



- 1+2 *Membrane cushion structure on the Water Cube, Beijing (Image source: Vector Foiltec GmbH).*
- 3 *Bonded oval-shaped membrane cushions made of ethylene tetrafluoroethylene (ETFE) films.*

MEMBRANE CUSHIONS AND ADHESIVE BONDING TECHNOLOGY – INNOVATION IN THE CONSTRUCTION INDUSTRY

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Status quo

Membrane cushions allow freedom of design in shape and color, and are used, for example, for transparent roofs and facades. Buildings such as the Beijing National Aquatics Center, colloquially known as the Water Cube, demonstrate this. Innovative membrane cushion technology for building structures and building envelopes is setting forward-looking standards in architecture.

The advantages of these structures are their lighter weight, greater flexibility, and more favorable cost than traditional building envelopes made of glass, metal, or rigid plastic elements. The film systems require relatively little material and this can be effectively recycled into type-pure materials.

Ethylene tetrafluoroethylene (ETFE) films are mainly employed. Features of these films are their extraordinary transparency, resistance to weathering, energy-saving potential, and self-cleaning properties. Due to their low weight and the resultant filigree bearing structures, they not only provide a much cheaper alternative to conventional structures but they also have incomparable resistance to collapse.

Adhesive bonding – The joining technique for membrane cushions

The multifunctional properties demanded of new membranes by the marketplace and the combinations of different materials that are needed for this necessitates the development of new joining technologies. Studies have shown that adhesive bonding technology is suitable for membrane cushions in the desired free forms.



Adhesive bonding – The procedure

Specification of the requirements on the adhesive

Transparency, UV stability, rapid curing, flame retardant properties, visual appearance (joint width: maximum 10 mm), suitable for automated adhesive application

Selection of the adhesive

Hotmelts (solvent-free), application to the bonding area in the hot state, hand tightness within seconds allows further processing or transport of the joined materials within a very short time

Surface pre-treatment with atmospheric pressure plasma

improves the wetting of the membrane films by the adhesive

Application of the adhesive

using a special wide-slit nozzle developed at the Fraunhofer IFAM

Range of services offered by the Fraunhofer IFAM

- | Specification of requirements for bonding processes in the construction industry
- | Development and modification of adhesives for special applications
- | Modification of the surfaces of materials which are not suitable for adhesive bonding (cleaning and activation)
- | Design and dimensioning of bonded joints via FEM simulation
- | Testing materials and components, for example, testing the fatigue properties of bonded joints
- | Development of special application techniques
- | Determination of parameters for bonding processes in the construction sector
- | Implementation of adhesive bonding technology into construction processes
- | Quality assurance for bonding processes
- | Workforce training for adhesive bonding in the construction industry

Adhesive bonding in the construction industry – The advantages

Adhesive bonding is already a key aspect of innovative technology development in the building industry. It hence provides an economical key contribution to maintaining existing jobs and the creation of new jobs.

- | Design freedom
- | Joining of virtually all materials, producing joints having long-term resistance
- | Integration of additional functions such as
 - compensation of tolerance
 - sealing effects
 - vibration damping
- | Weight reduction
- | Extensive load transmission leads to more uniform stress distribution
- | No material degradation by drilling, screwing, knocking, etc.
- | Low heat input
 - No change to the material microstructure and no thermal distortion of the adherends
 - Preservation of the material properties
- | No contact corrosion

- 4 *Magnification of the transparent, high-load bearing bonded seam of a membrane cushion.*
- 5 *Water Cube, Beijing: TEXTON® roof and facade systems produced by Vector Foiltec GmbH (Image source: Vector Foiltec GmbH).*