

## PTFE for construction

Our company is engaged in the design, fabrication, and construction of architectural membrane structures, and we are in a position to purchase membrane materials from membrane manufacturers.

Membrane materials used in architectural applications include PTFE-coated glass cloth membranes, PVC-coated polyester or glass cloth membranes with a top coat of PVDF or titanium oxide, and ETFE films.

Most of these membrane materials are utilizing Fluoropolymers PFAS, which will not be able to be used if fluoropolymers are restricted.

These membrane materials are used for architectural roofing & façade due to their lightweight nature, safety, design flexibility, and ability to create well-lit interiors underneath.

The main applications of membrane materials include stadiums, train stations, gymnasiums, sports facilities, recreational facilities, roofs of large plaza and shopping malls and wall facades of buildings.

Especially for applications that require durability of over 40 years, such as stadiums, PTFE-coated membrane materials are adopted.

In recent World Cups (in Germany, Brazil, South Africa, Qatar), the roofs of 23 out of all the 42 stadiums (55%) were membrane roofs, all of which used membranes utilizing PFAS.

Glass fabrics coated with PTFE possesses high durability, corrosion resistance, light transmission, and antifouling properties, making it an essential material among highly-durable membranes.

Glass fabrics coated with PTFE membranes have a proven track record of over 30 years of service life, with some projects even exceeding 50 years (project list attached in Section IV).

There is no alternative to PTFE coating for such highly durable membrane materials, and there are no membrane materials with comparable performance. If PTFE is restricted, there will be no viable alternative, and membranes will no longer be used on long lasting stadium roofs.

PVC membranes are commonly used for architectural structure, but their service life is approximately 10 years when not protected by a PVDF top coat, with the assumption of replacement within 10 years.

If PVDF Fluoropolymers, is top coated on PVC membranes, the service life extends to 15 to 25 years (depending on the type of PVDF).

In addition, if titanium oxide is top coated on PVC membranes, the service life is about 15 years. But PVC/TiO<sub>2</sub> is already existing for long time and is still representing a very low part of the PVC coated membranes worldwide and especially in Europe.

If PVDF top coating is prohibited, membrane materials will be limited to applications where replacement is possible within 10 to 15 years and the market for membrane structures will shrink significantly. PVC/TiO<sub>2</sub> will not be an alternative for PVDF.

Pure ETFE foils is a membrane material that can be used as an alternative to

glass. It is transparent, has the same durability as glass, and is lightweight and safe. Its safety even if it breaks, which is a big advantage over glass, greatly contributes to its adoption. ETFE foils are very light and more flexible than rigid glass panels. It is an alternative in challenging environment like earthquake or stormy zones.

If the use of ETFE is prohibited, there is no other resin that combines transparency, flexibility and durability as an alternative, so traditional glass will continue to be used in atriums.

ETFE is 100 times lighter than glass and its Environmental product declaration (EPD) is available (See the attached in Section IV).

Fluoropolymers are totally different from other PFAS. Their toxicological and environmental profiles are totally different than other PFAS chemicals that are of concern. Fluoropolymers used in Tensile architecture such as PVDF, ETFE, ECTFE, FEP, PFA, PTFE, are inert, stable, resistant to fire, stain resistant, and highly durable. All those characteristics make them unique and non-replaceable by any other alternative because no other material is able to achieve all performances together. And as there is no toxicological and environmental reason to consider them in the same restriction process as other PFAS. We are deeply concerned that the regulation of PFAS would set the architectural membrane industry back by 50 years and we support the statement made by FCJ on the issues of proposed restriction as per attached in section IV and request an exemption of all fluoropolymers from this restriction proposal under the REACH regulation.

**Answer to specific info request 1:**

Architectural membranes (Polyester coated with PVC & fluoropolymer top coat)

Architectural membranes (Glass coated with PTFE pure fluoropolymers)

Architectural membranes (ETFE film/foil for roofs & greenhouses)

**Answer to specific info request 8:**

a. PTFE is used for coating composite membranes with glass cloth. As a manufacturer of roofs we use Glass/PTFE membrane that represent a total consumption of PTFE is 3.8 tons. Pure ETFE foils are used as standalone architectural membrane. The annual usage of ETFE is 9.7 tons. We use PES/PVC/PVDF membranes. PVDF is thinly coated on the surface of PVC for its antifouling and weather-resistant properties. The annual usage of PVDF is 0.3 tons. b. (1) PTFE PTFE is coated on both sides of glass cloth and used as a membrane material, being the only resin that simultaneously possesses the durability of over 40 years, fire safety, dirt resistance, and light transmittance required for large-scale architectural membrane applications. PTFE is considered an indispensable material for roofs of buildings, such as stadiums, designed to be in use for over 40 years. (2) ETFE ETFE is a single film used in membrane structures, having transparency, durability of over 30 years, dirt resistance, and fire safety as a membrane material. In architecture, ETFE is employed as an alternative to glass, serving as the essential and sole material that combines transparency, durability, and safety. (3) PVDF PVDF is used as a PVC top coat, providing protection for PVC, enhancing durability and dirt resistance. General

PVDF top coated membranes are designed to have a durability of 15 years, while specialized PVDF top coated membranes are designed to have a durability of 25 years. c. Directly, membrane manufacturers, membrane processing companies, and construction companies within the EU will be affected. Indirectly, membrane manufacturers, membrane processing companies, and construction companies outside the EU that conduct business with EU will also be affected. The number of companies is unknown. d. Alternatives to PTFE membrane materials: The durability of PTFE membrane is 40~50 years. (1)Membrane material coated with PVC on both sides of glass cloth. The surface of this membrane is thinly coated with titanium oxide as an antifouling treatment. It has a durability of 15 years. It exhibits excellent antifouling performance. It's cost is lower than PTFE. Its tensile strength is low. This membrane material cannot serve as an alternative to PTFE membranes in terms of durability. (2)Membrane materials coated with PVC on both sides of polyester cloth. There are two types of membrane materials within this kind; one is top coated with titanium oxide and the other is top coated with PVDF for an antifouling treatment. Both have a durability of 15 years. They exhibit excellent dirt resistance. It is possible to manufacture ones with high tensile strength. However, as the thickness increases, permeability decreases. These membrane materials cannot serve as alternatives to PTFE membranes in terms of durability and fire resistance. (3)Membrane material coated with silicone on both sides of glass cloth. It is durable for over 20 years. Its antifouling performance is low and has not been improved for 30 years. Since no antifouling coating can be applied over silicone, it is impossible to provide antifouling property to it. It has low tensile strength and poor bonding performance. Although this membrane material has better durability than PVC, due to its poor antifouling and bonding performances, it cannot be used as an alternative. This material has been developed more than 20 years ago and never been a success in tensile roof with only few big project done which have not been success stories. It is concluded that no material is as durable as PTFE. Alternative to ETFE: The durability of ETFE is over 30 years. Membrane materials using transparent PVC have comparable transparency to ETFE, but their weather resistance is significantly poor, resulting in a service life of approximately 5 to 7 years. They cannot serve as alternatives for ETFE. There are no other transparent resins that can replace ETFE. Alternative to PVDF top coated membrane: The durability of a general PVDF top coated membrane is 15 years, while a specialized PVDF top coated membrane can last 25 years. (1)Acrylic top coated membrane: Acrylic top coat has lower UV blocking performance and a durability of 10 years, which is 5 years shorter than a general PVDF. Additionally, its antifouling performance is lower than PVDF. (2)Titanium oxide top coat membrane: The durability of a titanium oxide top coated membrane is 15 years, which is equivalent to a basic PVDF. However, it is 10 years shorter than a specialized PVDF. It exhibits excellent antifouling performance. e. Composite membrane material of glass cloth coated with silicone is available, but it has extremely poor antifouling performance. If used as a roofing material, regular cleaning every few months is necessary to maintain its

whiteness, which is not practical. If the membrane is initially made gray, the dirt becomes less visible, but it hinders light transmission, negating the benefits of using a membrane. Additionally, special tapes are required for bonding, and the thermal bonding process requires higher pressure compared to PTFE, resulting in the need for facility upgrades costing hundreds of thousands of dollars. f. Currently, the available alternative membrane material is PVC membrane with titanium oxide top coat, which has a service life of 15 years and good dirt resistance. However, using PVC membrane with titanium oxide top coated as an alternative to PTFE membrane in stadiums is not feasible due to its relatively short service life, requiring replacement every 15 years. Stadium owners are unlikely to accept the cost of frequent replacements within a short period. As a result, membrane solutions will no longer be chosen for stadiums, and alternative roofing materials will be selected instead. Moreover, in the case of existing PTFE membranes that have suffered partial damage from flying objects or other causes, repairs cannot be made with PVC membrane with titanium oxide top coat. Consequently, a switch to non-membrane roofing materials becomes necessary. However, this would involve structural changes, leading to a complete rebuild and placing a significant financial burden on the owners. (Please refer to the attachment in Section IV for the list of existing PTFE and ETFE projects within the EU.) As for the alternatives to PVDF top coat membrane, the durability of general PVDF is 15 years. Therefore, PVC membrane with titanium oxide top coat can be considered as a viable alternative with similar durability. However, PVC membrane with titanium oxide top coat is already existing for long time and is still representing a very low part of the PVC coated membranes worldwide and especially in Europe. Specialized PVDF membrane materials offer a durability of 20 to 30 years, making them less durable options compared to PVC membrane with titanium oxide top coat . As a result, the replacement cycle for PVC membrane with titanium oxide top coat would be sooner in these cases. g. In practice, there are no alternative membrane materials that can replace PTFE membrane or ETFE. Therefore, in the EU market, only PVC membranes without PVDF will be available, resulting in a significant contraction of the membrane structure market. It is certain that our group company in the EU (Taiyo Europe) will be greatly affected, and we will have no choice but to consider withdrawing from the EU market. On the other hand, outside the EU, we plan to continue manufacturing and selling PTFE membranes, ETFE, and PVDF top coat membranes as before. However, we will no longer be purchasing membrane materials from EU-based manufacturers subject to regulations. In addition, the existing PTFE membrane and ETFE buildings in the EU cannot be repaired if the membrane is damaged, so they will have to be changed to roof materials other than membrane materials. This would involve a complete structural overhaul, imposing a significant financial burden on the owners.

