. When manufacturing and using building materials, the construction personnel must strictly control their performance, so as to make sure that the material meets the national use standards and avoid problems such as waste of resources and environmental pollution. Based on the performance characteristics of FRP itself, the technicians put it into the roof heat preservation design, which can not only reduce the construction costs of project, but also effectively achieve energy conservation and emission reduction, and guarantee the overall quality of the engineering construction with the help of this material.

For example, the fiberglass reinforced plastics are adopted in a building project for roof construction to improve energy efficiency. Before the construction of the project, the construction personnel purchased many types of fiberglass reinforced plastics and adopted PU thermal insulation and anti-aging SMC roof tile installation technology, which effectively transform the roof of the building, enhance the overall performance of the building, and introduce it to many projects in the construction engineering, so as to improve its level of energy saving.
4. Conclusion
To sum up, under the rapid development of the domestic construction industry, there are a variety of pollution and resource waste problems emerging and the government also proposes the strategies about energy conservation and emission reduction timely, putting forward higher requirements for building energy saving. The application of fiberglass reinforced plastics can help construction personnel reduce energy consumption, improve energy-saving technology, and guarantee the energy-saving level of construction engineering under the influence of their own performance.

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