

NATURAL RUBBER LATEX BASED ADHESIVES TO BOND VARIOUS MATERIALS

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Natural rubber based mixtures can be used in various applications such as in adhesive industry in large proportions as sealants in metal cans, jars *etc.*, leak proof sealants for concrete and as a base material in the paint industry. It can be used in impregnation of textiles in water proofing applications, carpet backing, adhesive in pressure sensitive and quick grab in packaging industry *e.g.* in blister packs.

A characterisation of most sealants and adhesives is that they are applied in wet or fluid conditions so that the surfaces to be bonded are easily wetted or permeated; the load bearing strength of the bond develops by drying or by a chemical setting action.

The sealants and adhesives are generally based mainly on solutions of polymers including synthetic rubbers in organic solvents. However, the uncertain economics of oil derived solvents and their fire risks and environmental pollution have encouraged manufactures to seek alternative solvent free sealants and adhesive bases. Of these alternatives main emphasis at the moment is being placed on hot melt materials compounded from thermoplastic polymers and modifying resins and on water based polymer latices including natural rubber latex.

The main advantages of a latex based system over a solvent based one are:

1. The capital cost involvements is low as heavy machinery is not required.
2. Reduced fire risks in factories.
3. Reduced pollution of the atmosphere by solvent vapours which may be harmful to the factory workers.
4. Minor modifications in the basic formulations will allow its use in a number of applications eg-water based emulsions such as paints, concrete sealants *etc.*
5. Higher solid content at spreading viscosity due to low evaporation of water in the medium. Drying can be accelerated by doping certain non-toxic materials as impurities in the compounding formulation (Thomas & Muniandy, 1987; Vanderhoff *et al.*, 1973).

Nature of NR Latex

Natural rubber latex is a dispersion of rubber particles in an aqueous medium. The size of the particles on centrifuged latex concentrates varies from 0.1 - 3 μm in

diameter. The surface of the particles is covered by a layer of non rubber substances which maintains colloidal stability. The reduction of the molecular weight of the rubber in the latex is not possible and therefore the rubber content in latex is high in molecular weight.

The presence of the continuous water phase means that modifying agents, crosslinking agents, fillers, antioxidants etc which are not water soluble must be added in a finely dispersed form to ensure adequate distribution in the dry film. This constitutes a major difference between solution and latex adhesive.

Drying

In the solution adhesives rubber and resin are instantly mixed on a molecular scale and tack is immediately apparent in the adhesive of film. With a latex based adhesive contact between rubber and resin can only occur after partial drying. Developments of tack then follows from the diffusion of tackifying agent into the rubber.

The diffusion of water present in the system has to be maximised for quick drying effect. It is known that water transport behaviour in rubber is greatly influenced by the presence of small quantities of hydrophobic impurities in the medium and most of the water present in the rubber exists as droplets at the impurity sites (Thomas & Muniandy, 1987). The diffusion takes place through the rubber matrix which is assumed to be semi permeable. The driving force of the process is considered to arise from the free energy gradient of the water dissolved in the rubber phase.

It has also been found that when latex coagulum dries, it initially exhibits a rapid rate of water removal followed by a very much reduced rate during the final stage. The initial stage is surface evaporation controlled while the later stage is essentially a diffusion process. Indications that water may be transported via hydrophilic channels or capillaries during the final stage of drying have been investigated (Thomas & Muniandy, 1987; Vanderhoff *et al.*, 1973).

Adhesive bond

The adhesive bond which is the physical strength of the adhesive itself must have a high cohesive strength to act as a good adhesive. The two principle types of adhesion is known as 'specific' and 'mechanical'. specific adhesion is related to molecular attraction and polarity and is usually the deciding factor in selecting adhesives for use on metals, glass *etc.* Here it is a particularly interesting to note that being non polar raw NR does not adhere very strong to metal surfaces unless modified to induce polarity. It is true that synthetic polymers have gained some

prominence in the manufacture of adhesives in recent years. Every potential opening for adhesives demands individual treatment and in many cases the qualities and performance of the natural products are unsurpassed.

Superiority of NR

Natural rubber plays an important role in the adhesive industry which has conventionally used masticated rubber in solution adhesives. With the trend of development away from solution and towards water based dispersions NR latex needs to be examined as a potential adhesive base. In the first place the natural products inherent tack, a property which led to the production of rubber based fixatives remains unequalled. Again as basic polymer it is more versatile than the synthetics which tends to be favoured in more specialised applications. Proof of NR's versatility lies in the fact that starting from its traditional use in the rubber solutions used for patching motor inner tubes it has boomed to form the basics of successful upholstery solutions, pressure sensitives, proofing and sealing adhesives for water proof clothing and innumerable multi purpose adhesives. Reclaimed rubber, consisting of almost entirely of NR is also widely used as a base for inexpensive cements. Which gives exceptional adhesive properties due to the high polarity imparted due to the rubber.

The selection of NR based polymer obviously influences the choice as curing media during application of the final adhesive.

The majority of solvents used in conjunction with NR are less complex and cheaper than those required with synthetic polymers. In addition, vapours which they produce are less toxic in nature whereas the solvents used in synthetic based adhesives (specially the chloroprenes) tend to have deleterious effects *eg.* polystyrene foam. NR solutions and latex based preparations can be used with complete confidence. The auto-adhesive properties of the natural products are also of value in the stationery and book binding trades, where self seal adhesives are in increasing demand. Finally NR's flexibility and elasticity render it suitable as base for adhesives and backing compounds used in the textile, carpet and allied industries.

Industrial applications

A large proportion of rubber based adhesives is consumed by the manufacturers in the footwear and automotive industries. The building industry, notably for fixing tiles and other covering to floors, walls, ceilings *etc.* is another large consumer of the NR based adhesives. The increasing tendency to use under floor heating has introduced yet another adhesive performing factor resistance to heat ageing and this is one instance where adhesives based in specialised polymers have proved superior.

A range of natural rubber based adhesives have been developed by the RRISL which can be used ideally in formica, wood, can sealing and paper industry. They may be used on a much wider range of surfaces including ceramic and vinyl tiles, leather and the resultant bonds which they produce can readily accommodate the movements of the materials bonded and growth which occur as the result of thermal changes and moisture absorption.

REFERENCES

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