

# **ULTRA-HIGH-TEMPERATURE-RESISTANT FLUOROELASTOMER MATERIAL AND MARINE MEDIUM-VOLTAGE SUPER FIRE-RESISTANT CABLE COMPRISING SAME**

## **Technical Field**

The present invention relates to material preparation, in particular to an ultra-high-temperature-resistant fluororubber material and a marine medium-voltage ultra-fire-resistant cable comprising the same.

## **Background Art**

With the continuous increase in the designed tonnages of ships and marine platforms, the electricity consumption thereof also increases. In order to meet the requirements of high-power electric energy transmission, the voltage level of cables in the main lines has been increased from 1.8/3 kV or less to 3.6/6 kV or more. At the same time, in order to meet the fire protection requirements on ships and marine platforms, fire-resistant performance requirements have been put forward for cables with rated voltage of 3.6/6 kV or more in special areas.

Conventional insulation materials can no longer meet the fire-resistant requirements under high voltage because the voltage level of fire-resistant cables is increased from 1.8/3 kV or less to 3.6/6 kV or more. Conventional insulation materials typically use polyethylene material. However, the voltage level of medium-voltage cables is above 3.6/6 kV, and ordinary polyethylene material cannot withstand such high-voltage electric field. Therefore, there is a need for an ultra-high-temperature-resistant material to meet the fire-resistant requirements of medium-voltage cables.

## **Summary of the Invention**

The present invention overcomes the shortcomings in the prior art and provides an ultra-high-temperature-resistant fluororubber material and a marine medium-voltage ultra-fire-resistant cable comprising the same.

To attain the above object, in a first aspect, the technical solution provided by the present invention is as follows: an ultra-high-temperature-resistant fluororubber material, comprising:

100 parts of fluororubber;

15 parts of carbon black;

3 parts of peroxide vulcanizing agent;

4 parts of co-cross-linking agent;

3-5 parts of acid acceptor;

1-2 parts of auxiliary acid acceptor;

5 parts of filler;

2-6 parts of processing aid;

The fluororubber comprises a first fluororubber and a second fluororubber, the parts of the first fluororubber is greater than or equal to 1.5 times the parts of the second fluororubber, both the first fluororubber and the second fluororubber are ternary fluororubbers, the fluorine content of the first fluororubber is greater than or equal to 70%, and the fluorine content of the second fluororubber is set as 60%-65%;

The peroxide vulcanizing agent is set as diphenylethane peroxide.

More specifically, the fluorine content of the first fluororubber is set to be 70%, and the fluorine content of the second fluororubber is set to be 65%.

More specifically, there are 80 parts of the first fluororubber, and 20 parts of the second fluororubber.

More specifically, there are 80 parts of the first fluororubber, and 30 parts of the second fluororubber.

More specifically, the acid acceptor is set as light magnesium oxide.

More specifically, the filler is set as silicon dioxide.

More specifically, the auxiliary acid acceptor is set as calcium carbonate, and the co-cross-linking agent is set as allyl isocyanurate.

More specifically, the processing aid is set as polyethylene wax and engine oil.

In a second aspect of the present invention, the present invention provides a marine medium-voltage ultra-fire-resistant cable, comprising a conductor; a conductor shielding layer, an insulation layer, an insulation shielding layer, a metal shielding layer, a heat insulation layer, an armoring layer, and an outer sheath are sequentially arranged around the periphery of the conductor, and the insulation layer uses the ultra-high-temperature-resistant fluororubber material described above.

More specifically, the heat insulation layer is set as ceramicized polyolefin.

More specifically, the conductor, the conductor shielding layer, the insulation layer, the insulation shielding layer, and the metal shielding layer are sequentially arranged to form a wire core unit, a plurality of wire core units are twisted to form a cable core, and expanded glassfiber ropes are filled inside the cable core.

### **Beneficial Effects**

The present invention addresses the deficiencies in the background art and possesses the following beneficial effects:

In this technical solution, the fluororubber comprises a first fluororubber and a second fluororubber, the fluorine content of the first fluororubber is greater than or equal to 70%, and the fluorine content of the second fluororubber is set to be 65%-70%. Mixing the two fluororubbers can improve mechanical properties while ensuring heat resistance, and it is more cost effective than only using fluororubber with high fluorine content.

### **Description of Drawings**

Hereunder the present invention will be further described with reference to the accompanying drawings and examples;

FIG. 1 is a schematic diagram of the cross-sectional structure of the cable in the present invention;

In the figure: 1 - conductor; 2 - conductor shielding layer; 3 - insulation layer; 4 - insulation shielding layer; 5 - metal shielding layer; 6 - expanded fiberglass rope filling; 7 - non-woven fabric wrapping tape; 8 - heat insulation layer; 9 - armoring layer; 10 - outer sheath.

### **Detailed Description of the Embodiments**

To make the objects, technical solutions, and advantages of the present invention clearer, the technical solutions of the examples of the present invention will be described in more detail below with reference to the accompanying drawings of the examples of the present invention. In the drawings, the same or similar reference numerals denote the same or similar elements or elements having the same or similar functions throughout. The described examples are some, but not all, examples of the present invention. The examples described below with reference to the accompanying drawings are exemplary and intended to explain the present invention, and should not be construed as limiting the invention. Based on the examples of the present invention, all other examples obtained by those of ordinary skill in the art without creative effort are within the protection scope of the present invention.

In the description of the present invention, it should be understood that the orientational or positional relationship indicated by terms such as “center”, “longitudinal”, “transverse”, “front”, “back”, “left”, “right”, “vertical”, “horizontal”, “top”, “bottom”, “inner” and “outer” are based on the orientational or positional relationship shown in the accompanying drawings, only for the convenience of describing the present invention and simplifying the description, rather than indicating or implying that the device or element referred to must have a specific orientation, or be constructed and operated in a specific orientation, and therefore it should not be construed as limiting the protection scope of the present invention. The examples of the present invention will be described in detail below with reference to the accompanying drawings.

It should be understood that the accompanying drawings are only used for exemplary explanations of the present application.

The present invention will now be described in further detail with reference to the accompanying drawings and examples. These drawings are simplified schematic diagrams, which only schematically illustrate the basic structure of the present invention, and therefore only show the components relevant to the present invention.

An ultra-high-temperature-resistant fluororubber material comprises 100 parts of fluororubber; 15 parts of carbon black; 3 parts of peroxide vulcanizing agent; 4 parts of co-cross-linking agent; 3-5 parts of acid acceptor; 1-2 parts of auxiliary acid acceptor; 5 parts of filler; and 2-4 parts of processing aid. Further, the fluororubber comprises a first fluororubber and a second fluororubber, wherein there are 80 parts of the first fluororubber and 20 parts of the second fluororubber.

In another example, for example, for the cable radiating at a corner, the cable needs to have a higher flexibility, and thus the formulation is slightly adjusted:

An ultra-high-temperature-resistant fluororubber material comprises 100 parts of fluororubber; 10 parts of carbon black; 3 parts of peroxide vulcanizing agent; 4 parts of co-cross-linking agent; 3-5 parts of acid acceptor; 1-2 parts of auxiliary acid acceptor; 3 parts of filler; 4-6 parts of processing aid; and 1-2 parts of an optional softening agent, wherein, the optional softening agent is set as naphthenic oil, the fluororubber comprises a first fluororubber and a second fluororubber, wherein there are 70 parts of the first fluororubber and 30 parts of the second fluororubber.

The fluororubber comprises a first fluororubber and a second fluororubber, wherein the parts of the first fluororubber is greater than or equal to 1.5 times the parts of the second fluororubber, the fluorine content of the first fluororubber is greater than or equal to 70%, and the fluorine content of the second fluororubber is set to be 60%-65%; more specifically, the fluorine content of the first fluororubber is 70%, and the fluorine content of the second fluororubber is 65%. For fluororubber, the higher the fluorine content, the better the heat resistance and chemical stability of the material. Currently, commercially available fluororubber typically has a fluorine content of 65%-70%. However, to improve heat resistance, in this technical solution, the fluorine content of the first fluororubber is increased to the upper limit of 70%. This improves mechanical properties while ensuring heat resistance, and is more cost effective than only using fluororubber with high fluorine content.

Fluororubbers with different fluorine contents offer different performance advantages, particularly in aspects such as chemical resistance, heat resistance, and mechanical strength. There are three types of fluororubbers with different fluorine contents on the current market, that is, low-fluorine-content fluororubber with fluorine content of approximately 65%, medium-fluorine-content fluororubber with fluorine content of about 68%-71%, and high-fluorine-content fluororubber with fluorine content of greater than 70%.

Among them, the low-fluorine-content fluororubber exhibits better mechanical properties such as tensile strength and tear strength, and better permanent deformation performance after compression, and has a relatively lower cost. However, it has a slightly poor high-temperature resistance, a narrower long-term operating temperature range and a relatively weaker chemical resistance to certain chemical media.

The medium-fluorine-content fluororubber exhibits good high-temperature resistance, making it suitable for use at higher temperatures, good resistance to chemical media, especially oils, fuels, and certain organic solvents. However, it has a slightly higher cost when compared with the low-fluorine-content fluororubber and has a mechanical property slightly inferior to the high-fluorine-content fluororubber.

The high-fluorine-content fluororubber possesses excellent high-temperature resistance, making it suitable for use in extreme high-temperature environments. It offers better resistance to chemical media, especially strong acids, strong alkalis, and some strong oxidizing agents. It is the most expensive. Its mechanical properties such as tensile strength and tear strength may be inferior to low-fluorine-content fluororubber. It is more difficult to process and requires higher processing temperatures.

Therefore, in the formulation of this solution, 80 parts of the first fluororubber with fluorine content of 70% and 20 parts of the second fluororubber with fluorine content of 65% are used. In this solution, both the first fluororubber and the second fluororubber are set as ternary fluororubbers.

This ratio used in this solution improves mechanical properties while maintaining heat resistance, and is more cost effective than only using fluororubber with high fluorine content.

When preparing materials, priority is given to ensuring their heat resistance. Generally speaking, fluororubber with a higher fluorine content exhibits superior heat resistance. While the fluororubber with a fluorine content of 70% exhibits better performance, it is also harder and more expensive. The same heat resistance can also be achieved by adding a portion of fluororubber with a fluorine content of 65%. Moreover, the material formed by mixing the fluororubbers with the two fluorine contents provides better flexibility than only using the fluororubber with fluorine content of 70%. The flexibility is typically measured using Shore hardness, and the excessively hard materials cannot be bent during laying after cabling, affecting the use of the cable. At the same time, the processing performance of the material should also be considered, the fluororubber with high fluorine content may be more difficult to process, such as requiring higher processing temperatures, and the fluororubber with low fluorine content may be easier to process. The overall processing performance of the material can be improved by mixing these materials.

The performance comparison between the mixture of two types of fluororubbers in this solution and other commercially available materials:

| Material Type                                                                                                   | Shore A Hardness | Tensile Strength | Elongation at Break | Long-Term Operating Temperature | Temperature -Resistance Temperature |
|-----------------------------------------------------------------------------------------------------------------|------------------|------------------|---------------------|---------------------------------|-------------------------------------|
| Ethylene propylene rubber                                                                                       | 70~80            | 7.0~10.0         | 220~320             | 105                             | 120                                 |
| Chlorinated polyethylene                                                                                        | 60~65            | 10.0~14.0        | 450~550             | 90                              | 135                                 |
| Chlorosulfonated polyethylene                                                                                   | 55~62            | 12.1~15.2        | 300~500             | 105                             | 150                                 |
| Polychloroprene                                                                                                 | 58~70            | 13.9~16.8        | 500~600             | 70                              | 90                                  |
| Fluororubber (65%)                                                                                              | 72~85            | 10.1~15.3        | 200~300             | 120                             | 250                                 |
| Fluororubber (70%)                                                                                              | 80~91            | 12.2~20.1        | 150~250             | 120                             | 320                                 |
| 80 parts of fluororubber with fluoride content of 70% and 20 parts of fluororubber with fluoride content of 65% | 80~85            | 13.0~17.1        | 180~230             | 120                             | 300                                 |

As shown in the table above, to ensure both good tensile strength and temperature resistance, due to the fact that only using fluororubber with fluoride content of 70% is economically costly and results in higher hardness and only using fluororubber with fluoride content of 65% will result in an insufficient temperature resistance, thus a mixture of the two kinds of fluororubbers is used to ensure high-temperature resistance. Meanwhile, a higher Shore hardness will prevent the finished cable from bending during laying, affecting the use of the cable.

In this solution, the vulcanization system uses a more efficient combination of vulcanizing agent and accelerator, that is, a peroxide vulcanization system, because peroxide vulcanization provides

better high-temperature stability. More specifically, the peroxide vulcanizing agent is set as diphenylethane peroxide.

The acid acceptor is set as light magnesium oxide. Increasing the amount of acid acceptor can improve vulcanization quality and thus improve heat resistance. Therefore, the light magnesium oxide is set in 3-5 parts, preferable in 5 parts by weight.

The filler is set as silica. The silica with high purity and high dispersibility can improve the heat resistance of the vulcanized rubber.

The co-cross-linking agent is set as allyl isocyanurate. The auxiliary acid acceptor is set as calcium carbonate. The processing aid is set as polyethylene wax and engine oil, the polyethylene wax is set in 1-2 parts and the engine oil is set in 1-2 parts. The engine oil is set as naphthenic oil.

A process flow for producing and processing the ultra-high-temperature-resistant fluororubber material is specifically as follows:

First, preliminarily mixing the first fluororubber and the second fluororubber in the internal mixer, then adding carbon black, diphenylethane peroxide, allyl isocyanurate, light magnesium oxide, calcium carbonate, polyethylene wax, and engine oil for thoroughly mixing until all components are uniformly dispersed.

Subsequently, transferring the mixed rubber material to an open mixing mill for thin pass, to further improve the mixing uniformity and remove air, after thin-pass, leaving the rubber material to stand for 24 hours to allow better interaction of various components.

Next, extruding the rubber material with an extruder after standing, to form a desired shape, with the extrusion temperature being controlled at 100-140 °C. Finally, placing the extruded semi-finished product into a vulcanizing furnace for vulcanization, with the vulcanization temperature being set at 170-200°C, wherein the vulcanization time depends on the thickness and shape of the product, and generally ranges from 30 minutes to several hours. After vulcanization, cooling, cleaning, and inspecting the product to complete the insulation production process.

A marine medium-voltage ultra-fire-resistant cable, as shown in FIG. 1, comprises a conductor 1, a conductor shielding layer 2 is extruded around the conductor 1, an insulation layer 3 is extruded around the conductor shielding layer 2, and an insulation shielding layer 4 is extruded around the insulation layer 3, so as to form an insulation wire core; a metal shielding layer 5 is braided around the insulation wire core to form a wire core unit, and a plurality of wire core units are twisted to form a cable core, at the same time, non-woven fabric wrapping tape 7 is wrapped along with the twisting of the plurality of wire core units. Expanded fiberglass rope filling 6 is arranged in the voids of the cable core. A heat insulation layer 8 is extruded around the cable core. An armoring layer 9 is braided around the heat insulation layer 8. An outer sheath 10 is crosslinked around the armoring layer 9.

The conductor 1 is Class 5 tinned conductor specified in IEC 60228 standard and is formed by twisting several bundles of tinned monofilaments together. Each tinned monofilament has the same diameter. The diameter of the tinned monofilaments is set as needed, but the diameter of the tinned monofilaments is not less than 0.4 mm. Class 5 tinned conductor has good flexibility, and the finished cable manufactured from the same is easy to bend, reducing the difficulty of cable installation and laying, and decreasing the possibility of cable breakage.

The conductor shielding layer 2, the insulation layer 3, and the insulation shielding layer 4 are simultaneously extruded around the conductor 1 by using a 150+100+60 three-layer co-extrusion continuous vulcanization production line, so as to form the insulation wire core. The conductor shielding layer 2 is a semi-conductive conductor shielding layer. The insulation shielding layer 4 is a semi-conductive insulation shielding layer. The insulation layer 3 is made of ultra-high-temperature-resistant fluororubber, which possesses ultra-heat-resistant insulation properties below 260°C.

The metal shielding layer 5 is formed by braiding with tinned copper wires. The metal shielding layer 5 is braided around the insulation wire core to form the cable core. There are several tinned copper wires with the same diameters, and each tinned copper wire has a diameter of 0.2 mm. The braiding density of the tinned copper wires is greater than or equal to 80%.

The cable core is formed by twisting several insulation wire cores. More specifically, the cable core is formed by twisting three insulation wire cores. During the process of twisting the three insulation wire cores, a layer of non-woven fabric wrapping tape 7 is wrapped around the outer periphery of the three insulation wire cores, the non-woven fabric has a thickness of 0.2 mm, and an overlap rate of 15%-20%. Voids will be formed among the twisted cable cores, and if the voids are retained, they will affect the strength and fire resistance of the cable, and the cable are prone to deformation under squeezing, which will lead to uniform electric field breakdown. Thus, expanded fiberglass rope filling 6 is provided for the voids. Of course, the voids may be filled with ordinary fiberglass ropes, which are prickly to touch during the usage. Therefore, in this solution, the used fiberglass ropes are expanded fiberglass ropes that are subject to expansion treatments. The preparation of the expanded fiberglass rope mainly includes fiber forming, fiber stranding, and expansion treatment.

The heat insulation layer 8 is made of low-smoke halogen-free ceramicized polyolefin material, which is produced by extrusion with an extruder.

The armoring layer 9 is an armoring layer braided by tinned copper wires, there are several tinned copper wires with the same diameter, each tinned copper wire has a diameter of 0.4 mm. The braiding density is greater than or equal to 80%.

The outer sheath 10 is an irradiated crosslinked low-smoke halogen-free sheath, the material of which is extruded with an extruder.

Because the outer diameter of the medium-voltage cable is relatively large, electrons are emitted vertically from directly above the cable, molecular chains of the sheath crosslink under the action of electrons, which leads to that the sheath directly above the cable undergoes higher electron action than the sheath directly below the cable, and thus an uneven irradiation phenomenon occurs. To ensure uniform irradiation on the cable, a reflection magnet is installed below the cable to use strong magnetic field for altering the movement direction of electrons, so that the outer sheath 10 of the cable receives a uniform electron action, thus guaranteeing consistent performance of the outer sheath 10 of the cable.

The manufacturing process of a marine medium-voltage ultra-fire-resistant cable is as follows:

Twisting several bundles of tinned monofilaments into the conductor 1, then sequentially extruding the conductor shielding layer 2, the insulation layer 3, and the insulation shielding layer 4 from near the conductor 1 to far from the conductor 1 in the production line, setting the conductor shielding

layer 2 and the insulation shielding layer 4 as semi-conductive shielding material, setting the insulation layer 3 as ultra-high-temperature-resistant fluororubber material to ensure the cable's fire resistance. The conductor 1, the conductor 1 shielding layer, the insulation layer 3 and the insulation shielding layer 4 are tightly bonded together to form the insulation wire core.

A metal shielding layer 5 is braided around the insulation wire core to form a wire core unit. The metal shielding layer 5 is formed by braiding tinned copper wires. Then, three wire core units with the same structure and performance are twisted together to form a cable core. During the twisting process of the three wire core units, a layer of non-woven fabric is wrapped around the outer periphery thereof. After the non-woven fabric is wrapped, voids are formed inside the cable core. To reduce cable deformation under squeezing, expanded glassfiber ropes are filled into these voids.

After completing the filling with the expanded fiberglass ropes, a heat insulation layer 8 is extruded around the outer periphery of the cable core. The heat insulation layer 8 is made of low-smoke halogen-free ceramicized polyolefin material. After the heat insulation layer 8 is extruded, an armoring layer 9 is formed around the heat insulation layer 8. The armoring layer 9 is also formed by braiding tinned copper wires, but the diameter of the tinned copper wire in the armoring layer 9 is larger than the diameter of the tinned copper wire in the metal shielding layer 5. After the armoring layer 9 is formed, an outer sheath 10 is extruded around the armoring layer 9. The outer sheath 10 is an irradiated crosslinked low-smoke halogen-free outer sheath 10, and a reflection magnet is added during the irradiation cross-linking process to ensure the performance consistency of the outer sheath 10.

When the cable is connected to a 6kV voltage, the entire cable can withstand burning at 830°C for 120 minutes without short circuit or open circuit, and can operate normally.

The ceramicized polyolefin will form a ceramic shell within 3-5 minutes with flame at 830°C, forming a dense and heat-resistant oxygen-barrier layer. This makes it difficult for external heat to be transferred into the internal of the cable. Simultaneously, the internal wrapping materials of the insulation layer and filling layer meet the requirement for high-temperature resistance. The high dielectric constant and high heat resistance of the internal fluororubber material allow for normal operation under high temperature and high voltage conditions. This guarantees that the entire cable can be burned in an 830°C flame for 120 minutes without short circuit or open circuit, and can operate normally.

The present invention addresses the deficiencies in the prior art and offers the following beneficial effects:

In this solution, the fluororubber comprises a first fluororubber and a second fluororubber, the first fluororubber has a fluorine content greater than or equal to 70%, while the second fluororubber has a fluorine content of 65%-70%. Mixing the two kinds of fluororubbers improves mechanical properties while maintaining heat resistance, and is more cost effective than only using fluororubber with high fluorine content. The involved insulation layer 3 of the cable uses ultra-high-temperature-resistant fluororubber, which possesses excellent insulation and heat resistance. The filler material uses expanded fiberglass ropes, which tightly fill the cable core, preventing voids caused by the decomposition of conventional filler materials at high temperatures, deformation of the insulation layer under squeezing pressure, and uniform electric field breakdown. Simultaneously, the fiberglass ropes are subject to expanding treatments to soften the fiberglass,

avoiding the problem of being prickly to touch during use. The insulation layer 8 is made of ceramicized polyolefin, which forms a tight insulation layer 8 at a temperature of above 500°C, effectively isolating heat outside the cable core and ensuring insulation integrity to meet the requirement for normal electric energy transmission in case of fire.

Those skilled in the art can make various changes and modifications without departing from the technical concept of the present invention according to the above mentioned description based on the suggestion from the preferred examples of the present invention described above. The technical scope of the present invention is not limited to the contents of the specification, but must be determined according to the scope of the claims.

Although the preferred embodiments of the present invention have been described above in detail with reference to the accompanying drawings, the present invention is not limited to the specific details of the above embodiments. Within the scope of the technical concept of the present invention, various simple variations can be made to the technical solution of the present invention, and these simple variations all fall within the protection scope of the present invention.

In addition, it should also be noted that the various specific technical features described in the above specific embodiments can be combined in any suitable manner without contradiction. In order to avoid unnecessary repetition, the present invention will not describe the various possible combinations separately.

Furthermore, various different embodiments of the present invention can be combined in any way, as long as they do not deviate from the spirit of the present invention, and such combination should also be regarded as the content disclosed by the present invention.

## CLAIMS

1. An ultra-high-temperature-resistant fluororubber material, characterized in that, said material comprises:

100 parts of fluororubber;

10-15 parts of carbon black;

3 parts of peroxide vulcanizing agent;

4 parts of co-cross-linking agent;

3-5 parts of acid acceptor;

1-2 parts of auxiliary acid acceptor;

3-5 parts of filler;

2-6 parts of processing aid;

the fluororubber comprises a first fluororubber and a second fluororubber, the parts of the first fluororubber is greater than or equal to 1.5 times the parts of the second fluororubber, both the first fluororubber and the second fluororubber are ternary fluororubbers, the fluorine content of the first fluororubber is greater than or equal to 70%, and the fluorine content of the second fluororubber is 60%-65%;

the peroxide vulcanizing agent is diphenylethane peroxide.

2. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that the fluorine content of the first fluororubber is set to be 70%, and the fluorine content of the second fluororubber is set to be 65%.
3. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that there are 80 parts of the first fluororubber, and 20 parts of the second fluororubber.
4. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that there are 70 parts of the first fluororubber, and 30 parts of the second fluororubber.
5. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that the acid acceptor is set as light magnesium oxide and the filler is set as silicon dioxide.
6. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that the auxiliary acid acceptor is set as calcium carbonate, and the co-cross-linking agent is set as allyl isocyanurate.
7. The ultra-high-temperature-resistant fluororubber material according to claim 1, characterized in that the processing aid is set as polyethylene wax and engine oil.
8. A marine medium-voltage ultra-fire-resistant cable, characterized in that, said cable comprises a conductor (1); a conductor shielding layer (2), an insulation layer (3), an insulation shielding layer (4), a metal shielding layer (5), a heat insulation layer (8), an armoring layer (9), and an outer sheath (10) are sequentially arranged around the conductor (1), and the insulation layer (3)

is made of the ultra-high-temperature-resistant fluororubber material according to any of claims 1-7.

9. The marine medium-voltage ultra-fire-resistant cable according to claim 1, characterized in that the heat insulation layer (8) is made of ceramicized polyolefin.
10. The marine medium-voltage ultra-fire-resistant cable according to claim 1, characterized in that the conductor (1), the conductor shielding layer (2), the insulation layer (3), the insulation shielding layer (4), and the metal shielding layer (5) are sequentially arranged to form a wire core unit, a plurality of wire core units are twisted to form a cable core, and expanded glassfiber ropes are filled inside the cable core.