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Introductory Chapter: The Importance of Adhesives in the World

António B. Pereira and Alexandre Luiz Pereira

1. Introduction

An adhesive is a natural or synthetic product that can hold pieces together, usually by surface connection. These materials can be metals, composites, ceramics, etc., and combinations between ones. Its use has been going on for many years, but from the year 40, the technology of adhesives evolved considerably [1]. It is due to the use of synthetic polymers in the adhesives.

These polymers easily adhere to most materials and can transmit stress considerably. There are several types of adhesives, each of which is naturally more suitable for each application.

The range is extensive, from epoxy, and polyurethane, to polyimide, with one or more components. They can be applied, e.g., in the form of a paste, liquid, film, or pellets. There are hot melt adhesives, reactive hot melt, thermosetting, thermoplastic, pressure sensitive, and contact. The applications can be of the structural kind, in cases where high mechanical strength is usually required, but there are also applications for other purposes, such as silicone sealing. The adhesives may also contain additives in your composition, such as metal nanoparticles (e.g., copper, nickel, or silver), water, oil, etc., to improve their properties and increase their durability.

2. Applications of the adhesives

Aeronautical applications have been one of the main motivations for the development of adhesive technology with the use of adhesively bonded joints. However, today, other areas are also gaining from adhesive bonded technology. They are the automotive, naval, sports industries, and so on. Reducing the weight of an automotive vehicle generates fuel savings, an increase in speed, and a decrease in pollutant levels, for this, lighter materials such as aluminum, composites, and plastics have been used in their projects. The binding of these materials by traditional methods (bolts, rivets, welds, brazing, and other interference connections) is difficult to make, hence the preference for adhesive bonded [2]. Composites and adhesives develop together because bonding with adhesive is better in this case. It is possible to find in the literature several works made of composites reinforced with vegetable fibers and their adhesively bonded [3]. Another example in the naval area is the use of composites or metal-composites glued to repair pipelines, it is due to corrosion resistance and low

weight, also the bonding in the composite with adhesive is better [4]. In the industry in general, it has become a common practice to repair pipelines using adhesive joints [5]. In the sports area, equipment such as bicycles, helmets, rackets, etc., that use lighter materials such as plastics and composites in their projects, also use this bonding technology through adhesively bonded joints [1]. Adhesives are used in almost all consumer products. You can bond almost anything, from rock (civil construction, decorative items), and metals to plastics, including natural materials such as sisal fibers. In a general way, the use of adhesives ranges from simple pens to much more sophisticated pieces, like some components of a spaceship.

Adhesive bonded and their projects for adhesively bonded joints are areas that need knowledge of various sciences and technologies: namely, physics, chemistry, mechanics, the study of surfaces, types of polymers for adhesives, the mechanical design of adhesive joints, as well as knowledge of economics [1]. Thus, the study of adhesives is a multidisciplinary area of great growth and technological importance today.

3. Some advantages and limitations of the adhesives

There are several advantages to using adhesively bonded joints, some are uniform stress distribution in the bonded area, vibration dampening, joining on surfaces of different materials, (e.g., vegetable-fiber-reinforced polymer matrix composites bonded with metals [6]), allows joining surfaces with irregular geometries, may be more economically viable [1].

Adhesive applications still have limitations (compared with traditional mechanical methods), therefore, the importance of the study and development of this area. In an adhesive bonded, stresses such as cleavage and peel on adhesive bonded must be avoided, shear stresses are preferable, avoid geometries that present localized stresses, a careful preparation of the surfaces to be bonded (cleaning and degreasing with solvents, abrasion, etc.) [1]. **Figure 1** shows the types of stresses that should be avoided in adhesively bonded joints.

Figure 2 shows a single-lap adhesive joint working in shear stresses. This is a better condition, as the stresses are parallel to the adhesive bonded and are also better distributed.

Mechanical strength in structural metal applications still has limitations. Really, for example, the bonding of two stainless steel pieces is very compromised being done with adhesives. Just think that steel has an ultimate strength of 600 MPa, while the adhesive resists, at most 10% of that, i.e., 60 MPa. In metal of the thickness thin, these limitations are less.

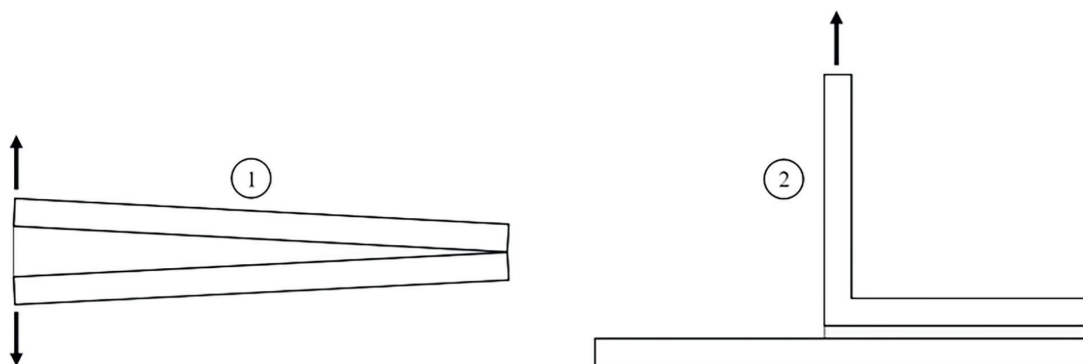


Figure 1.
Stresses that should be avoided in adhesively bonded joints: (1) cleavage, and (2) peel.

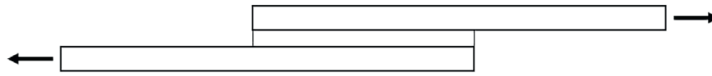


Figure 2.
Single-lap adhesive joint working in shear stresses.

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Author details


António B. Pereira^{1*} and Alexandre Luiz Pereira²

1 TEMA – Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Aveiro, Portugal

2 Federal Center of Technological Education in Rio de Janeiro (CEFET/RJ), Brazil

*Address all correspondence to: abastos@ua.pt

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