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OPTICAL COMPOSITIONS OF SILICONE RUBBER

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ABSTRACT OF THE DISCLOSURE

Compositions containing improved physical properties are disclosed that are particularly useful in the manufacture of articles wherein optical clarity is desirable, and compositions consisting essentially of (1) 60 to 70 parts of a dimethylvinylsilyl endblocked copolymer consisting essentially of about 6 to 9 mol percent of phenylmethylsiloxane units, about 0.1 to 0.2 mol percent of vinylmethylsiloxane units, and the balance essentially dimethylsiloxane units, (2) 30 to 40 parts of a dimethylvinylsilyl endblocked copolymer consisting essentially of about 15 to 25 mol percent of methylvinylsiloxane units, about 4 to 6 mol percent of phenylmethylsiloxane units, and the balance essentially dimethylsiloxane units, there being a total of 100 parts of (1) and (2) in the composition, and (3) 2 to 10 parts, per 100 parts of (1) and (2), of a resin consisting essentially of trimethylsiloxane units, dimethylvinylsiloxane units and $SiO_{4/2}$ units, the ratio of the sum of the trimethylsiloxane units and dimethylvinylsiloxane units to the $SiO_{4/2}$ units in the resin being in the range of 0.6–1.2:1, at least (1) and (2) being free of materials having molecular weights of less than about 5000, all said parts being on a weight basis. These compositions are useful, for example, as interlayers in safety glass, in the preparation of pharmaceutical equipment, in the preparation of volumetric apparatus and in the preparation of lenses, especially contact lenses.

In recent years silicone rubber has been suggested as a substitute for methylmethacrylate and other plastics in the preparation of contact lenses and other optical materials. Illustrative of such disclosures are U.S. Pats. 3,036,-985 and 3,228,741 and British Pats. 927,202 and 1,040,-408 the latter British patent corresponding to U.S. Pat. 3,341,490. Generally speaking, the silicone rubbers have been slow to find asceptance in contact lenses because of their poor physical properties. It is therefore an object of this invention to provide a composition which upon curing becomes a siilcone rubber that overcomes the deficiencies of the prior art materials. For example, it has been found that the compositions of this invention produce materials which have substantial increase in the modulus at no sacrifice of strength or tear resistance. It has also been found that the compositions of this invention exhibit substantialy reduced shrinkage upon processing as compared to similar prior art materials.

More specifically, this invention relates to a composition consisting essentially of (1) 60 to 70 parts of a dimethylvinylsilyl endblocked copolymer consisting essentially of about 6 to 9 mol percent of phenylmethylsiloxane units, about 0.1 to 0.2 mol percent of vinylmethylsiloxane units and the balance essentially dimethylsiloxane units, and (2) 30 to 40 parts of a dimethylvinylsilyl endblocked copolymer consisting essentially of about 15 to 25 mol percent of methylvinylsiloxane units, about 4 to 6 mol percent of phenylmethylsiloxane units and the balance essentially dimethylsiloxane units, there being a total of 100 parts of (1) and (2) in the composition, and (3) 2 to 10 parts, per 100 parts of (1) and (2), of a resin consisting essentially of trimethylsiloxane units, dimethylvinylsiloxane units and $SiO_{4/2}$ units, the ratio of the sum of the trimethylsiloxane units and dimethylvinylsiloxane units to the $SiO_{4/2}$ units in the resin being in the range of 0.1–1.2:1, at least (1) and (2) being free of materials having molecular weights of less than about 5,000, all said parts being on a weight basis.

This invention further relates to the vulcanized elastomeric products prepared by vulcanizing the compositions of this invention. Contact lenses prepared from the compositions are another facet of this invention. An especially preferred composition for making contact lenses is one which consists essentially of (1) about 65 parts of a dimethylvinyl endblocked copolymer consisting essentially of about 7.5 mol percent of phenylmethylsiloxane units, about 0.14 mol percent of vinylmethylsiloxane units and about 92.36 mol percent of dimethylsiloxane units, (2) about 35 parts of a dimethylvinylsilyl endblocked copolymer consisting essentially of about 20 mol percent methylvinylsiloxane units, about 5 mol percent phenylmethylsiloxane units and about 75 mol percent dimethylsiloxane units, and (3) about 3 to 7 parts of a resin consisting essentially of trimethylsiloxane untis, dimethylvinylsiloxane units and $SiO_{4/2}$ units, the ratio of the sum of the trimethylsiloxane units and dimethylvinylsiloxane units to the $SiO_{4/2}$ units in the resin being in the range of about 0.6–1.2:1, said parts being on a weight basis.

Other objects, advantages and aspects of this invention will be apparent from the following description, examples and claims.

Copolymers of the general type employed in the compositions of this invention as well as means for their preparation are well known to those skilled in the art. Copolymers used in preparing the compositions can be in the form of gums, fluids, or combinations of these. As pointed out above, at least copolymers (1) and (2) in the composition must be free of materials having molecular weights below 5,000. It is preferable that resin (3) also be free of these lower molecular weight materials. Copolymers prepared by conventional methods normally contain such lower molecular weight materials but can be freed of them by suitable techniques such as fractionation, exhaustive stripping, and extraction. These techniques are described in numerous places in the literature. However, the particularly preferred technique for removing lower molecular weight materials is by extractionation as described in U.S. patent application Ser. No. 539,746 now U.S. Pat. 3,440,264, filed Apr. 4, 1966 by Donald E. McVannel, the disclosure of which is incorporated herein by reference. In essence the process disclosed for removing lower molecular weight materials from the polymers involves the fractionation of the polymer in solvent through a permeable membrane.

The compositions of this invention can be vulcanized by conventional techniques well known to those skilled in the art. For example, the compositions can be vulcanized by irradiation or with peroxides employing the usual organic peroxide vulcanizing agents. Two organic peroxide vulcanizing agents that have been found to be particularly useful are dicumyl peroxide and tertiary butyl perbenzoate.

The mixing of the copolymers and resin to produce the composition of this invention can be done by any desired technique. Obviously, it is desirable that the technique employed should result in a reasonably uniform or homogenous composition in order that the best results are obtained. The particular mixing technique used will be determined by such factors as the equipment available, the nature of the copolymers being mixed (for example whether they are gums, fluids or both) and the ultimate use of the composition. For the preparation of contact lenses it is preferred at this time that the copolymers be mixed in the form of solvent solutions and that the resin