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MANUFACTURE OF SPONGE RUBBER

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This invention relates to the manufacture of sponge rubber from latex and more particularly to heat-setting a latex froth by means of a low frequency balanced alternating electric current.

The heat-setting of shaped latex froths containing heat-setting agents by passing low frequency balanced alternating electric currents from electrodes through the froths to generate the desired amount of heat in the froth to set or gel the same, prior to subjecting the gelled froth to conventional vulcanizing conditions, is known. The use of various metals as the electrodes, gives rise to unsightly pitting or discoloration, or both, of the surface of the sponge rubber molded against the electrodes. For instance, aluminum, which is commonly used for molds, gives very bad pitting; iron or stainless steel, which is also used for molds, gives pitting accompanied by brown discoloration; and tin, which has been suggested for electrodes in low frequency alternating current heating, leaves yellow and black spots on the surface of the final sponge rubber article.

I have found that if the surface of the electrode in contact with the froth in such low frequency balanced alternating current heating is made of zinc or cadmium, the surface of the sponge article which was in contact with the zinc or cadmium electrode during its setting or gelling will be free from pits and discoloration.

In carrying out the present invention, a heat-settable latex froth is introduced into a mold by forming the froth in the mold as by chemical blowing by evolving a gas in the latex in the mold, or by chemically blowing the latex in bulk or mechanically whipping a body of latex into a froth and pouring the froth into individual stationary or traveling mold, or by pouring or otherwise introducing the froth into a traveling continuous mold. Such molds will contain two electrodes, at least one of which will be in contact with a portion of the outer surface of the sponge article being molded. The second electrode could be embedded in the body of the froth being molded and removed after gelling of the froth, but generally each electrode will be comprised in one of the two parts of a two-part mold, usually the body part and the cover part. For example, the bottom and top plates of a box type mold may be composed of metal with the sides made of wood or other insulating material, or the mold may be all made of wood with metal plates secured to the opposite inner faces of the top and bottom sections, the metal plates, of course, being made the electrodes for the low frequency electric current to be passed through the froth. Also, the

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body of the mold may be of metal and comprise one electrode, and the cover of the mold may also be of metal and comprise the other electrode, such cover and body being separated by a gasket or spacer of insulating material, such as wood, rubber or the like. One or both of such electrodes may be made wholly of zinc or cadmium, or may be made of any desired metal with a surface coating of zinc or cadmium on the face of the electrode which contacts the foam.

The function of the electrodes, in the low frequency balanced alternating current heating of the latex froth of the present invention, is very different from that in the deposition of solid rubber masses on electrodes in the so-called electrodeposition of rubber from liquid latex by the use of direct electric current or unbalanced alternating current. Also, of course, the low frequency electric current heating to which the present invention relates, where the low frequency electric current for heating the foam is carried through the foam, is very different from the so-called high frequency dielectric heating where the heat is created in the latex foam as an electric insulator which is placed in a varying electrostatic field of high frequency, such as radio frequency.

The latex for preparing sponge rubbber according to the present invention may be a natural rubber latex, or a conjugated diene polymer synthetic rubber latex, or mixtures of any of the same. Such conjugated diene polymer synthetic rubber latex may be an aqueous emulsion polymerizate of one or a mixture of butadienes-1,3, for example, butadiene-1,3, 2-methyl-butadiene-1,3 (isoprene), 2-chloro-butadiene-1,3 (chloroprene), piperylene, 2,3-dimethyl butadiene-1,3. The conjugated diene polymer synthetic rubber latex, as known, may also be a mixture of one or more of such butadienes-1,3 with one or more other polymerizable compounds which are capable of forming rubbery copolymers with butadienes-1,3, for example, up to 70% of such mixture of one or more compounds which contain a single $CH_2{=}C<$ group where at least one of the disconnected valences is attached to an electro-negative group, that is, a group which substantially increases the electrical dissymmetry or polar character of the molecule. Examples of compounds which contain a $CH_2{=}C<$ group and are copolymerizable with butadienes-1,3 are aryl olefins, such as styrene, and vinyl naphthalene; the alpha methylene carboxylic acids, and their esters, nitriles and amides, such as acrylic acid, methyl acrylate, methyl methacrylate, acrylonitrile, methacrylonitrile, methacrylamide; methyl vinyl ether; methyl vinyl ketone; vinylidene chloride.

The latex may be compounded with the usual vulcanizing and other compounding ingredients and the froth will contain a conventional heat-setting agent which may be added to the latex before frothing, or to the froth, as before pouring into the molds. Such heat-setting agent, as is well known, may be an alkali-metal silicofluoride, or ammonium sulfate or other ammonium salt which together with zinc oxide forms a heat-setting combination. The latex compound may be converted into a froth by whipping in a beater, such as a Hobart mixer, or by the evolution of a gas in the latex, as by the decomposition of hydrogen peroxide or the reaction of a carbonate and an acid in the latex in the presence of a stabilizer. Such methods of compounding the latex and preparing the froth are well known.

The following is illustrative of the present invention, the parts referred to therein being by weight:

Sixty-three per cent natural rubber latex was compounded according to the following formulation:

	Parts by weight
Rubber (in latex)	100
Potassium oleate	2.8
Sulfur	2.5
Accelerator	2.7
Zinc oxide	5
Antioxidant	1

The compounding ingredients were added as aqueous solutions or pastes in known manner, after which water was added to a final concentration of 60% solids. The latex was whipped to a froth in a conventional Hobart mixer to a density of .103 grams per cubic centimeter. Four parts of potassium silicofluoride gelling agent were added at the end of the whipping operation. The whipped froth was poured into a mold comprising a bottom metal pan 13¼" x 17½", and 3¼" deep, which served as one electrode. This pan was made of aluminum and the interior surface of the same was a sprayed zinc coating. A 13¼" x 17½" metal top plate was used, to which was fastened ten rows of fourteen closed end cores, each core being ¾" diameter and 2½" long, the cores projecting into the pan or mold space to form tubular openings in the finished sponge cushion in the usual manner. The top plate served as the other electrode and the electrodes comprising the top plate and bottom pan section of the mold were separated by a rubber gasket. The top plate was of aluminum, and not surfaced with zinc. The froth was heated by passing a low frequency (60 cycles, 110 volts) electric current through the same. The heating cycle was characterized by a rapid increase in current to about 16 amperes during the first three minutes. The current then fell off to 10 amperes, and after ten minutes no current flowed, the temperature of the latex foam reaching 90° C. to 100° C. in the ten minutes. After such heating the sponge had become permanently set. It was then placed in an air oven at 100° C. for 15 minutes to vulcanize the sponge, after which it was removed from the mold. The resultant cured sponge had an undistorted outer surface free from pitting and devoid of coloration, wherever the surface had been in contact with the bottom pan electrode which was zinc-sprayed. The portion of the surface which was in contact with the top plate and the cores was badly pitted. In that this surface acts as the bottom of a seat cushion, such pitting on the bottom surface of the cushion and in the tubular openings extending into the body of the cushion, was not objectionable. Such pitting, however, would be very objectionable in the main exposed surface portion of the cushion corresponding to the bottom or pan portion of the mold.

If desired both sections of the above referred mold could be made of zinc or have the interior faces made of zinc coating, as by spraying on an aluminum mold, or dipping in case of a sheet steel mold. The body of the electrodes could be of other metals than the aluminum used, provided, of course, at least the pan portion had a zinc coating on the interior surface of the same. As stated above, tests on stainless steel and iron show pitting and brown discoloration of the sponge surface. Copper shows very bad pitting and black discoloration. Lead shows black discoloration. Tin and nickel show yellow and black spots. Silver shows bad pitting and black spots. Chromium shows bad pitting and green discoloration. Magnesium shows bad pitting. Where the inner electrode surface is composed of cadmium, similarly to the zinc coated bottom mold section above, the surface of the sponge rubber molded against it was devoid of any surface distortion or pitting or discoloration.

In view of the many changes and modifications that may be made without departing from the principles underlying the invention, reference should be made to the appended claims for an understanding of the scope of the invention.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. The process of producing sponge rubber from a latex which comprises introducing a heat-settable latex froth into a mold, and setting the froth in the mold by passage of a low frequency alternating electric current through the froth between metal electrodes, at least one of said electrodes being in contact with a portion of the outer surface of the sponge article being molded and the surface of which electrode in contact with the foam is composed of a metal selected from the group consisting of zinc and cadmium.

2. The process of producing sponge rubber from a latex which comprises introducing a heat-settable latex froth into a mold, and setting the froth in the mold by passage of a low frequency alternating electric current through the froth between metal electrodes, at least one of said electrodes being in contact with a portion of the outer surface of the sponge article being molded and the surface of which electrode in contact with the foam is composed of zinc.

3. The process of producing sponge rubber from a latex which comprises introducing a heat-settable latex froth into a mold, and setting the froth in the mold by passage of a low frequency alternating electric current through the froth between metal electrodes, at least one of said electrodes being in contact with a portion of the outer surface of the sponge article being molded and the surface of which electrode in contact with the foam is composed of cadmium.

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No references cited.