

MATCHING ADHESIVES TO MATERIALS

The Key to Durable and Reliable Bonding

Successful bonding is never a coincidence.

Behind every strong and durable adhesive connection lies one essential principle: **The right adhesive must match the right material, application, and environment.**

In modern façade construction and industrial applications, adhesive technology has become a highly advanced engineering solution. Yet many bonding failures still occur because the fundamentals of adhesive selection are underestimated.

At TWEHA®, we believe that understanding how adhesives work is the foundation for long-term performance and reliability.

Why Adhesive Failures Occur

Most adhesion failures can be traced back to four critical causes:

- A mismatch between the adhesive and the materials being bonded
- A mismatch between the adhesive and the environmental conditions
- A mismatch between the adhesive and the forces acting on the bond during its lifespan
- Insufficient or incorrect surface preparation

This is exactly why selecting the correct adhesive or sealant is so critical.

A bonded façade system is exposed to:

- Wind loads
- UV radiation
- Moisture
- Temperature fluctuations
- Structural movement
- Expansion and contraction forces

Only a properly selected adhesive system can withstand these conditions over the long term.

Understanding Adhesion Failure

When adhesive failure occurs, the type of failure often reveals the underlying cause.

Cohesive Failure

If adhesives remain on both bonded surfaces after separation, this is known as cohesive failure.

In this case:

- The adhesive itself may not have had sufficient strength
- The curing conditions may have been inadequate
- Environmental exposure may have exceeded the adhesive capabilities

Adhesive Failure

If adhesive remains only on one side of the joint, the issue is usually related to:

- Poor surface preparation
- Incorrect adhesive selection
- Incompatible substrate materials

Understanding these failure mechanisms is essential to creating reliable bonded systems.

Adhesion and Cohesion — The Science Behind Bonding

To fully understand how adhesives work, two important forces must be considered:

Adhesion

Adhesion is the force that creates the bond between the adhesive and the substrate surface.

Cohesion

Cohesion is the internal strength of the adhesive itself — the force that keeps the adhesive layer together under load.

A successful adhesive system combines both strong adhesion and strong cohesion.

Different Types of Adhesion

Modern adhesive technologies use multiple bonding mechanisms simultaneously to achieve high performance.

Chemical Adhesion

Chemical adhesion creates extremely strong molecular bonds between adhesive and substrate.

Examples include:

- Covalent bonding
- Ionic bonding
- Hydrogen bonding

This is particularly important when bonding materials such as:

- Glass
- Metals
- Mineral surfaces
- Ceramics

For example, silane adhesion promoters are widely used because they chemically react with surfaces rich in hydroxyl groups, creating highly durable bonds.

Physical Adhesion

Physical adhesion works differently.

Here, the adhesive:

- Mechanically locks into porous surfaces
- Uses intermolecular attraction forces
- Diffuses partially into the substrate material

This mechanism is often used when bonding:

- Textiles
- Plastics
- Composite materials
- Porous surfaces

In many plastic bonding applications, solvent-based systems partially soften the surface, allowing materials to merge at the molecular level — also known as a “solvent weld.”

Surface Wetting — One of the Most Important Factors

Even the strongest adhesive cannot bond properly if it cannot wet the surface correctly. Successful bonding requires the adhesive to spread evenly across the substrate surface. In simple terms: **The surface tension of the adhesive must be lower than the surface tension of the material.**

This explains why some materials are easy to bond, while others are notoriously difficult.

Easy-to-Bond Materials

- Metals
- Glass
- Mineral surfaces

These materials have high surface energy, making them ideal for adhesive bonding.

Difficult-to-Bond Materials

- Polyethylene (PE)
- Polypropylene (PP)
- Silicone
- PTFE (Teflon™)

These materials have extremely low surface tension, making adhesion far more challenging. In such cases, surface preparation becomes essential.

The Importance of Surface Preparation

Surface preparation is often the difference between long-term success and premature failure.

Proper preparation may include:

- Cleaning
- Degreasing
- Abrasion
- Priming
- Chemical activation

These treatments increase the surface energy and improve adhesive performance dramatically.

At TWEHA®, we continuously emphasize that even the best adhesive system cannot compensate for poor substrate preparation.

Bonding Is Engineering — Not Guesswork

Modern adhesive bonding is far more than simply applying glue between two materials.

It is a precise engineering process involving:

- Material compatibility
- Environmental resistance
- Mechanical performance
- Structural behavior
- Long-term durability

That is why expertise matters.

TWEHA® — Your Knowledge Partner in Bonding

At TWEHA®, we combine decades of practical façade experience with deep technical knowledge of adhesive technologies and substrate behavior.

We help façade professionals worldwide select the correct bonding solution for:

- Ventilated façade systems
- Composite panels
- Fiber cement
- Ceramics
- Natural stone
- Metal cladding
- High-performance façade applications

Because successful bonding starts with understanding the materials.

And when the right adhesive is perfectly matched to the right application, bonding becomes one of the most durable, reliable, and aesthetically advanced fixing methods available today.

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