

Adhesive Bonding

Adhesive bonding is a process of joining materials in which an adhesive (liquid or a semi solid state material) is placed between the faying surfaces of the work piece / parts (adherents) to be joined. Either heat or pressure or both are applied to get bonding.

Four essential steps are required to follow to make an adhesive joint including (a) preparation of the surfaces, (b) application of the adhesive on to the mating surfaces, and (c) assembly of work pieces / parts and (d) curing the joint.

a) Preparing the surface

The work piece surfaces are cleaned by chemical etching or mechanical abrasion. Grinding, filing, wire brushing, sanding and abrasive blasting are some of the mechanical cleaning methods. Next the prepared surfaces are tested by their affinity to be wetted by water. It is called water-break test. Smooth spread of water is an indication that the surface is chemically clean while the collection of droplets indicates the possibility of oil film in the surface.

b) Application of the adhesive to the surface

Adhesives are applied on to the work piece surface by hand brushing, spraying, roller casting, knife coating and dipping. They are also applied as sheet or tape type coating to the surface. The adhesive are either applied as one thick layer on one of the work piece surface, or as a thin layer on surfaces of both the work piece.

c) Assembly of work pieces

After the application of the adhesive, the work pieces are assembled and held together by means of clamps, tools, tack welds, or other fixtures. During the assembly process, sufficient care should be taken so that the open time of the adhesive is not exceeded, the parts are put together in the proper sequence, the bonding is performed under specified environmental conditions, and the parts are held together until cured.

d) Curing the joint

Curing is the process during which an adhesive changes from a liquid state to solid. The curing of the adhesive is performed with pressure and either heat or addition of suitable catalyst. The pressure should always be uniformly distributed over the entire joint. The curing temperature, time and the pressure combinations for different adherents and adhesive combinations are given elsewhere.

Adhesive Types

A large number of commercial adhesives are available. They can be classified into three categories: (1) natural, (2) inorganic, and (3) synthetic.

1. **Natural adhesives** are derived from natural sources (e.g., plants and animals), including gums, starch, dextrin, soy flour, and collagen. This category of adhesive is generally limited to low-stress applications, such as cardboard cartons, furniture, and bookbinding; or where large surface areas are involved (e.g., plywood).
 2. **Inorganic adhesives** are based principally on sodium silicate and magnesium oxychloride. Although relatively low in cost, they are also low in strength—a serious limitation in a structural adhesive.
 3. **Synthetic adhesives** are those that are not found in nature and are designed and manufactured by man. Synthetic adhesives are the most widely used adhesives in the various sectors that use these materials, because the mechanical, physical and chemical properties of these adhesives are far superior to natural adhesives. Synthetic adhesives include a variety of thermoplastic and thermosetting polymers
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Advantages

1. Fast and cheap joining technique
2. The adherents are not affected by heat
3. Uniform stress distribution
4. Possibility to join large structures
5. Ability to join different materials
6. Possibility to join very thin adherents
7. Gas proof and liquid tight joints
8. No contact corrosion
9. Good damping properties
10. High dynamic strength

Limitations

1. Joints are generally not as strong as other joining methods;
2. Adhesive must be compatible with materials being joined;
3. Service temperatures are limited;
4. Cleanliness and surface preparation prior to application of adhesive are important;
5. Curing times can impose a limit on production rates; and
6. Inspection of the bonded joint is difficult.

Applications of Adhesive Bonded Joints

1. Bonding of metal to non-metals especially plastics is the major application of adhesive bonding.
 2. Widely applicable in fastening of stiffeners to the aircraft skin and in assembling honeycomb structures in aircraft
 3. Using extensively in the fabrication of aircraft internal structures and providing the smooth surface for supersonic planes.
 4. Useful in automobile industry for attaching brake lining to shoes, automatic transmission bands, and stiffeners
 5. Find applications in the fabrication of railway coaches, boats, refrigerators, storage tanks, and microwave reflectors for radar and space communications.
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