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(57) Abrégé/Abstract:
There is provided hot water and alkali removable pressure-sensitive adhesive composition based on emulsion pressure-sensitive adhesive polymers used in combination with a rosin based acidic tackifier and a rosin based surfactant.

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(54) Title: REMOVABLE PRESSURE-SENSITIVE ADHESIVES FOR RECYCLABLE SUBSTRATES

(57) Abstract

There is provided hot water and alkali removable pressure-sensitive adhesive composition based on emulsion pressure-sensitive adhesive polymers used in combination with a rosin based acidic tackifier and a rosin based surfactant.

REMOVABLE PRESSURE-SENSITIVE ADHESIVES FOR RECYCLABLE SUBSTRATES

Field of Invention

This invention relates to pressure-sensitive adhesives formulated to exhibit the properties of a permanent adhesive for use with paper and polymer film backed labels and which remove cleanly from nonpaper surfaces such as polymeric (plastic), glass and metal substrates under the action of hot water or with hot alkaline solutions such as household detergent solutions or caustic alkali solutions with or without use of some manual force to assist removal.

Background of the Invention

Pressure-sensitive adhesives which are used for label applications do not in general remove cleanly from nonpaper substrates. Some residue of the adhesive is left on the substrate thus making its cleaning less effective or more involved. There is a growing need in the market today for environmentally or user friendly pressure-sensitive adhesive labels which can be cleanly removed from the substrate during domestic or industrial cleaning processes. This is true in the case of price marking and product identification labels used on metals, polymers (plastics), glass, wood and painted or water resistant coated substrates.

Attention in this regard has focused on water

dispersible, water soluble, repulpable and wet stick adhesives. Most of the base polymers for such adhesives are not inherently pressure-sensitive adhesives. Being nontacky they require the addition of high levels of plasticizers and/or tackifiers. Carboxyl content of the base polymer is also high, exceeding 10% by weight of the polymer, such carboxyl groups are incorporated into the polymer during polymerization. When the base polymer used for a removable adhesive is pressure-sensitive, it is usually compounded with at least 10% by weight of a vinyl carboxylic acid polymer either in the acid or salt form and various amounts of plasticizers and/or tackifiers.

U.S. Patent 4,033,918 to Hauber discloses a water removable pressure-sensitive adhesive composition which comprises based on 100 parts weight of the total solids, of from 25 to 35 parts by weight of a crosslinked acrylic acid ester copolymer which contains 10 to 20% by weight of unsaturated carboxylic acid, vinyl acetate, 2-ethyl hexyl acrylate, acrylonitrile, diethyl maleate and mixtures thereof, from 10 to 20 parts by weight of an uncrosslinked acrylic acid ester copolymer, from 10 to 20 parts by weight of polyvinylmethyl ether, from 10 to 20 parts by weight of an alkali metal and/or ammonium salt of polyacrylic acid, polymethacrylic acid or a copolymer of acrylic and methacrylic acids; 10 to 20 parts by weight of monomeric plasticizer such as a polyvinyl methyl ether or phthalate ester and 10 to 15 parts by weight of an emulsifying agent such as ethoxylated phenols.

U.S. Patents 3,865,770, 4,413,080 and 4,569,960 to Blake disclose tapes providing water dispersible/water soluble pressure-sensitive adhesives for use as a repulpable splicing tape. The adhesives described are solvent polymerized alkyl acrylate and acrylic acid polymers, neutralized with alkanolamines, or potassium hydroxide used in combination with sodium hydroxide

and/or lithium hydroxide. The polymer is further blended with acidic rosin or rosin derivatives and plasticized with hydrophilic polyoxyethylene compounds. Adhesive compositions comprise a polymer containing 60-85% alkyl acrylate and 10 to 40% vinyl carboxylic acid. The formulated adhesives have 35 to 150 parts by weight of acidic rosin, and/or 50 to 250 parts by weight of surfactant (ethoxylated alkyl phenols and/or complex acidic esters of phosphoric acid). High levels of plasticizer and high levels of rosin acid pose aging problems due to separation or migration thereby decreasing the adhesive properties. The adhesive tapes are sold in closed containers to preserve adhesive properties which are rapidly lost on exposure to atmospheric humidity.

U.S. Patent No. 4,492,724 to Albright, et al. describes a humidity resistant wet-stick pressure-sensitive adhesive made up of three components. Two are nonpressure-sensitive polymeric components containing high levels of polymerizable acids and the third component consisting of an ethoxylated alkyl arylphenol which serves as a plasticizer/tackifier to make the composition a pressure-sensitive adhesive. The first component is a copolymer of vinyl acetate, alkyl acrylate and acrylic acid in which the acrylic acid is present in an amount of from 20 to 55% by weight, the second component is an acrylic acid polymer which is present from 8 to 35% by weight and the plasticizer is present in an amount of from 20 to 65% by weight.

U.S. Patent No. 4,413,082 to Gleichenhagen, et al. teaches a water soluble pressure-sensitive adhesive composition for repulpable splicing tape comprising from 30 to 80 parts of a copolymer of 70 to 88% by weight of butyl acrylate of which 5 to 25% can be a mixture of vinyl acetate and fumaric acid dialkyl ester and 12 to 30% by weight vinyl carboxylic acid blended

with from 20 to 70 parts by weight of a water soluble plasticizer which is ethoxylated alkyl phenol, ethoxylated alkyl mono or diamine and from 2 to 30 parts by weight of an acidic rosin. The adhesive is water soluble and contains more than 10% of vinyl carboxylic acid in the polymer.

U.S. Patent 4,418,120 to Kealy, et al. relates to a tackified crosslinked acrylic adhesive which display improved adhesion to low energy substrates. The adhesive is based on a solution polymer of isooctyl acrylate and acrylic acid containing from 3 to 7% by weight acrylic acid, 100 parts of which is blended with 20 to 50 parts of a tackifying rosin ester having an acid number less than 20, additionally the adhesive contains certain antioxidants and a crosslinking agent, is coated and dried at 70°C to allow for crosslinking. The composition is required to be free of surfactants to achieve the designated performance.

U.S. Patent 4,726,982 to Traynor, et al. relates to a tackified acrylic pressure-sensitive adhesive for application to high solids automotive paints. The adhesive is also a solution polymer of acrylic acid ester of nontertiary alcohol containing from 4 to 14 carbon atoms, which polymers contain from 10 to 40 parts of N-vinyl lactam and is tackified with 5 to 50 parts, based on the weight of the polymer, of tackifying resins such as isobornyl methacrylate, rosin ester, and/or mixed aliphatic/aromatic polymeric tackifier resins. A suitable combination of the N-vinyl lactam and the tackifier is needed to provide high adhesion to automotive paint. Compositions with less than 10% N-vinyl lactam do not provide the high adhesion. The tackifying resins are either esters or hydrocarbon resins with no carboxyl functionality.

Summary of the Invention

The present invention pertains to water insoluble pressure-sensitive emulsion polymers which on blending with low levels of a surfactant and a tackifier provide a pressure-sensitive adhesive, when applied with a paper or film backing, which can be removed clean from a nonpaper surface under at least the action of hot water or hot alkaline conditions such as detergent or caustic alkali. It aids in label removal from the substrate at the time of acquisition or at the time of substrate recycling or recovery. The formulated adhesive exhibits excellent adhesion to and clean removal from a wide variety of substrates including metal, glass and polymeric substrates (plastics). Clean removability includes self-separating, hand peeling without leaving an adhesive residue or if some residue is left, removability fo the residue with no more than moderate thumb rubbing.

Accordingly, the present invention provides a pressure-sensitive adhesive composition which comprises:

(a) an acrylic, pressure-sensitive adhesive polymer formed by emulsion polymerization, which polymer comprises, on a polymerized basis and based on the total weight of the monomers:

(i) at least one alkyl acrylate containing from 4 to 8 carbon atoms in the alkyl group, the total amount of alkyl acrylate monomers being at least about 35 percent by weight of the monomers; and

(ii) at least one unsaturated carboxylic acid containing from 3 to 5 carbon atoms, present in a total positive amount up to about 5 percent by weight of the monomers, or a rubber-based emulsion polymer which is sufficiently polar to be compatible with a rosin acid tackifier and rosin-based surfactant, and

(b) as additives for each 100 parts by weight of the polymer:

(i) from about 3 to about 20 parts by

weight of a rosin acid tackifier, and

(ii) from about 1 to about 10 parts by weight of a rosin-based surfactant,

said pressure-sensitive adhesive composition when applied to paper backing being capable of clean removability from a nonpaper surface of a polar or nonpolar substrate on exposure to the action of hot water or alkali for less than about 5 minutes.

According to the present invention, there is provided an emulsion pressure-sensitive adhesive polymer which is acrylic or elastomeric-based and which is blended with one or more acidic rosin-based tackifiers and one or more rosin-based surfactants to provide a pressure-sensitive adhesive system which displays excellent adhesion to a wide variety of surfaces ranging from polar, relatively high energy surfaces such as stainless steel to nonpolar, relatively low energy surfaces such as polyethylene. The pressure-sensitive adhesive composition displays permanent adhesive characteristics yet removes clean from nonpaper surfaces of substrate under the action of hot water or an alkaline solution.

The preferred inherently tacky, acrylic emulsion pressure-sensitive adhesive polymers of the instant invention comprise, on a polymerized basis and, based on the total weight of the monomers, at least one alkyl acrylate containing from about 4 to about 8 carbon

atoms in the alkyl group, preferably 2-ethyl hexyl acrylate, the alkyl acrylate present being in a total amount of at least about 35 percent by weight of the monomers, and at least one unsaturated carboxylic acid present in a positive amount up to 5 per cent by weight of the acrylic-based pressure-sensitive adhesive polymer. It is preferred that the alkyl acrylate be present in a total amount of from about 35 to about 60 percent by weight; and that there also be present at least one vinyl ester containing from 2 to about 16 carbon atoms in the alkyl chain of the ester, preferably vinyl acetate, said vinyl ester present in a total amount of from about 15 to about 35 percent by weight; at least one diester of a dicarboxylic acid wherein each alkyl group of the diester independently contains from about 6 to about 16 carbon atoms, with di-2-ethyl hexyl maleate or di-2-ethyl hexyl fumarate being preferred, said diesters being present in a total amount of from about 20 to about 40 percent by weight. It is preferred that the adhesive contain 1 to 3 percent, of an unsaturated carboxylic acid containing from 3 to about 5 carbon atoms, preferably acrylic and/or methacrylic acid, and that said emulsion polymer have a glass transition temperature of less than about -30°C and a gel content of from about 50 to about 70 percent by weight of the polymer.

Although the acrylic emulsion adhesive polymers of the instant invention can be prepared by using conventional surfactants, it is preferred to additionally employ a reactive surfactant which polymerizes and becomes part of the emulsion polymer. If employed, the amount of reactive surfactant used in the preparation of the emulsion pressure-sensitive adhesives of the present invention may be in an amount up to about 0.4 percent by weight of the total monomers, preferably from about 0.1 to about 0.25 percent by weight. The preferred reactive surfactants

are anionic vinyl functional surfactants, such as sodium vinyl sulfonate and sodium styrene sulfonate.

The preferred acrylic emulsion polymer system comprises a copolymer of about 15 to about 35% by weight vinyl acetate, about 20 to about 40% by weight of di-2-ethylhexyl maleate, about 35 to about 60% by weight of 2-ethylhexyl acrylate and 1 to 3% by weight of one or more vinyl unsaturated carboxylic acids and for each 100 parts by weight of the polymer from about 3 to about 20 parts by weight of acidic rosin or rosin derivative provided as a tackifier and about 1 to about 10 parts by weight of rosin-based surfactant preferably an ethoxylated rosin-based surfactant.

The adhesives have wide applicability as an aggressive adhesive for paper and film labels and tapes which can be removed clean from the nonpaper substrates, thus making recycling/recovering operations or simply the removal of a price label at substrate acquisition easy. The base polymer of the present invention as compared to the '918 patent has a different composition in that the adhesive of this invention is preferably not externally crosslinked and preferably contain more than 20% dialkyl maleate and more than 20% vinyl acetate besides acrylic acid ester. The formulated adhesive contains more than 80% by weight of polymer, less than 5% of surfactant and less than 10% tackifier the later being rosin-based as opposed to polyvinylmethyl ether or phthalate esters.

The preferred elastomeric pressure-sensitive adhesive copolymer is a styrene-butadiene copolymer containing from about 20 to about 50% by weight styrene and is especially useful in adhering to polypropylene and polystyrene surfaces.

The acrylic-based adhesives of the present invention are different than the adhesives of Blake in that the base polymer preferably contains vinyl esters and alkyl diesters besides the alkyl acrylate and has low levels

of vinyl carboxylic acid, i.e., much less than 10% contrary to the high acid requirement of Blake. The adhesive compositions of the present invention are not cold water dispersible or water soluble as taught by Blake. Blake also does not disenable the use of a rubber-based polymer in the adhesive composition. However, labels made from the composition of the invention remove clean from the substrate in hot water.

Detailed Description

The present invention relates to pressure-sensitive adhesive compositions based on emulsion acrylic and rubber polymers which provide high adhesion and high tack to polar and nonpolar substrates with excellent cohesion which polymers are modified by rosin-based acidic tackifiers and rosin-based surfactants which allow retention of permanent adhesion characteristics, but which enable clean removability from a wide variety of nonpaper surfaces including metal, glass and polymeric substrates under the action of hot water and alkali solution.

By the expression "nonpaper surface," as used herein, there is meant a surface which does not break up or absorb significant amounts of moisture and include polar and nonpolar surfaces such as metal, glass, plastics, wood, paint, coated surfaces, even coated paper substrate which allow hot water and alkaline solutions to cause clean removability of the adhesive coated label without an adverse effect on the substrate.

By the expression "clean removability", there is meant self-removability, hand removability by peeling leaving no adhesive residue and if an adhesive residue remains, removability of the residue by light to moderate thumb rubbing. This duplicates the action of easy label removability from a household product after purchase without sacrifice of permanent adhesion of label with a surface while the product is on display for sale.

The clean removable adhesive compositions of this invention are based on acrylic-based emulsion polymers and rubber-based or elastomeric emulsion polymers which are compatible with the rosin-based surfactants and rosin-based tackifiers.

The acrylic-based emulsion pressure-sensitive adhesive polymers used in the invention are polymers

which contain at least 35 percent by weight total of one or more alkyl acrylates containing from about 4 to about 8 carbon atom in the alkyl group and a positive amount up to about 5 percent by weight total of vinyl unsaturated carboxylic acids containing from about 3 to about 5 carbon atoms.

The emulsion-based acrylic pressure-sensitive adhesive polymers of the instant invention are preferably inherently tacky polymers which contain, on a percent by weight basis, from about 35 to about 60 percent by weight total of one or more alkyl acrylates containing about 4 to about 8 carbon atoms in the alkyl group. Preferably the total alkyl acrylate concentration, including mixtures of alkyl acrylates, is from about 40 to about 50 percent by weight of the monomers. Useful alkyl acrylates include n-butyl acrylate, 2-ethyl hexyl acrylate, isooctyl acrylate, and the like, with 2-ethyl hexyl acrylate being preferred.

The second monomeric component of the acrylic emulsion polymers is one or more vinyl esters present in a total amount of from about 15 to about 35 percent by weight, preferably from about 20 to about 25 percent by weight based on total weight of the monomers, said vinyl esters containing from 2 to about 16 carbon atoms in the alkyl group of the ester.

Representative of the vinyl esters include vinyl acetate, vinyl butyrate, vinyl propionate, vinyl isobutyrate, vinyl valerate, vinyl versitate, and the like. Vinyl acetate is preferred.

The third component of the acrylic emulsion polymer used in the instant invention is one or more diesters of a dicarboxylic acid and mixtures thereof, present in a total amount of from about 20 to about 35 percent by weight based on the total weight of the monomers. Each ester group of the diester of the dicarboxylic acid independently contains from about 6 to about 16,

preferably from about 6 to about 12, carbon atoms. The preferred diesters are di-2-ethyl hexyl maleate, di-2-ethyl hexyl fumarate and mixtures thereof.

A fourth component of the acrylic emulsion polymers of the instant invention is at least one unsaturated carboxylic acid containing from about 3 to about 5 carbon atoms and present in a total amount of up to about 5 percent by weight of the polymer, preferably from 1 to about 3 percent by weight. The unsaturated carboxylic acid includes, among others, acrylic acid, methacrylic acid, itaconic acid, and the like. Acrylic acid, methacrylic acid, and more preferably mixtures thereof, are presently preferred.

The acrylic emulsion polymers of the instant invention may be prepared in the presence of a reactive surfactant which polymerizes during formation of the polymer and becomes an integral part of the polymer. Preferred reactive surfactants include anionic vinyl functional monomers such as sodium vinyl sulfonate, sodium styrene sulfonate and the like. The reactive surfactant is present as part of the total surfactant system and in an amount up to about 0.4 percent by weight of the total monomers, preferably about 0.1 to about 0.25 percent by weight.

The presently preferred acrylic emulsion polymer contains, about 48 percent by weight 2-ethyl hexyl acrylate, about 21 percent by weight vinyl acetate, about 29 percent by weight di-2-ethyl hexyl maleate, about 1 percent by weight acrylic acid, and about 1 percent by weight methacrylic acid and are formed as an emulsion having a solids content of about 59.6% and a pH of about 3.8.

The monomer proportions are preferably adjusted in such a way that the adhesive has a glass transition temperature less than about -30°C, preferably less than about -34°C, giving a good balance of adhesion and tack at room temperature and low temperatures. Depending on

polymerization conditions, copolymers showing two distinct glass transition temperatures, one in the region of -45 to -60°C and the other in the region of -15 to -30°C, have been observed.

Gel content or percent insolubles maybe and are preferably in the range of 50 to 65 percent by weight which provides excellent cohesive strength without the use of multifunctional monomers or external crosslinking. In this regard, gel represents the amount of polymer which is insoluble in tetrahydrofuran expressed in percent by weight and determined by the membrane gel partitioning method. In this method, about 600 to 800 milligrams of 100 percent solid polymer is weighed onto a millipore* membrane disk of 5 micrometer porosity. The disk is heat sealed and transferred to a scintillation vial. About 20 milliliters of tetrahydrofuran is added to the vial and the vial is rotated on a shaker for 16 to 24 hours. The sealed disk is then removed, washed with tetrahydrofuran, and dried first by placing it on a Whatman No. 1 filter paper, followed by exposure to 100°C in the oven for a few hours. The dried disk is weighed and the insoluble portion of the polymer determined by the equation:

$$\text{Per cent insoluble} = \frac{(b - c) \times 100}{a} = \% \text{ gel}$$

wherein

a = total weight of 100 percent solids polymer;

b = the weight of the polymer plus membrane before tetrahydrofuran treatment; and

c = polymer plus membrane remaining after tetrahydrofuran treatment.

The acrylic emulsion polymers of the instant invention are prepared by emulsion polymerization under conditions of agitation in an autogenous atmosphere in

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the presence of suitable polymerization initiators such as peroxydisulfate and peroxides. Depending on desired polymer properties including gel content, the preferred levels of these initiators are in the range of from about 0.5 to about 1.0 percent by weight based on the total weight of the monomers. The presently preferred initiators are potassium persulfate, t-butyl hydrogen peroxide, and the like. Level of agitation will vary depending on the system and will influence conversion. Typically, about 30 to 50 percent of the total initiator is added along with an initial monomer charge to the reactor, and the rest is added along with the balance monomers during polymerization over a period of from about 4 to about 5 hours. For the polymer to be free from coagulum and to maintain grit levels less than 20 ppm, it is desirable to maintain the pH of the emulsion during polymerization between from about 2 to about 4, preferably from about 2.5 to about 4. This can be achieved by the use of buffers such as sodium bicarbonate and sodium acetate, typically in amounts up to 0.3 percent by weight based on the weight of the monomer.

The stabilizer system used during polymerization contains a combination of anionic and nonionic surfactants present in an amount up to about 3.5 percent by weight based on the weight of the monomers. A suitable anionic surfactant is the sodium salt of an ethoxylated nonylphenol sulfate, and a suitable nonionic surfactant is ethoxylated nonylphenol. The best balance of properties is achieved by maintaining the anionic to nonionic surfactant ratio approximately 3 to 1.

The acrylic emulsion polymers of the instant invention are produced at high solids level content, typically about 50 to about 70 percent by weight. Reaction is carried out at temperatures from 70 to 85°C with an initial charge of up to about 10 percent by

weight of the total monomers, with the balance of the monomers being added to the emulsion reaction system over a period of about 4 to about 5 hours, with total monomer conversion approaching 100 percent.

The presently preferred acrylic emulsion polymer used for removability purposes is the pressure-sensitive adhesive described in Example 3 of US Patent No. 5,164,444. Good conversion is obtained by feeding a pre-emulsified monomer mix along with potassium persulfate as catalyst into the reactor over a period of 4 to 5 hours at temperatures ranging from 70 to 85°C. The adhesive polymer as such is a permanent electronic data processing label adhesive used on (EDP) and other paper facestock and build in adhesion over a period of time causing the facestock to tear in 180 or 90° peel tests. The adhesive has low levels of vinyl carboxylic acid unlike polymers taught in the prior art.

The elastomeric or rubber-based polymers which can be employed in the removable permanent adhesive compositions are any rubber-based emulsion polymer which is sufficiently polar to be compatible with the rosin-based surfactants and tackifiers used to induce clean removability. The presently preferred rubber-based polymers are carboxylated styrene-butadiene random copolymers of from about 20 to about 50% styrene content. Block copolymers based on styrene and butadiene or isoprene which exhibit a sufficient degree of polarity may also be used.

It is possible to modify the rheology of the polymer for coating purposes by use of conventional thickeners such as SCT*-270 manufactured and sold by Union Carbide and present in an amount up to 0.2 percent by weight. Although not required, it is also feasible to modify the properties by the use of tackifiers and the like. For general purpose applications, it is desirable to have good adhesion to both hydrophobic substrates such

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as polyethylene and hydrophilic substrates such as stainless steel.

By formulating the adhesive with suitable rosin acid and rosin based tackifiers and rosin based surfactant systems labels and tapes made with the formulated adhesive composition remove clean from substrates in hot water or in hot alkaline wash cycle either by use of household detergents such as Cascade® or caustic alkali (2-3% by weight of solution). The blended product essentially consists of 100 parts of the emulsion polymer, about 3 to about 20 parts rosin acid tackifier and from about 1 to about 10 parts surfactant. The preferred composition consists of 100 parts of the emulsion polymer, about 3 to about 15 parts of rosin acid tackifier, and from about 1 to about 5 parts by weight surfactant.

Surfactants useful in the present invention include nonionic ethyleneoxide adducts of pale wood rosin containing about 15 moles of ethylene oxide, sold by Hercules, Inc. under the trade name AR-150. Being rosin based, this surfactant differs from surfactants disclosed in the prior art which are mainly polyoxyalkylene alkyl phenols, polyoxyalkylene glycols and polyoxyalkylene phenols. When present as per the prior art, they are required to be used in greater than 20 parts by weight based on 100 parts by weight of polymer and in most cases >50 parts by weight to give the required performance. The level of rosin based surfactant used in the instant invention is less than 10 parts by weight per 100 parts polymer, the optimum level being about 1.0 to about 5.0 parts by weight. The other rosin based surfactants which may be useful are Dresinates* made by Hercules, Inc. which are potassium or sodium salts of modified rosin. Suitable surfactants include Dresinate 81, 90-95 and Dresinate 214, 515, and 731. Higher amounts of surfactant tend to reduce the shear and adhesion values on the required

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substrates.

The tackifying resins suitable for this application are noncrystallizing resins and include fully or partially polymerized rosins, modified rosins, disproportionate rosins, stabilized rosins, hydrogenated rosins and the like, preferably having an acid number (Acid No.) greater than 50 and less than 210 (acid no. expressed as mg. of KOH/gram of resin) with a softening point of about 50 to about 170°C. The most preferred resins have a softening point of about 60 to about 95°C and an Acid No. of 100 to 140. The preferred resins are Sylvatac*R-85, R-95 and R-295 sold by Arizona Chemicals, Unitac*70 sold by Union Camp, Foral* AX, Hercules 731D resin, Pentalyn*261 supplied by Hercules, Snowtack* 301A, 342A, 820A, 380A, 380B and 385F sold by EKA Nobel. The resins with acid number in excess of 160 and softening points exceeding 100°C tend to create partial incompatibility with the polymer when used in levels higher than 10 parts per 100 parts of the polymer. Resin levels exceeding 20 parts reduce the shear values and cause zippiness during peel.

The tackifying resins can be used in the dispersion form or in the solubilized form. Resin dispersions are commercially available from the supplier and are used as such. For solid resins, solubilization is effected either by dissolving the resin by water and ammonium hydroxide with a suitable anionic surfactant or by dissolving the resin in isopropyl alcohol and ammonium hydroxide then diluting the solution with water and adding a suitable anionic surfactant. The total solid content of the tackifying resin is maintained between about 40 to about 60% by weight. The optimum level for the application is about 5 to about 20 parts by weight and the preferred level is 5 to about 15 parts for 100 parts of the polymer.

The tackifying resin by itself or the surfactant by itself when combined with the polymer do not promote

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removability in hot water or under hot alkaline conditions. When blended in suitable ratios and coated on paper facestock the adhesives afford clean removability as defined above in less than 5 minutes from the surface of the substrate when immersed in agitated hot water or in hot alkaline solutions such as detergent solutions or 2-3% caustic alkali, held at 40 to about 60°C. They may be and preferably are formulated to resist cold water removal in a reasonable amount of time. This allows them use on labels adhered to substrates which contract cold water for extended periods of time. The label remains intact, although it may in some instances be peeled from the substrate. In any event the bond is not undermined and will recover on drying. The appropriate pH of the blended product is maintained between about 6.5 and about 8 by the addition of ammonium hydroxide. Use of alkali metal hydroxides in the place of ammonium hydroxide tends to adversely affect peel and tack adhesion by inducing zippiness on peel which is unacceptable.

A preferred adhesive composition of the invention consists of 100 parts by weight of the emulsion polymer, 1 to about 10 parts by weight of the surfactant and about 3 to about 20 parts by weight of the tackifying resin. The preferred composition consists of 100 parts by weight of the emulsion polymer, about 1 to about 10 parts of AR*-150 surfactant, and about 3 to about 20 parts of Snowtack 385F or a combination of Snowtack 385F with 380A or 380B or 820A or 301A.

In a preferred method of formulation, the surfactant is added to an emulsion containing the polymer with agitation followed by the addition of the tackifying resin solution or dispersion. pH is then adjusted to about 6.5 to about 7.5. The emulsion is then coated at 20 to 25 g/m^2 coat weight on a release paper, dried at 70°C for 10 minutes and laminated to the backing

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preferably high gloss, DSX paper and dual print paper. Polymeric film backing or face stocks may also be used.

In the following Examples (Ex) and Controls (Cont) 2.5 x 10 cm paper backed labels were applied to the substrate and tested for removability after 1 week dwell by immersing the total construction in the respective solutions at the required temperatures and observing the time the label self-separates from the substrate. For purposes of Tables 1 to 4, a formulation is considered excellent if the label self separates from a given substrate in less than about 5 minutes without leaving any adhesive residue in hot water or alkali and excellent if self removal is from multiple substrates. Controls have a removal time of more than 5 minutes for all substrates evaluated. Table 1 illustrates the different acrylic-based compositions based on solubilized tackifier resin. Table 2 is for water dispersions of tackifier resins. The numbers are parts by weight in grams of the components which went into the formulation for each 100 parts of the preferred polymer. Removability data indicate the time in minutes for the label to cleanly self-separate from the substrate without a residue. The temperatures of the hot water and the alkali were maintained between 50 to about 60°C. All formulations which pass the removability test on polyethylene (PE) and stainless steel (SS) are considered capable and pass the same test on polyester (PET) and glass (GL) and vice a versa. All samples which pass in hot water also pass in hot alkaline conditions. Table 3 provides adhesive properties of some of Exemplary Example compositions and Control compositions.

Table 4 gives cold water removability.

Clean removability includes the added task of peeling a label from a substrate with or without leaving some adhesive residue which can be removed with light to moderate thumb rubbing. This mimics removal

of label by soaking in water after purchase. Systems based on styrene-butadiene random copolymers are illustrated as to performance in Tables 5 and 6 and are particularly utile for the purpose of adhering to polystyrene and polypropylene substrates.

While adhesives are intended as hot water and alkali removable adhesives, they have been found to have utility in binding grips to golf shafts. when formed as a double sided tape and adhered to the shaft the outside can be wetted, the grip slid over the wet adhesive and the bond formed on evaporation of water. This eliminates the use of organic solvents to activate the adhesive. The acrylic-based compositions are preferred for this special application.

Table 1

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.	Hot Water Removal Time, Min PE	PET	3% NaOH Removal Time, Min SS	GL
Ex1	AR-150	5.0	Pentalyn 261	5.0	<2.0	-	<3	<2
Ex2	AR-150	5.0	Pentalyn 261	10.0	<3.0	-	<3	<3
Ex3	AR-150	2.5	Pentalyn 261	5.0	2.0	-		--
Ex4	AR-150	2.5	Pentalyn 261	7.5	2.5	-		--
Ex5	AR-150	5.0	Unitac 70	10.0	2.0	-		--
Ex6	AR-150	5.0	Unitac 70	20.0	2.0	-		--
Ex7	AR-150	5.0	Unitac 70	15.0	2.0	-	3	-
Ex8	AR-150	5.0	Unitac 70	5.0	-	-	<5	-
Ex9	AR-150	2.5	Unitac 70	7.5	<2.0	-	-	-
Ex10	AR-150	5.0	Sylvatac R85	5.0	<5.0	-	-	-
Ex11	AR-150	2.5	Sylvatac R85	5.0	-	-	5	-
Ex12	AR-150	5.0	Sylvatac R85	7.5	<3.0	-	-	-
Ex13	AR-150	2.5	Sylvatac R85	7.5	7	-	4	-
Ex14	AR-150	5.0	Sylvatac R85	10.0	<4.0	-	-	-
Ex15	AR-150	2.0	Sylvatac R85	5.0	>2.0	-	-	-
Ex16	AR-150	2.25	Sylvatac R85	7.5	<5.0	-	-	-
Ex17	AR-150	2.0	Sylvatac R85	10.0	<4.0	-	-	-
Ex18	AR-150	2.25	Sylvatac R85	10.0	<2.0	-	-	-
Ex19	AR-150	5.0	Resin* 731D	10.0	<3.0	-	-	-
Ex20	AR-150	2.5	Resin 731D	10.0	<3.0	-	-	-
Ex21	AR-150	5.0	Foral* AX	10.0	<4.0	-	-	-
Ex22	AR-150	2.5	Foral AX	10.0	<4.0	-	-	-
Ex23	Dresinate731	5.0	Snowtack 301A	5.0	<3.0	-	-	-
Ex24	Dresinate515	5.0	Snowtack 301A	5.0	<4.0	-	-	-
Cont1	AR-150	0.0	Unitac 70	10.0	>10.0	-	>10	-
Cont2	AR-150	5.0	Unitac 70	0.0	>10.0	-	>10	-
Cont3	AR-150	10.0	Unitac 70	0.0	>10.0	-	>10	-
Cont4	AR-150	1.0	Sylvatac R85	5.0	>15.0	-	-	-
Cont5	AR-150	1.75	Sylvatac R85	5.0	>15.0	-	-	-
Cont6	AR-150	1.5	Sylvatac R85	7.5	>15.0	-	-	-
Cont7	Dresinate91	5.0	Sylvatac R85	0.0	>30.0	-	-	-
Cont8	Dresinate91	2.5	Sylvatac R85	5.0	>15.0	-	-	-
Cont9	Dresinate91	1.5	Sylvatac R85	5.0	>15.0	-	-	-
Cont10	AR-150	5.0	Resin 731D	5.0	<10.0	-	-	-
Cont11	AR-150	2.5	Resin 731D	5.0	>30.0	-	-	-
Cont12	AR-150	5.0	Foral AX	5.0	10.0	-	-	-
Cont13	AR-150	2.5	Foral AX	5.0	>15.0	-	-	-

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Table 1 Continued

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.	Hot Water Removal Time, Min PE	PET	3% NaOH Removal Time, Min SS	GL
Cont14	Dresinate 731	3.0	Snowtack 301A	5.0	<7.0	-	-	-
Cont15	Dresinate 515	3.0	Snowtack 301A	5.0	>10.0	-	-	-

HW = hot water
PE = high density poly ethylene milk cans
PET = polyester film
SS = Stainless steel
GL = Glass
The sign > indicates that the test was discontinued after that period of time

2126351

Table 2

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.%	Hot Water Removal Time, Min PE	PET	3% NaOH Removal Time, Min SS	GL
Ex25	AR-150	5.0	Snowtack 301A	5.0	<2	<2	<3	-
Ex26	AR-150	5.0	Snowtack 301A	20.0	<5	<2	<3	-
Ex27	AR-150	5.0	Snowtack 301A	10.0	<5	-	<3	-
Ex28	AR-150	2.5	Snowtack 301A	10.0	<5	-	-	-
Ex29	AR-150	5.0	Snowtack 301A	15.0	<2	-	<1	-
Ex30	AR-150	2.5	Snowtack 301A	15.0	<3	-	<2	-
Ex31	AR-150	3.25	Snowtack 301A	5.0	<4	-	-	-
Ex32	AR-150	3.0	Snowtack 301A	7.5	3	-	-	-
Ex33	AR-150	2.75	Snowtack 301A	7.5	-	-	2	-
Ex34	AR-150	1.5	Snowtack 301A	10.0	<4	-	-	-
Ex35	AR-150	1.25	Snowtack 301A	10.0	<4	-	-	-
Ex36	AR-150	2.82	Snowtack 301A	8.0	1	-	5	-
Ex37	AR-150	1.75	Snowtack 301A	12.25	2	-	5	-
Ex38	AR-150	2.95	Snowtack 301A	7.5	2	-	2	-
Ex39	AR-150	3.1	Snowtack 301A	5.0	<3	-	<5	-
Ex40	AR-150	3.15	Snowtack 301A	5.0	<5	-	<5	-
Ex41	AR-150	5.0	Snowtack 385F	10.0	<2	-	-	-
Ex42	AR-150	2.5	Snowtack 385F	10.0	<5	-	-	-
Ex43	AR-150	5.0	Snowtack 385F	15.0	3	-	-	-
Ex44	AR-150	2.5	Snowtack 385F	15.0	<5	-	-	-
Ex45	AR-150	3.75	Snowtack 385F	5.0	<1	-	- -	
Ex46	AR-150	3.3	Snowtack 385F	5.0	<2	<2	<2	-
Ex47	AR-150	2.82	Snowtack 385F	8.0	<2	-	<5	-
Ex48	AR-150	2.85	Snowtack 385F	7.5	3	-	<5	-
Ex49	AR-150	2.95	Snowtack 385F	7.5	2	-	<5	-
Ex50	AR-150	3.5	Snowtack 380A	10.0	<3	<4	-	<2
Ex51	AR-150	3.25	Snowtack 380B	7.5	<3	<5	-	<2
Ex52	AR-150	3.25	Snowtack 820A	6.85	<5	<5	-	<2
Ex53	AR-150	3.2	Snowtack 385F	5.0	2	1	3	-
Ex54	AR-150	3.15	Snowtack 385F	5.0	6	-	3	-
Cont16	AR-150	2.5	Snowtack 301A	5.0	10-15	-	-	-
Cont17	AR-150	2.75	Snowtack 301A	5.0	<10	-	-	-
Cont18	AR-150	2.5	Snowtack 301A	7.5	<10	-	-	-
Cont19	AR-150	0.0	Snowtack 301A	10.0	>15	-	<4	-
Cont20	AR-150	0.0	Snowtack 301A	20.0	>15	-	-	-
Cont21	AR-150	2.5	Snowtack 385F	5.0	10-15	-	-	-
Cont22	AR-150	2.75	Snowtack 385F	5.0	>10	-	-	-
Cont23	AR-150	2.5	Snowtack 385F	7.5	9	-	-	-
Cont24	AR-150	3.0	Snowtack 385F	7.5	<7	-	-	-

Table 2 Continued

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.%	Hot Water Removal Time, Min PE	PET	3% NaOH Removal Time, Min SS	GL
Cont25	AR-150	2.75	Snowtack 385F	7.5	<10	-	-	-
Cont26	AR-150	0.0	Snowtack 385F	10.0	>15	-	<4	-
Cont27	AR-150	0.0	Snowtack 385F	20.0	>15	-	<4	-
Cont28	AR-150	3.1	Snowtack 385F	5.0	6	-	<6	-

The adhesive formulations provide good adhesion on all the application substrates building to permanency with facestock tear on most of the substrates. Illustrative examples are given in Table 3. All the samples were coated on release liner, dried at 70°C and transferred onto high gloss paper. The coat weights ranged from 20-24/qm^2.

2126351

Table 3

Ex/Cont.	90° Peel SS	N/m PE	PET	RTS 500 g.min
Ex3	-	200	-	-
Ex5	510	260	488	14
Ex6	630pt	300	580pt	30
Ex11	pt	190	pt	25
Ex13	-	180	-	20
Ex19	-	170	-	11
Ex36	-	236	-	7
Ex37	-	275	-	10
Ex38	-	200	-	9
Ex39	pt	260	pt	10
Ex40	pt	170	pt	10
Ex46	540pt	255	332s1pt	-
Ex47	-	256	-	17
Ex48	-	255	-	18
Ex49	-	233	-	7
Ex50	400pt	185	400pt	22c
Ex51	400pt	162	400pt	35c
Ex52	420pt	214	470	24c
Ex53	pt	240	pt	15
Cont14	-	200	-	60
Cont28	pt	244	pt	16
Cont29	pt	240	pt	17

pt = facestock tear
c = cohesive failure

The adhesives of the invention are formulated to separate clean from a substrate within about 5 minutes under exposure to hot water or alkali at 50-60°C or more. This is to satisfy domestic and industrial needs of rapid separation without residue. It is preferred they resist cold water separation, except by peeling because on shelf presentation a labeled substrate may require ongoing resistance to exposure to cold water, although cold water attack at the adhesive-substrate interface may enable repositionable peeling during the period of cold water exposure. In addition, some

applications permit cold water removability in addition to hot water/alkali removability. The data in Table 4 establishes times in minutes of cold water separation for some Examples and Controls as a point of reference for other characteristics of label performance.

Table 4

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.	Cold Water Removal Time, Min PE	PET
Ex1	AR-150	5.0	Pentalyn 261	5.0	7	4
Ex2	AR-150	5.0	Pentalyn 261	10.0	-	-
Ex3	AR-150	2.5	Pentalyn 261	5.0	>10	>10
Ex4	AR-150	2.5	Pentalyn 261	7.5	>10	-
Ex5	AR-150	5.0	Unitac 70	10.0	-	-
Ex6	AR-150	5.0	Unitac 70	20.0	-	-
Ex7	AR-150	5.0	Unitac 70	15.0	-	-
Ex8	AR-150	5.0	Unitac 70	5.0	-	-
Ex9	AR-150	2.5	Unitac 70	7.5	>25	-
Ex10	AR-150	5.0	Sylvatac R85	5.0	5	-
Ex11	AR-150	2.5	Sylvatac R85	5.0	>10	-
Ex12	AR-150	5.0	Sylvatac R85	7.5	3	-
Ex13	AR-150	2.5	Sylvatac R85	7.5	7	-
Ex14	AR-150	5.0	Sylvatac R85	10.0	4	-
Ex15	AR-150	2.0	Sylvatac R85	5.0	>20	-
Ex16	AR-150	2.25	Sylvatac R85	7.5	>20	-
Ex17	AR-150	2.0	Sylvatac R85	10.0	10	-
Ex18	AR-150	2.25	Sylvatac R85	10.0	9	-
Ex19	AR-150	5.0	Resin 731D	10.0	7	-
Ex20	AR-150	2.5	Resin 731D	10.0	10	-
Ex21	AR-150	5.0	Foral AX	10.0	>15	-
Ex22	AR-150	2.5	Foral AX	10.0	>15	-
Ex23	Dresinate 731	5.0	Snowtack 301A	5.0	10	-
Ex24	Dresinate 515	5.0	Snowtack 301A	5.0	>10	-
Ex25	AR-150	5.0	Snowtack 301A	5.0	12	5
Ex26	AR-150	5.0	Snowtack 301A	20.0	<10	<5
Ex27	AR-150	5.0	Snowtack 301A	10.0	14	-
Ex28	AR-150	2.5	Snowtack 301A	10.0	14	-
Ex29	AR-150	5.0	Snowtack 301A	15.0	<10	-
Ex30	AR-150	2.5	Snowtack 301A	15.0	12	-
Ex31	AR-150	3.25	Snowtack 301A	5.0	>20	-
Ex32	AR-150	3.0	Snowtack 301A	7.5	13	-
Ex33	AR-150	2.75	Snowtack 301A	7.5	>30	-

2126351

Table 4 Continued

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.	Cold Water Removal Time, Min PE	PET
Ex34	AR-150	1.5	Snowtack 301A	10.0	10	-
Ex35	AR-150	1.25	Snowtack 301A	10.0	>15	-
Ex36	AR-150	2.82	Snowtack 301A	8.0	<10	-
Ex37	AR-150	1.75	Snowtack 301A	12.25	<10	-
Ex38	AR-150	2.95	Snowtack 301A	7.5	>15	-
Ex39	AR-150	3.1	Snowtack 301A	5.0	>20	-
Ex40	AR-150	3.15	Snowtack 301A	5.0	>20	-
Ex41	AR-150	5.0	Snowtack 385F	10.0	12	-
Ex42	AR-150	2.5	Snowtack 385F	10.0	>20	-
Ex43	AR-150	5.0	Snowtack 385F	15.0	<10	-
Ex44	AR-150	2.5	Snowtack 385F	15.0	>20	-
Ex45	AR-150	3.75	Snowtack 385F	5.0	7	-
Ex46	AR-150	3.3	Snowtack 385F	5.0	>30	-
Ex47	AR-150	2.82	Snowtack 385F	8.0	>15	-
Ex48	AR-150	2.85	Snowtack 385F	7.5	>20	-
Ex49	AR-150	2.95	Snowtack 385F	7.5	>20	-
Ex50	AR-150	3.5	Snowtack 380A	10.0	10	10
Ex51	AR-150	3.25	Snowtack 380B	7.5	>20	10
Ex52	AR-150	3.25	Snowtack 820A	6.85	>20	10
Ex53	AR-150	3.2	Snowtack 385F	5.0	>30	-
Ex54	AR-150	3.15	Snowtack 385F	5.0	>30	-
Cont1	AR-150	0.0	Unitac 70	10.0	>30	-
Cont2	AR-150	5.0	Unitac 70	0.0	>30	-
Cont3	AR-150	10.0	Unitac 70	0.0	>30	-
Cont4	AR-150	1.0	Sylvatac R85	5.0	>25	-
Cont5	AR-150	1.75	Sylvatac R85	5.0	>30	-
Cont6	AR-150	1.5	Sylvatac R85	7.5	>30	-
Cont7	Dresinate 91	5.0	Sylvatac R85	0.0	>30	-
Cont8	Dresinate 91	2.5	Sylvatac R85	5.0	>15	-
Cont9	Dresinate 91	1.5	Sylvatac R85	5.0	>15	-
Cont10	AR-150	5.0	Resin 731D	5.0	19	-
Cont11	AR-150	2.5	Resin 731D	5.0	>30	-
Cont12	AR-150	5.0	Floral AX	5.0	>15	-
Cont13	AR-150	2.5	Floral AX	5.0	>15	-
Cont14	Dresinate 731	3.0	Snowtack 301A	5.0	>30	-
Cont15	Dresinate 515	3.0	Snowtack 301A	5.0	>30	-
Cont16	AR-150	2.5	Snowtack 301A	5.0	>60	-
Cont17	AR-150	2.75	Snowtack 301A	5.0	>30	-
Cont18	AR-150	2.5	Snowtack 301A	7.5	>20	-

Table 4 Continued

Ex/ Cont	Surfactant	wt.%	Tackifying Resin	wt.	Cold Water Removal Time, Min PE	PET
Cont19	AR-150	0.0	Snowtack 301A	10.0	>30	-
Cont20	AR-150	0.0	Snowtack 301A	20.0	>30	-
Cont21	AR-150	2.5	Snowtack 385F	5.0	>60	-
Cont22	AR-150	2.75	Snowtack 385F	5.0	>30	-
Cont23	AR-150	2.5	Snowtack 385F	7.5	>30	-
Cont24	AR-150	3.0	Snowtack 385F	7.5	>20	-
Cont25	AR-150	2.75	Snowtack 385F	7.5	>30	-
Cont26	AR-150	0.0	Snowtack 385F	10.0	>30	-
Cont27	AR-150	0.0	Snowtack 385F	20.0	>30	-
Cont28	AR-150	3.1	Snowtack 385F	5.0	>30	-

> means that test was discontinued at the stated time

The adhesive formulations provide good adhesion on all the application substrates building to permanency with facestock tear on most of the substrates. Illustrative examples are given in table III. All the samples were coated on release liner, dried at 70°C and transferred onto High Gloss paper. The coat weights ranged from 20-24g/sqm.

Examples 55 to 66

There was employed as the emulsion polymer carboxylated styrene butadiene dispersions of about 49% solids content. Styrene was 25% (BASF NS 144), 35% (BASF NS 166) and 45% (BASF NS 222). The surfactant was AR-150 from Hercules, Inc., an ethylene oxide derivative of rosin, and as the tackifier Snowtack 301A from Eka Nobel, a 50% solids water-borne dispersion of rosin and having a high acid number of about 160 mg KOH/gm a particle size of about 0.5 microns and a melt point of 64°C. To facilitate coating, there was employed Polyphobe* 102 thickener from Union Carbide Corp. While useful on a variety of substrates, the adhesive systems were particularly suitable as a removable adhesive for polypropylene and

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polystyrene substrates. The results of testing on such substrates is reported in Table 5, wherein

Y = self separating or easy removability by hand with or without light to moderate thumb rubbing of adhesive residue after 5 minutes immersion;

M = marginal removability requiring heavy thumb rubbing to remove adhesive residue; and

N = adhesive residue non-removable even with heavy thumb rubbing.

None of the compositions were removable on soaking in ice water for 15 minutes.

Table 6 shows that varying the styrene content of the polymer used in the dispersion of Example 57 had no significant effect on removability using the 50°C immersion test.

Table 5

EXAMPLE	55	56	57	58	59	60	61	62	63	64
% dry weight	1	2	3	4	5	6	7	8	9	10
NS 144	84.3	86.1	79.4	82.6	90.0	86.9	79.7	89.7	84.4	82.0
SNOWTACK 301A	10.4	6.4	13.7	14.3	6.7	10.8	15.4	4.8	10.4	10.1
AR-150	5.2	7.5	6.9	3.1	3.3	2.3	4.9	5.5	5.2	7.9
Hot Water (40°C) Removability										
Polypropylene	N	N	M	M	M	M	M	Y	Y	Y
Polystyrene	N	Y	Y	N	N	N	Y	M	M	M
Hot Water (50°C) Removability										
Polypropylene	Y	N	Y	Y	Y	Y	Y	Y	Y	Y
Polystyrene	M	Y	Y	M	M	M	Y	M	Y	Y
24 Hr. Peel (N/m)										
Polypropylene	123	123	158	175	123	158	175	123	140	158
Polystyrene	263	210	245	385	368	333	350	263	350	333

Table 6

	Ex. 57 25% Styrene	Ex. 65 35% Styrene	Ex. 66 45% Styrene
Polypropylene	Y	Y	Y
Polystyrene	Y	Y	Y

WHAT IS CLAIMED IS:

1. A pressure-sensitive adhesive composition which comprises:

(a) an acrylic, pressure-sensitive adhesive polymer formed by emulsion polymerization, which polymer comprises, on a polymerized basis and based on the total weight of the monomers:

(i) at least one alkyl acrylate containing from 4 to 8 carbon atoms in the alkyl group, the total amount of alkyl acrylate monomers being at least about 35 percent by weight of the monomers; and

(ii) at least one unsaturated carboxylic acid containing from 3 to 5 carbon atoms, present in a total positive amount up to about 5 percent by weight of the monomers, or a rubber-based emulsion polymer which is sufficiently polar to be compatible with a rosin acid tackifier and rosin-based surfactant, and

(b) as additives for each 100 parts by weight of the polymer:

(i) from about 3 to about 20 parts by weight of a rosin acid tackifier, and

(ii) from about 1 to about 10 parts by weight of a rosin-based surfactant,

said pressure-sensitive adhesive composition when applied to paper backing being capable of clean removability from a nonpaper surface of a polar or nonpolar substrate on exposure to the action of hot water or alkali for less than about 5 minutes.

2. A pressure-sensitive adhesive composition as claimed in claim 1 in which the acrylic, pressure-sensitive adhesive is inherently tacky and comprises, on a polymerized basis and based on the total weight of the monomers:

(a) at least one alkyl acrylate containing from 4 to 8 carbon atoms in the alkyl group, the total amount of alkyl acrylate present being from about 35 to 60 percent by weight;

(b) at least one vinyl ester containing from 2 to 16 carbon atoms in the alkyl group of the acid, the total amount of the vinyl ester present being from 15 to about 35 percent by weight;

(c) at least one diester of a dicarboxylic acid in which each alkyl group of the diester independently contains from 6 to 12 carbon atoms, the total of the diesters present being in amount form about 20 to about 40 percent by weight; and

(d) at least one unsaturated carboxylic acid containing from 3 to 5 carbon atoms, the total of the unsaturated carboxylic acid being present in a positive amount up to about 5 percent by weight, said polymer having a glass transition temperature of less than about $-30^{0}C$ and a gel content of from about 50 to about 70 percent by weight of the polymer.

3. A pressure-sensitive adhesive as claimed in claim 1 in which the acrylic emulsion polymer is an inherently tacky pressure-sensitive adhesive polymer and comprises:

(a) at least one alkyl acrylate selected from the group consisting of 2-ethylhexyl acrylate, isooctyul acrylate, and mixtures thereof, the total amount of alkyl acrylate present being from about 40 to about 50 percent by weight;

(b) vinyl acetate in an amount of from 15 to about 35 percent by weight;

(c) at least one diester of a dicarboxylic acid selected from di-2-ethylhexyl maleate and di-2-ethylhexyl fumarate and mixtures thereof present in an amount from about 20 to about 40 percent by weight; and

(d) an unsaturated carboxylic acid selected from the group consisting of acrylic acid, methacrylic acid and mixtures thereof present in an amount of from about 1 to about 3 percent by weight, said polymer having a glass transition temperature of less than about -30°C and a gel content of from about 50 to about 70 percent by weight of the polymer.

4. A pressure-sensitive adhesive composition as claimed in claim 1 in which the inherently tacky, acrylic pressure-sensitive adhesive polymer comprises based on the total weight of the monomers:

(a) about 48 percent by weight 2-ethylhexyl acrylate;

(b) about 21 percent by weight vinyl acetate;

(c) about 29 percent by weight di-2-ethylhexyl maleate; and

(d) about 1 percent by weight acrylic acid and about 1 percent by weight methacrylic acid.

5. A pressure-sensitive adhesive as claimed in claim 1 in which the rubber-based emulsion polymer is a carboxylated styrene-butadiene random copolymer containing from about 20 to about 50% by weight styrene.

6. A pressure-sensitive adhesive as claimed in any one of claims 1 to 5 in which the tackifier is provided in a concentration of about 3 to about 15 parts by weight.

7. A pressure-sensitive adhesive as claimed in any one of claims 1 to 6 in which the surfactant is provided in an amount of from about 1 to about 5 parts by weight.

8. A pressure-sensitive adhesive as claimed in any one of claims 1 to 7 in which the tackifier has an acid number greater than about 50 and less than about 210.

9. A pressure-sensitive adhesive as claimed in any one of claims 1 to 7 in which the tackifier is noncrystallizing, has an acid number greater than about 50 and less than about 210 and is selected from the group consisting of at least partially polymerized rosins, modified rosins, disproportionate rosins, stabilized rosins, hydrogenated rosins and mixtures thereof.

10. A pressure-sensitive adhesive as claimed in any one of claims 1 to 9 in which the surfactant is a nonionic pale wood rosin containing about 15 mols of ethyleneoxide.