Improved methods and progress of emulsion acrylic acid pressure sensitive adhesive

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Abstract. The research progress of emulsion acrylic pressure-sensitive adhesive is the focus of this paper. The methods of producing this kind of pressure-sensitive adhesive and their advantages and disadvantages in recent years are summarized. The advantages of adding silicone monomer, adhesive resin, active emulsifier or core-shell polymerization are discussed. At last, the emphasis and prospect of emulsion acrylate pressure-sensitive adhesive in the future are prospected.

1. Introduction
Pressure-sensitive adhesives, as adhesives, do not need solvents or heat energy. They only need a little pressure to stick the things they want to stick well, and the initial and subsequent persistent stickiness are good [1-2]. Another thing is very good: it can be used repeatedly when it is not contaminated by other objects, and it usually does not destroy the surface of the adhesive after use. Over time, people have developed new products - internal cross-linking without external cross-linking. For example, pressure-sensitive adhesives formed by copolymerization of N-hydroxymethylacrylamide and glycidyl acrylate can be internally cross-linked [3]. The pressure sensitive adhesive is mainly emulsion type and solvent type. The pressure sensitive adhesive is mainly emulsion type and solvent type. This article will describe the research progress of emulsion type pressure-sensitive adhesive in the production process and performance improvement since twenty-first Century.

2. Improved methods
The polyacrylate emulsion pressure sensitive adhesive has also exposed some defects during its use: water resistance, high temperature resistance and high humidity resistance are not ideal. The improvement of the following methods can greatly improve the performance of the polyacrylate emulsion type pressure sensitive adhesive, and the above shortcomings can also be improved.

2.1. Crosslinking Modification
The key to the preparation of pressure sensitivity is to keep the initial viscosity and peeling strength in balance. If the molecular weight of the copolymer is not high, try to improve it or cross-link it with something else. Then the molecular weight of the product will be increased, and the problem between performance and coating technology will be solved. Another point is more critical: after crosslinking, the adhesion of PSA is improved, which indicates that the temperature of PSA is increased. In addition
to these, the solvent resistance and aging resistance of pressure sensitive adhesives have also been improved. There are many classifications of this emulsion [4].

Wu S B [5] also studied Be-carboxyl or hydroxyl resins, and also studied the effects of temperature and pH value. Zhao Yongde, [6] and other synthetic core shell emulsions have epoxy and carboxyl groups. It is discussed whether the molecules will be affected by cross-linking reaction in the process of coating. Others [7] chose the method of combining internal and external functional monomers to prepare acrylic pressure sensitive adhesives which are very environmentally friendly. But if the crosslinking agent is changed to metal salt, bad results will appear, such as the initial viscosity and bonding force are not ideal. A part of amino resin crosslinking agent can obtain pressure sensitive adhesives with good comprehensive properties, high temperature resistance, high initial viscosity.

Liu R [8] found that the cross-linking reaction was very slow in the absence of catalyst. If toluene sulfonic acid was added to the reaction, the cross-linking reaction speed would be greatly increased. The diffusion of particles stopped before the end of the cross-linking reaction, which could form a complete structure, and the polymer changed in a distance with roughly the same particle radius.

JP2001-247832 [9] introduces acrylic polymer, which can be used to peel adhesive tape. The film on the base film is suitable for this product, and the different effects of different components on the properties of pressure sensitive adhesives are discussed. The results showed that when the content of vinyl acetate was controlled at 10%, MMA control was 6%, PVA content was controlled by 3%, the amount of crosslinking agent was controlled by 2%, and the amount of initiator was controlled at 0.2%, the conversion rate and performance of emulsion reached the best [10].

Carbonyl, a cross-linked monomer, has double bonds and carbonyl groups on one molecule at the same time. When it is copolymerized, carbonyl groups appear in the copolymer chain, which makes the reaction have crosslinking points. There is no cross-linking between carbonyl groups. If binary polyhydrazide is added, it reacts with carbonyl groups to form bonds at room temperature.

The acrylic emulsion developed by Bakker P[11] also contains hydrazide groups on the surface of the acrylic emulsion containing the carbonyl group. The emulsion has excellent properties and can be cured at room temperature and has excellent properties. Hioue M [12] et al. took polyurethane as the core and adopted a feeding method called power feeding. A composite emulsion, called polyurethane acrylate, was prepared by copolymerization with other monomers. Its structure has three different PU/PA core-shell: A/U, U/A and A/U-g-A. The results of ESCA and FTIR showed that after the emulsion became membrane, polyurethane was concentrated on the surface of the membrane, and he could adhere to various plastics well.

2.2. Adding tackifier to improve bonding strength
Polyacrylate emulsion pressure sensitive adhesive can adjust the type and quantity of monomers, so that it can change its viscosity. Whether it is pressure sensitive adhesive or initial viscosity, it can be improved by adding tackifier resin. With the development of technology, some enterprises have added tackifier resin to acrylic emulsion pressure sensitive adhesive, which has improved the bonding strength. The viscosity increasing resin emulsion used for blending has also developed rapidly.

2.3. Silicone modified polyacrylate emulsion pressure sensitive adhesive
Polyacrylate emulsion pressure sensitive adhesive has low temperature toughness and high temperature stability, so it is very difficult to bond with low surface material. The acrylic emulsion is mixed with silicone monomer, or the emulsion is copolymerized by two monomers of silicone and acrylic ester. The adhesive produced is ideal in many performance aspects. This adhesive product is very popular and expensive. In recent years, there have been many publications on this kind of pressure sensitive adhesives.
2.4. Improving Water Resistance with Reactive Emulsifier
Reactive emulsifier is also a kind of polymeric emulsifier. Its molecular structure contains carboxyl, hydroxyl, double bond, and can copolymerize with other monomers. Harvey [13] et al. developed a water-resistant pressure-sensitive adhesive with this emulsifier. Wang Feng et al. [14] developed a pressure sensitive adhesive with good water resistance by using this emulsifier.

2.5. Modification by Polymerization
The core shell emulsion polymerization method can improve the cohesion of pressure sensitive adhesives, and the polymer molecules of pressure sensitive adhesive increase greatly, and the glass transition temperature will also increase. This will achieve good results, so that the pressure sensitive adhesive prepared will have wider application prospects. R temperature range, especially the low temperature area with good bonding effect, the core shell emulsion polymerization represents a concept of "particle design". It is very convenient in controlling and designing the structure of latex particles, and the control performance of polymer can reach [15].

2.6. High solid content polyacrylate emulsion pressure sensitive adhesive
The solid content of the pressure sensitive adhesives used in industry is not high, about 55%. This content of pressure sensitive adhesives has a very large performance deficiency, because it may appear similar to paint drying, speed is not fast, high energy consumption characteristics. In fact, his solution is also very simple. Only when the content of PSA is increased to 60%, the problems of drying paint and slow speed can be solved. Moreover, the products made in this way have many advantages, such as environmental friendliness, safe production process and low cost of preparation. Therefore, the performance of polyacrylate emulsion pressure sensitive adhesive is obvious, and improving its content can meet the needs of pressure-sensitive adhesive in today's society. At present, there are reports that the content of patents can be increased to about 80 percent in the world. At the same time, the polyacrylate emulsion pressure sensitive adhesive in China is also overestimated by [15].

3. Summary and Prospect
Now the society is paying more and more attention to environmental protection. The technology of synthetic emulsion type pressure sensitive adhesive is progressing. Compared with other types of pressure sensitive adhesives, the emulsion type pressure sensitive adhesive ring is more friendly to the environment, and has no pollution, low cost, short polymerization time, and has good adhesion to any other material. Therefore, emulsion type pressure sensitive adhesive has formed a mainstream in the market. But at the same time, emulsion type pressure sensitive adhesive also has shortcomings. Some shortcomings of emulsifiers may cause irreparable properties. In this way, the development of emulsion type pressure sensitive adhesive is restricted to some extent, and the emulsion acrylic pressure sensitive adhesive has brought hope for this purpose. The pressure-sensitive adhesive has improved the performance of the original product, and has also developed some products with new characteristics. The emulsion acrylic pressure sensitive adhesive has made great progress in the adhesive industry, and its application scope is wider and wider. Acrylic pressure-sensitive adhesives are in great demand in every industry. In order to make the comprehensive performance of emulsion polyacrylate pressure sensitive adhesive more outstanding, people pay more and more attention to the improvement of emulsion polymerization process and the development of new emulsion polymerization method. In the future, acrylic pressure sensitive adhesive will be more friendly, more environmental friendly, more convenient and more high-performance than before.

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