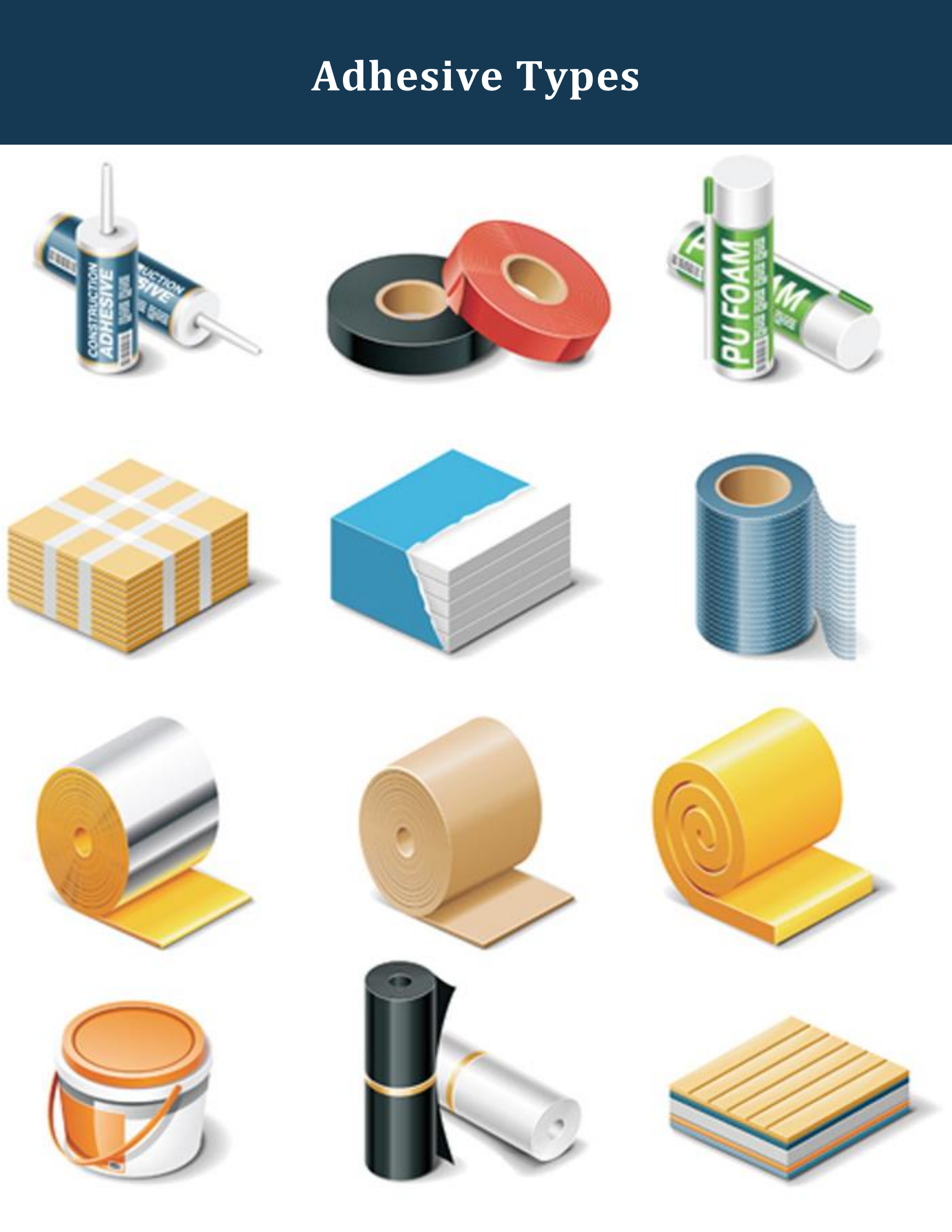
Adhesive Types



Introduction

Adhesives can be classified into three main types given below. There are of course several products that are combinations of these three types but essentially all adhesives can be grouped into these categories.

1. Chemical reactive types
2. Thermoplastic (Hot melt adhesive)
3. Evaporation or diffusion types

1.0 Chemical reactive types

Basically an adhesive of this type is supplied in a low molecular weight form and after application a polymerisation reaction is allowed to take place. Types of Chemical reactive adhesive are:

1.1 Two component pack.

Supply the produce as a two component pack, i.e. base plus hardener. Examples of this type are:

Adhesive/ Base	Curing Agent / Hardener
Epoxy adhesives based on epichlorhydrin bisphenol	Cured with amines or polyamide
Phenolics adhesives i.e. a novalac type	Hexamethylene Tetramine
Unsaturated polyesters	Organic peroxide, i.e. M.E.K. peroxide and cobalt naphthenate
Polysulfide	Lead Dioxide or an Isocyanate
Polyurethanes	Isocyanate
Silicone polymers	metal salt of' an organic acid, e.g. lead octoate
Reactive acrylics	peroxides or amines

Common problems associated with two component types - difficult to ensure correct and adequate mixing of the two components (often by unskilled personnel or in adverse conditions).

1.2 Moisture (Single Component Adhesives)

Polymerisation can be achieved by relying on moisture either on the surface of the adherend or in the atmosphere to effect a cross-linking mechanism on some other "natural" component. In this case the adhesive is supplied as a single component.

Polyurethane	Polyurethane containing an isocyanate group.
Cyanoacrylates	These are the instant bond adhesives.
Silicones	Silicones containing an acetyle group. These are the common R.T.V. silicones whichwith moisture releases acetic acid causing a cross-linking of the paste to an elastomer.
Anaerobic	Anaerobic which rely on absence of oxygen.

Common problems associated with moisture type adhesives - Poor shelf life even when stored in sealed containers. Once container is opened the life will drop rapidly

1.3 Heat

Heat curing adhesives consist of a pre-made mixture of two or more components. When heat is applied the components react and cross-link. This type of adhesive includes thermoset epoxies, urethanes, and polyimides Curing a chemical reactive type is by utilising heat to polymerise the adhesive components.

Examples are:

Expoxies	Expoxies with the catalyst incorporated in the adhesive in a latent form, e.g. dicyandiamide which will require a temperature of 175oC to effect a cure
Phenolics	Phenolics of the resole type
Polyvinyl acetates	Polyvinyl acetates which are based on polyvinyl alcohol reacted with an aldehyde. The conversion

	is normally about 80% and on heating after application the cross linking is completed.
Urethanes	Urethanes incorporating a blocked isocyanate. The free isocyanate groups are all reacted with a temporary blocking agent such as phenol which is stable up to 150oC.

Common problems associated with moisture type adhesives - Poor shelf life plus the problem of heating the adhesive or adherend.

1.4 Radiation

Ultraviolet (UV) light curing adhesives, also known as light curing materials (LCM), have become popular within the manufacturing sector due to their rapid curing time and strong bond strength. Light curing adhesives can cure in as little as a second and many formulations can bond dissimilar substrates (materials) and withstand harsh temperatures. These qualities make UV curing adhesives essential to the manufacturing of items in many industrial markets such as electronics, telecommunications, medical, aerospace, glass, and optical. Unlike traditional adhesives, UV light curing adhesives not only bond materials together but they can also be used to seal and coat products. They are generally acrylic-based.

2.0 Thermoplastic (Hot melt adhesive) type

Basically the adhesives in this class are thermoplastic in nature which means they are heated to a sufficient temperature where they will flow and wet the substrates and then set and develop the bulk strength on cooling. The ideal Hot Melt adhesive is a solid up to a temperature of 80oC (as a minimum) but will then melt sharply to give a low viscosity fluid that is easily applied and capable of wetting the adherend followed by rapid setting upon cooling. They normally contain a base high molecular weight polymer together with tackifying resins and viscosity depressants.

Ethylene vinyl acetate	a polyethylene chain containing the highly polar acetate group.
Ethylene-ethyl acrylate	which has an ethyl acrylic grouping
Ionomers	derived from ethylene acrylic acid copolymers but including a metal cation or some of the pendant carboxyl groups. The metal cation is free to cross-link with the anionic side groups similar to a thermosetting resin but the reaction is thermally reversible.
Phenoxies	similar chemical structure to epoxides
Polyamides (veg origin)	of low to intermediate molecular weight based on the unsaturated dibasic acids of vegetable origin.
Polyesters (saturated)	
Vinyl resins	such as polyvinyl acetate, polyvinyl butyral and polyvinyl ethers – used in various special areas.

Common problems associated with hot melt adhesives - Uneven heating during application could lead to thermal degradation.

If held at a high temperature for a long time the thermoplastic nature of the polymer is affected.

Also the stress concentrations built up during curing caused by shrinking process

3.0 Evaporation or diffusion types

In adhesives of this class the adhesive polymers is essentially in its final form however wetting of the adherend is achieved by dissolving or dispersing the polymers in a suitable solvent.

3.1 Solvent Based Systems

Rubber adhesives	Rubber adhesives - usually based on an elastomer which is either natural or synthetic. **Synthetic rubber -** polychloroprene nitrile rubber (a copolymer of butadiene and acrylonitrile) butyl rubber (a copolymer of isobutylene and isoprene) Styrene butadiene rubber. **Natural rubber -** Natural rubber is essential isoprene.
phenol-formaldehyde adhesives	Normally resins, usually phenol-formaldehyde based, are incorporated.
Resorcinol Formaldehyde adhesives	Phenolic or resorcinced formaldehyde resins dissolved in a solvent.

Vinyl adhesives	Vinyl resins such as polyvinyl acetate, polyvinyl chloride, polyvinyl ether etc.
Acrylic adhesives	Acrylic resins based on methyl methacrylate, ethyl acrylate, acrylic acid etc.
Others	Miscellaneous resins such as cellulose acetate and polyamides.

Common problems associated with Evaporative based adhesives - Elimination of the dispersing medium which could be toxic or inflammable or slow to leave the adherend.

A large percentage of the adhesive is basically waste and non-recoverable.

Possible damage to the adherend by the dispersing medium.

3.2 Water Based Systems

Very few polymers have sufficient molecular weight to be attractive as adhesives and which can dissolve in water. Examples are:

Rubber latices	Polychloroprene, Nitrile or Styrobutadiene rubber.
Vinyl resins	Polyvinyl acetate emulsions are very widely used.
Acrylic resins	Acrylic resins which offer some advantages over PVA types such as water and solvent resistance.

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