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METHOD OF MAKING POLYETHYLENE COATED RAZOR BLADES

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This invention relates to coated cutting blades and to a method of making the same. More particularly, the present invention relates to coated razor blades and to a method of making the same.

Cutting blades have always presented certain problems, for example the problems of maintaining a sharp edge during extended storage periods, as well as through repeated use. Cutting blades for certain uses have presented additional problems connected with such uses. For example, cutting blades which are used where there is considerable contact between a blade side and another surface, such as the contact which occurs in shaving-type cutting, involves the effect of the blade on the other surface. As another example, cutting blades which are used to shave hairs involve the problems of the pull of the blade on the hairs and the effect of the blades on the skin, as well as the overall ease with which such shaving can be done.

In order to lessen some of the undesirable effects which occur during the use of cutting blades, various lubricants have been utilized. For example, blades have been coated with oil for use in many applications. In addition, various shaving preparations, soaps and the like, have been employed when blades have been used for shaving. Furthermore, blade edges have been made sharper for greater cutting ease and blades have been developed of metals which will hold a sharper edge for longer periods of time. Blades have also been made which will resist attack by materials which cause a degradation of the blades.

Some coatings have also been developed to provide the blades with additional protection against the materials which attack them. For example, certain resins have been applied to steel blades to prevent the blades from rusting due to the action of water. Certain materials have been applied to blades to facilitate shaving with them, such materials providing a greater ease of shaving than the corresponding uncoated blades. These materials have included silicone coatings and halogenated hydrocarbon coatings. However, none of these materials completely satisfies all of the above requirements.

The present invention provides a coated cutting blade which is an improvement over the blades now known in the art. Blades which are coated in accordance with the present invention when used for shaving provide: (1) superior shavability, i.e., they more readily shave hair with less discomfort; (2) superior durability, permitting a large number of shaves per blade; (3) superior storage properties, in that they can be kept for long periods of time without losing their sharpness or deteriorating in any way; (4) are simpler and less expensive to make and are made of materials which are both readily available and inexpensive.

The method employed to coat blades in accordance with the present invention is simple, provides uniform coatings and is rapid and inexpensive to employ.

In accordance with the present invention, cutting blades, particularly razor blades, are coated with a polyethylene resin by first applying the resin to the blade and thereafter heating the blade in an oxygen-free atmosphere to fuse the resin on the blade.

The blades which may be coated in accordance with the present invention may include single and double edge razor blades, made for example of hardenable stainless steel or of a carbon steel, or may be surgical instruments, scissor blades or the like.

A preferred preliminary step involves first cleaning the blades with a detergent or any organic solvent which will dissolve grease, for example, carbon tetrachloride, trichloroethylene or other halogenated ethylene, benzene, petroleum ether or chloroform, to remove grease, dirt and the like. This can be done by dipping the blades or spraying the blades with the solvent or a mixture of solvents.

A second preferred preliminary step involves preheating the blades to a temperature of from about 25° C. to about 180° C. We have found that this step greatly improves the quality of the coatings.

The coating can be applied to the blades by dipping, spraying, brushing, or the like with an emulsion, suspension or solution of the polyethylene resin which can be at room temperature or could be preheated and maintained at a temperature up to about 170° C. ,

While we do not wish to be bound by any particular theory it is believed that the effectiveness of the present coatings is due to the anchoring of the polyethylene chains to the blade as a result of the chain-scission and free radical production caused by the heating process. The fact that oxygen is excluded from the blades during such heating, permits such anchoring to occur, since it prevents attack on the chain by the oxygen and eliminates the possibility of attack by oxygen on the blades themselves, which attack would otherwise occure at the high temperatures at which the fusion of the coating takes place. The absence of oxygen is believed to result in the free radicals remaining in an uncombined form for a longer period of time than would occur in an atmosphere of air.

After the blades have been heated in an oxygen-free atmosphere, they are permitted to cool and are ready for use.

Polyethylene resins which can be employed in this invention are preferably employed per se. However, the ethylene polymer may contain minor percentages, up to 50 percent by weight, and preferably up to about 20 percent by weight of other olefinic monomers than ethylene. For example, the polyethylene resin may be in the form of a copolymer of ethylene and, up to 50 percent by weight of the ethylene, of an olefinic monomer such as vinyl chloride, vinyl acetate, vinylidene cholire, methyl methacrylate, acrylonitrile, butadiene, maleic anhydride, formaldehyde and ethyl acetate. The polyethylene resin may also be present in the admixture with up to 50 percent by weight of other polymers, which are compatible with polyethylene, such as polypropylene, polyisobutylene, polyvinyl isobutyl ether, polyvinyl alcohol, polyvinyl acetate and polyvinyl chloride. As used herein "polyethylene" means an ethylene homopolymer and the term "polyethylene resin" includes homopolymers of ethylene as well as copolymers and admixtures of ethylene with up to 50 percent by weight, based on the ethylene, of other olefinic monomers.

The molecular weight of the polyethylene resin employed may vary from as low as 1,000 to as high as 2,000,000 or more. The essential requirement of the polyethylene is that it be substantially solid at temperatures up to 50° C. Polyethylenes which are solid at higher temperatures, (for example, at 150° C.) would be satisfactory. Polyethylenes having densities as low as .910 and as high as .965 have been successfully employed and are satisfactory for use in the present invention.

The polyolefin may be applied to the blade by spraying, by dipping, by flame techniques and the like. The polyolefin may be dissolved, suspended or emulsified with suitable solvents prior to application to the blade. Suitable solvents include carbon tetrachloride, benzene, toluene, xylene, amylacetate, trichloroethylene, tetrachloroethylene, hexachlorobutadiene, methylcyclohexanone, petroleum ether, turpentine, naphtha and the like.

After the blade has been coated with the polyolefin resin, it is then placed in an oxygen-free atmosphere and heated at a temperature and for a sufficient period of time to fuse the polyolefin to the blade. This may be done, for example, by employing resistance heating, induction heating, infrared heating or heating by means of light amplification by stimulation of electromagnetic radiation (laser) or by the use of ionizing radiation. The coated blades should be heated at a temperature between about 150° C. and 500° C. and preferably between about 210° C. and 370° C. for a period of from about 15 seconds up to about 15 minutes and preferably from about ½ minute to about 3 minutes.

The non-oxidizing atmosphere can be an inert atmosphere, such as could be obtained in an inert gas, e.g. nitrogen, or in a vacuum, or may be a reducing atmosphere, such as would be obtained using a natural gas.

The following examples are illustrative. Experiments 1 and 2, which follow the examples, are outside the scope of the present invention and are presented for comparison purposes only.

EXAMPLE 1

Standard commercially available safety razor blades of hardened carbon steel were treated by washing them with hot chloroform and drying. The blades were then mounted on bayonet-type carriers. Twenty blades were retained as controls and twenty blades were heated in an oven until the blades reached a temperature of 130° C., after which they were removed from the oven and immediately dipped into a coating solution. The coating solution had been prepared by dissolving 250 mg. of a polyethylene resin having an average molecular weight of 38,000 (Tenite Polyethylene 1H55P) in 100 ml. of benzene. After being dipped in the 0.25% polyethylene solution, the blades were refrigerated until they returned to room temperature. They were then connected to an electrical system which permitted a voltage to be applied across the blades. The system was such that the electrical leads to the blades and the blades themselves were all enclosed in a glass container. The glass container was then flushed with a reducing atmosphere of natural gas, and the natural gas was continuously passed through the container while a voltage was applied across the blades until the temperature of the blades reached 260° C. This blade temperature was maintained for a period of 1 minute, by regulating the amount of voltage which was applied across the blades. The flow of natural gas was thereafter increased in order to cool the blades to room temperature while still maintaining them in a reducing atmosphere. After the blades have been cooled, they were removed and examined microscopically. The edge of the blades was found to be coated fairly evenly with a soft thin film about 2,000 Angstroms thick. Scratch tests of the film on the blades revealed that a soft coat lay underneath a fused overcoat.

The blades were examined for Newtonian fringes by irradiating the surface with monochromatic light and by observing the surface through a microscope with a calibrated eyepiece. The number of minima of reflected radiations were then observed at different distances from the blade edge. The polyethylene which adhered to the cutting edge of the blades showed a few scattered fringes in the zone within 0.001 inch from the ultimate edges. This is an indication that the coating formed a relatively smooth surface. This is in contrast to blades coated with silicones or with a halogenated hydrocarbon, which coatings exhibited much greater regularity in fringe patterns, thus indicating that they had a greater degree of change in thickness within the first 0.001 inch from the ultimate edge. Six shaving tests were conducted on these blades by a sixty-six member shaving panel. These shaving tests were conducted as follows:

One half of each tester's face was shaved with a coated blade and the other half was shaved with an uncoated control blade. Conventional methods were employed for preparing the beard for shaving. The controls in the present case were uncoated blades of exactly the same kind as the blades which were coated. To eliminate differences which might exist between blades, two bayonets of the same stock were employed. The blades on one bayonet were coated and the blades on the other bayonet were left uncoated and in order to test for durability of the coating, the blades and ther controls were used in six having tests. Thirty-three persons in a shaving panel of fifty-four persons rated the shavability of the polyethylene-coated blades as greatly superior to that of the untreated controls. Eight preferred the control, and 13 had no preference. (See p. 30, Table I, Test 1.) The panel noted that the polyethylene coated blades appeared to be sharper than the uncoated blades. The panel also noted that the polyethylene coating materially reduced skin drag and decreased the cutting force required to sever the beard hair, thus aiding in providing a comfortable shave.

EXAMPLE 2

Similar type blades to those employed in Example 1 were cleaned in hot chloroform, dried and preheated to a temperature of 130° C. They were then removed from the preheating zone and immediately dipped in a 0.25% solution (in benzene) of a polyethylene resin similar to that employed in Example 1. After dipping, the coated blades were stored in a refrigerator overnight. The blades were then heated in the same manner as in Example 1 by resistance heating in a natural gas reducing atmosphere until the temperature of the blades reached 260° C. and the blades were maintained at that temperature for a period of 1 minute. The natural gas flow was identical to that employed in Example 1. The blades were evaluated microscopically, by fringe count, and by shaving panels as in the case of Example 1. The blades were found to have an even coating comprised of a soft undercoat and a harder overcoat which was not easily removed by cutting through paper. Only a few fringes were observed in the zone within 0.001 inch from the ultimate edge. The shaving panel found the blades to possess good shaving characteristics.

EXAMPLE 3

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1 except that the temperature to which they were heated by resistance heating was 210° C., and the period of time for which they were heated was 12 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The results of these tests indicated that the blades prepared in this manner were preferred over the uncoated controls. The coating on the blades was barely grooved by a paper cut, was soft and had a slight undercoating and a few Newtonian fringes were observed.

EXAMPLE 4

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1 except that the temperature to which they were heated by resistance heating was 215° C., and the period of time for which they were heated was 6 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The results of these tests indicated that the blades prepared in this manner were satisfactory. The coating was somewhat uneven. No grooves were observed after a paper cut. Thirteen out of a total of twenty shaving panel members preferred these blades to the uncoated controls. Only two preferred the untreated blade.

EXAMPLE 5

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1 except that the temperature to which they were heated by resistance heating was 320° C. and the period of time for which they were heated was 5 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The blades were found to have a satisfactory coating and to give desirable shaving characteristics which were superior to the uncoated blades, for the following reasons: The blades had a thin coating at the ultimate edge, gave a soft scratch and were found to have about four fringes when observed under a microscope. The film was grooved by a paper cut and pulled back slightly from the ultimate edge. Fifteen out of twenty-three shaving panel member preferred the coated blade over the uncoated controls, whereas only four preferred the uncoated blade.

EXAMPLE 6

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1, except that the temperature to which they were heated by resistance heating was 230° C., and the period of time for which they were heated was 4 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The blades were found to have a satisfactory coating and to give desirable shaving characteristics, which were superior in the case of the coated blade to those of uncoated blades.

EXAMPLE 7

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1, except that the temperature to which they were heated by resistance heating was 290° C. and the period of time for which they were heated was 3 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The blades were found to have a satisfactory coating and to give desirable shaving characteristics, which are superior to those of uncoated blades.

EXAMPLE 8

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1, except that the temperature to which they were heated by resistance heating was 260° C., and the period of time for which they were heated was 1 minute. These blades were examined microscopically and fringe counts were made. Scratch tests and evaluation by a shaving panel were also conducted. The blades were found to have a satisfactory coating and to give desirable shaving characteristics, which were superior to those of uncoated blades.

From the preceding examples it can be seen that when a polyethylene resin of the type shown in these examples is employed, the fusing can be at a temperature of from about 210° C. to about 320° C. for a period of from about 0.5 minute to about 12 minute.

EXAMPLE 9

The same type blades as employed in Example 1 were treated in the same manner as that described in Example 1, except that the concentration of the polyethylene solution and the preheating temperature were varied and that the coating was fused at 290° C. for ¾ of a minute. The concentration of the polyethylene was 0.1% and the preheat temperature was 100° C. The blades prepared in this manner were evaluated in a similar manner to the blades in Example 1. They were not found to be as satisfactory as the blades prepared in Example 1, having a poorer distribution of resin on the blade.

EXAMPLE 10

The same type blades as employed in Example 1 were treated in the same manner as that described in Example 1, except that the concentration of the polyethylene solution and the preheating temperature were varied and that the coating was fused at 290° C. for ¾ of a minute. The concentration of the polyethylene was 0.1% and the preheat temperature was 150° C. The blades prepared in this manner were evaluated in a similar manner to the blades in Example 1. They were not found to be as satisfactory as the blades in Example 1 for the following reasons: The high preheat temperature prevented the formation of a smooth film and the resin was found to be in the form of small discrete globules.

EXAMPLE 11

The same type blades as employed in Example 1 were treated in the same manner as that desccribed in Example 1, except that the concentration of the polyethylene solution and the preheating temperature were varied and that the coating was fused at 290° C. for ¾ of a minute. The concentration of the polyethylene was 0.2% and the preheat temperature was 135° C. The blades prepared in this manner were evaluated in a similar manner to the blades in Example 1. They were found to be as satisfactory, having an even coating of a soft film which was slightly grooved by a paper cut. Thirty-one of forty-nine shaving panel members preferred the blades over uncoated control blades. Ten preferred the control.

EXAMPLE 12

The same type blades as employed in Example 1 were treated in the same manner as that described in Example 1, except that the concentration of the polyethylene solution and the preheating temperature were varied and that the coating was fused at 290° C. for ¾ of a minute. The concentration of the polyethylene was 0.3% and the preheat temperature was 135° C. The blades prepared in this manner were evaluated in a similar manner to the blades in Example 1. They were found to be satisfactory, having a soft even coat which exhibited about 4–6 fringes and having a soft undercoating. Shaving panel results showed that the blades lessened hair pull and gave a smooth and comfortable close shave.

EXAMPLE 13

The same type blades as employed in Example 1 were treated in the same manner as that described in Example 1, except that the concentration of the polyethylene solution and the preheating temperature were varied and that the coating was fused at 290° C. for ¾ of a minute. The concentration of the polyethylene was 0.3% and the preheat temperature was 125° C. The blades prepared in this manner were evaluated in a similar manner to the blades in Example 1. They were found to be satisfactory, the coating being in the form of a soft even film which showed 4–6 fringes. Shaving panel results showed that 25 panel members from a panel of 42 preferred the coated blade over the uncoated controls whereas six preferred the control.

The blades which had been pretreated in this manner were more satisfactory than the blades which were treated in accordance with Examples 9 through 12 and were as satisfactory as the blades prepared under the conditions given in Example 1.

EXAMPLE 14

Carbon steel rezor blades of the same type as employed in Example 1 were cleaned and dried in the same manner as Example 1 and mounted on bayonet-type carriers. The blades were then preheated to 130° C. and dipped immediately into a coating solution prepared by making a 1% suspension of a low molecular weight polyethylene (E 10) in benzene. The polyethylene had a molecular weight of 2500, a density of 0.94 (ASTM method D 796–60T) and a penetration hardness of 6.2 mm. at 100 g. for 5 seconds at 77° F. and a tensile strength of 1300 p.s.i. (ASTM method D 638–61T). The blades were removed from the polyethylene solution and refrigerated until their temperature returned to room temperature (25° C.). They were then heated by resistance heating in the same manner as Example 1 in an atmosphere of nitrogen at a temperature of 290° C. for 0.75 minute. The blades were then evaluated in the same manner as Example 1. The blades coated in this manner were found by the shaving panel to be significantly better than uncoated blades employed as controls. Twenty-eight out of fifty-five panel members found that the coated blade appeared sharper and materially reduced hair pull. Ten preferred the uncoated blade and 17 showed no preference. (See p. 30, Table I, Test 2.)

EXAMPLE 15

Carbon steel razor blades of the same type as employed in Example 1 were cleaned and dried in the same manner as Example 1 and mounted on bayonet-type carriers. The blades were then preheated to 130° C. and dipped immediately into a coating solution prepared by making a 1% suspension of a low molecular weight polyethylene (E 11) in benzene. The polyethylene had a molecular weight of 1500, a density of 0.938 and a penetration hardness of 0.25 mm. at 100 g. for 5 seconds at 77° F. and a tensile strength 510 p.s.i. The blades were removed from the polyethylene solution and refrigerated until their temperature returned to room temperature (25° C.). They were then heated by resistance heating in the same manner as Example 1 in an atmosphere of nitrogen at a temperature of 290° C. for 0.75 minute. The blades were then evaluated in the same manner as Example 1. The blades coated in this manner were found by the shaving panel to be significantly better than uncoated blades.

EXAMPLE 16

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hercules Hi Fax 1401) having a density of 0.945 (ASTM D 1505–60 T) and a melt index at 190° C. of 0.6 (ASTM D 1238–57T) was dissolved in toluene. The resulting extract was diluted with toluene until the resulting solution contained 0.5% polyethylene on a total weight basis. After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of propane gas, which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 minute. The resulting coated blades were evaluated by a shaving panel which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were found to be equivalent to the silicone coated blades with regard to shavability and lack of hair pull and to give a smooth, close shave.

EXAMPLE 17

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

Polyethylene having a molecular weight of about 500,000 (Hercules Hi Fax 1601) having a density of 0.945 (ASTM D 1505–60T) and a melt index at 190° C. of 0.2 (ASTM D 1238–57T) was dissolved in toluene. The resulting solution was diluted with toluene until the resulting solution contained 0.5% polyethylene on a total weight basis. After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of propane gas, which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 minute. The resulting coated blades were evaluated by a shaving panel which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were preferred over the silicone coated blades, providing better shavability, a smoother shave and less hair drag.

EXAMPLE 18

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hercules Hi Fax 1701) having a density of 0.945 (ASTM D 1505–60T) and a melt index of 2.0 at 250° C. (ASTM D 1238–57T) was dissolved in toluene. The resulting solution was diluted with toluene until the resulting solution contained 0.5% and polyethylene on a total weight basis. After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of propane gas, which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 of a minute. The resulting coated blades were evaluated by a shaving panel, which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were equivalent to the silicone coated blades, giving equivalent shavability with a smooth shave and no hair drag.

EXAMPLE 19

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hercules Hi Fax 1801) having a density of 0.945 and a melt flow index of 0.3 at 250° C., was dissolved with toluene. The resulting solution was diluted with toluene until the resulting solution contained 0.5% the polyethylene on a total weight basis. After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of propane gas which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 minute. The resulting coated blades were evaluated by a shaving panel which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were equivalent to the silicone coated blades, providing good shavability, a smooth close shave and having no hair drag.

EXAMPLE 20

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

Polyethylene having a molecular weight of about 2,000,000 (Hercules Hi Fax 1900) having a density of 0.945 and a reduced specific viscosity of 25 was extracted with toluene. The resulting extract was diluted with toluene until the resulting solution contained 0.4% the polyethylene on a total weight basis. After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated, by resistance heating, in an atmosphere of propane gas, which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 minute. The resulting coated blades were evaluated by a shaving panel which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were perferred over the silicone coated blades for the following reasons: They provided better shavability, had less hair drag and gave a smoother shave. Thirty-three out of 56 shaving panel members perferred the blades to silicone coated blades.

EXAMPLE 21

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 150° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hercules Hi Fax 2000) having a density of 0.962 and a melt index of 90° at 190° C. was dissolved in toluene. The resulting solution was diluted with toluene until the resulting solution contained 0.25% of polyethylene, on a total weight basis.

After the blades were dipped in the extract, they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of propane gas, which had been purified by passing it through activated charcoal and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 290° C., at which temperature they were maintained for 0.75 minute. The resulting coated blades were evaluated by a shaving panel which also evaluated blades which had been coated with a silicone coating. The polyethylene coated blades were equivalent to the silicone coated blades, giving comfortable close shaves with no hair pull.

EXAMPLE 22

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 180° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hercules Hi Fax 1900) having a density of 0.945 and a reduced specific viscosity of 25 was dissolved in xylene. The resulting solution was diluted with xylene until the resulting solution contained 0.5% the polyethylene on a total weight basis.

After the blades were dipped in the extract they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in a natural gas atmosphere from which oxygen had been removed and which had been dried by contact with a drying agent. The blades were heated by resistance heating until they reached a temperature of 370° C. and were maintained at that for 1 minute.

The flow rate of the gas then increased, to expedite the cooling of the blades to room temperature, and the blades were thereafter examined microscopically. The edges were found to be coated evenly with a soft thin film of about 2,000 Angstrom units in thickness.

Tests by a sixty-six member shaving panel rated the shavability of the blades coated in this manner as superior to an untreated control and as superior to a commercially available silicone-coated blade.

EXAMPLE 23

Carbon steel safety razor blades were cleaned and dried as in Example 1 and then preheated to 160° C. The blades were then sprayed by means of an atomizing spray gun with a 0.3% solution of a high molecular weight polyethylene resin (Hi Fax 1601), toluene being employed as the solvent. After spraying, the blades were refrigerated to cool them to room temperature. The blades were then heated by resistance heating in the same manner as in Example 1 and were maintained in a reducing atmosphere of natural gas at a temperature of 290° C. for 0.75 minute. The blades were then cooled to room temperature in the atmosphere of natural gas and were removed and examined microscopically. The edges of the blades were found to be coated evenly with a soft thin film and the shavability of the blades was evaluated by a shaving panel which found them to be significantly preferred over uncoated control blades.

EXAMPLE 24

Double edge stainless steel razor blades were cleaned by first dipping them in chloroform and then dipping them in trichloroethylene. The blades were then dried and preheated to 155° C., after which they were immediately dipped in a 0.25% xylene solution of a high molecular weight polyethylene (Hi Fax 1601). The blades were then refrigerated until they reached room temperature and the blades were then fused in a reducing atmosphere of natural gas, as in Example 1, by resistance heating at 290 C. for 0.75 minute. Evaluation of the blades by a shaving panel showed that they were preferred to uncoated control blades.

EXAMPLE 25

Carbon steel razor blades of the type employed in Example 1 were cleaned as in Example 1 and preheated to 155° C. They were then dipped in a 0.25% xylene solution of a copolymer of polyethylene and vinyl acetate, the vinyl acetate being present at 15% of the weight of polyethylene, (Du Pont Alathon 3100). The coated blades were then refrigerated until they reached room temperature and the coating was then fused on the blades by resistance heating at 290° C. for 0.75 minute. The treatment produced an even coating and evaluation by a shaving panel showed that the blades were significantly superior in shavability to uncoated blades. Seven out of a shaving panel of nine members preferred the treated blade over the uncoated blade.

EXAMPLE 26

Carbon steel razor blades of the type employed in Example 1 were cleaned and dried as in Example 1 and preheated at 150° C. A toluene solution was prepared containing 90 parts of polyethylene having a molecular weight of 500,000 (Hi Fax 1601) and 10 parts of polybutene. The total solids content of the solution comprised 0.5% by weight. The preheated blades were dipped into the solution and then refrigerated until their temperatures returned to room temperature. The blades were then heated by resistance heating at 290° C. at a reducing atmosphere for a period of 0.75 minute. The resulting blades were found to have an even coating and shaving panel evaluation indicated that the blades were significantly superior in shavability to uncoated blades. Eight out of twelve shaving panel members preferred the coated blades over the uncoated blades wereas none preferred the uncoated control.

EXAMPLE 27

In a similar manner to Example 26, a mixture of 80% polyethylene and 20% polypropylene, said mixture being dissolved in toluene, was used as the coating solution. The other conditions present in Example 26 were the same. This treatment produced an even coating and evaluation by a shaving panel showed that the coated blades were significantly superior to an uncoated blade.

EXAMPLE 28

In a similar manner to Example 26 a mixture of 90% polyethylene (Hi Fax 1601) and 10% polyisobutylene, said mixture being dissolved in toluene was used as the coating solution. The other conditions present in Example 26 were the same. This treatment produced an even coating and evaluation by a shaving panel showed that the coated blades were significantly superior to an uncoated blade.

EXAMPLE 29

Standard razor blades of the same type as employed in Example 1 were cleaned and dried as in Example 1 and were then preheated to a temperature of 180° C. The blades were then immediately dipped in a solution which was prepared as follows:

A high molecular weight polyethylene (Hi Fax 2600) having a density of 0.962 and a melt index of 0.2 at 190° C. (as determined by ASTM methods D 1550–60T and D 1238–57T) was dissolved in xylene. The resulting solution was diluted with xylene until the resulting solution contained 0.5% polyethylene on a total weight basis.

After the blades were dipped in the extract, they were refrigerated until they reached room temperature. The coated blades were then heated by resistance heating in an atmosphere of dry nitrogen until they reached a temperature of 370° C. and were maintained at that temperature for 1 minute.

The flow rate of the gas was then increased, to expedite the cooling of the blades to room temperature and the blades were thereafter examined microscopically. The edges were found to be coated evenly with a soft thin film of about 2,000 Angstrom units in thickness.

Tests by a sixty-six member shaving panel rated the shavability of the blades coated in this manner as superior to an untreated control and as superior to a commercially available silicone-coated blade.

In order to illustrate in more detail the preferences indicated by the shaving panels, the following table has been prepared. In the table, the total shaving panel size for each test series is given, the type of coating is given, the number of persons preferring the coated blade is given, the rating is given, the type of blade used as a control is given, the number of persons preferring the controls is given together with a rating for the control, the number of persons having no preference between the coated blade and the uncoated blade is also given. The shaving panel tested the blades as described earlier in the specification and the ratings were on a scale of 0–9 based on the following qualities: comfort of shave and closeness of shave, 0 being the lowest rating and 9 being the highest rating. The figure given in the table is the average of the numerical value (given on the 0–9 scale) assigned to the blades by each panel member.

In the case of test 1, the coating was applied to a blade which had been preheated to 130° C. and the coated blade was fused in a resistance atmosphere for 1 minute at 260° C. Tests 2, 3, 4, 5, 6, 7, 8 and 9 were conducted with fusing at 290° C. for 0.75 minute. In tests 2 and 3 the preheating temperature was 130° C. In tests 4–9 the preheating temperature was 150° C. The conditions in tests 1–9 corresponds, respectively, to the conditions in Examples 1, 14, 15, 20, 20, 20, 22, 20 and 20.

Table I

Test	Total panel size	Blade coating of present invention	Preferred by—	Rating	Control Blade	Preferred by—	Rating	Equal	Ratio of panel members preferring coated blades of this invention to control blades
1	54	1H55P	33	4.5	Uncoated	8	3.4	13	4.1:1
2	55	E10	28	4.5	do	10	3.9	17	2.8:1
3	52	E11	22	3.9	do	6	3.1	24	2.7:1
4	58	Hi Fax 1900	49	7.4	do	4	5.1	5	12:1
5	50	Hi Fax 1900	30	6.3	Silicone coating.	5	5.3	15	6:1
6	56	Hi Fax 1900	33	6.6	do	6	5.5	17	5.5:1
7	20	Hi Fax 1900	13	6.3	Uncoated	1	4.9	6	13:1
8	33	Hi Fax 1900	21	5.6	do	4	4.4	8	5.2:1
9	54	Hi Fax 1900	24	6.1	Silicone coating.	7	5.4	23	3.5:1

The following experiments are presented for comparison:

EXPERIMENT 1

A group of the same type blades as were employed in Example 1 were subjected to the identical conditions employed in Example 1, except that the temperature to which they were heated by resistance heating was 160° C. and the period of time for which they were heated was 15 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and subjective evaluation by shaving panels were also conducted. The results of these tests indicated that the blades prepared in this manner were not satisfactory, for the following reasons: Scratch tests indicated that the coating would readily flake from the blade. Subsequent shaving tests confirmed the fact that the blade coating was not durable. Fifty-five of sixty-five panelists found that the blades did not give an improved shave.

EXPERIMENT 2

A group of the same type blades as were employed in Experiment 1 were subjected to the identical conditions employed in Experiment 1 except that the temperature to which they were heated by resistance heating was 260° C. and the period of time for which they were heated was 15 minutes. These blades were examined microscopically and fringe counts were made. Scratch tests and subjective evaluation by shaving panels were also conducted. The results of these tests indicated that the blades prepared in this manner were not satisfactory, the coating being too hard and flaky and providing inadequate lubrication for good shaving.

We claim:

1. A method for applying a polyethylene resin coating to the cutting edge of a razor blade which comprises applying a polyethylene resin to a blade and thereafter heating the blade in an oxygen-free atmosphere at a temperature of from about 150° C. to about 500° C. for a period of from about 0.25 to 15 minutes.

2. The method of claim 1 wherein the heating is resistance heating.

3. The method of claim 1 wherein the heating is induction heating.

4. The method of claim 1 wherein the oxygen-free atmosphere is an inert gas.

5. The method of claim 1 wherein the oxygen-free atmosphere is a reducing gas.

6. The method of claim 1 wherein the oxygen-free atmosphere is a propane gas.

7. The method of claim 1 wherein the oxygen-free atmosphere is a natural gas.

8. The method of claim 1 wherein the oxygen-free atmosphere is a vacuum.

9. A method for applying a polyethylene resin coating to the cutting edge of a razor blade which comprises preheating said blade to a temperature of from about 25° C. to about 180° C. and thereafter applying a polyethylene resin to said preheated blade, permitting the resulting coated blade to cool to room temperature, and thereafter heating the resulting coated blade in an oxygen-free atmosphere at a temperature of from about 150° C. to about 500° C. for a period of from about 0.25 to 15 minutes.

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