

INCONSPICUOUS PAVEMENT MARKINGS AND
METHOD FOR MAKING

FIELD OF INVENTION

5 The present invention relates to pavement markings which may be adhered to a roadway so as to be visually inconspicuous to motor vehicle drivers and a method for making such pavement markings.

10 BACKGROUND

Typically, pavement markings are used to provide visual guidance to motor vehicle drivers by using conspicuous coloring and retroreflective or active lighting. Pavement markings are used as traffic control
15 markings for a variety of uses, such as lane striping and stop bars. Pre-formed pavement markings typically comprise a wear-resistant top layer overlying a conformable base sheet. Skid-resistant granules, e.g., such as disclosed in U.S. Patent No. 5,094,902, are
20 typically applied to the upper surface of the top layer. Such markings are often applied to road surfaces using pressure sensitive adhesive or contact cement.

Known traffic control markings also include markings intended to operate in a non-visual manner, e.g.,
25 magnetic marking systems such as disclosed in WO 96/16231 and radar reflective marking systems such as disclosed in European Patent Application 0135740 (Eigenmann).

SUMMARY

30 The present invention provides a novel visually inconspicuous pavement marking comprising a base sheet having a top layer with an upper surface with a plurality of skid-resistant granules on the upper surface. The skid-resistant granules are selected from two or more
35 color groups. The granules and top layer are selected such that the marking is visually inconspicuous on the surface to which it is applied.

Pavement markings of the invention are substantially visually inconspicuous. As a result, the markings are not distracting to drivers of motor vehicles.

Experiments have shown that preferred pavement markings
5 of the invention can be made as durable as currently available long life pavement markings, and possess other desirable characteristics typically associated with traditional pavement markings.

Visually inconspicuous pavement markings of the
10 invention are useful in many situations. Illustrative uses include masking uses and non-visual uses such as with radar and magnetic sensor systems. An illustrative example of a masking use is in temporary construction zones, where it may be desirable to temporarily mask pre-
15 existing permanent pavement markings so as not to distract motor vehicle drivers from temporary pavement markings, e.g., altered lanes, etc.

The invention also provides a method of making a visually inconspicuous pavement marking. The method
20 consists of providing a conformance layer, applying a polymeric top layer to the conformance layer, and depositing a plurality of skid-resistant granules on the upper surface of the polymeric layer. The skid-resistant granules are selected from two or more color groups and
25 adhere to or are partially embedded in and protrude from the upper surface of the top layer.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be further explained with
30 reference to the drawings, wherein:

Figure 1 is a cross-sectional view of a preferred embodiment of the invention.

Figure 2 is a schematic diagram of a preferred embodiment of the invention.

35 These figures, which are idealized, are not to scale and are intended to be merely illustrative and non-limiting.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

As mentioned above, the invention provides a visually inconspicuous pavement marking comprising a base sheet having a top layer with an upper surface with a plurality of skid-resistant granules. The skid-resistant granules are selected from two or more color groups. The granules and top layer are selected such that, in overall appearance, the marking is relatively inconspicuous on the surface to which it is applied. The skid-resistant granules are adhered to or are partially embedded in and protrude from the polymeric top layer. By pavement marking it is meant any traffic-bearing surface.

Referring to Fig. 1, there is shown a cross-sectional view of a preferred embodiment of a pavement marking 10 according to the present invention. The pavement marking 10 comprises a base sheet 12 that is adhered to a pavement surface 14 by means of a suitable adhesive 13. Base sheet 12 comprises optional conformance layer 16 and top polymeric layer 15. In some embodiments, the base sheet 12 is substantially flat and has substantially no protrusions as shown. In other embodiments, however, the base sheet may have protrusions. Skid-resistant granules 11 are deposited on the upper surface of the top polymeric layer 15 of the base sheet.

Figure 2 depicts a top view of an illustrative embodiment of a pavement marking 10 according to the present invention adhered to a pavement marking 14. Pavement marking 10 optionally has a series of slots 18 to interact with a radar sensing device, the series extending substantially the entire length of the pavement marking.

Skid-resistant granules 11 are used to provide a marking material preferably having a residual skid resistance in the British Portable Skid Resistance test of at least 50 BPN. BPN means the British Portable

Number as measured using a Portable Skid Resistance Tester built by Road Research Laboratory, Crawthorne, Berkshire, England. Skid-resistant granules of suitable size, shape, and hardness can be readily selected by
5 those skilled in the art. Typically, the granules are either spheroidal or irregular in shape, and range from about 0.5 to 3.0 millimeters in diameter.

Skid-resistant granules may be made of a variety of materials, including but not limited to ceramic, sand,
10 stone, aluminum oxide, and glass. In a preferred embodiment, the granules are ceramic spheroids that are a fired ceramic comprising a mineral particulate, pigment, and a binder, such as disclosed in U.S. Patent 5,094,902. These ceramic spheroids are extremely durable and impart
15 excellent skid-resistant characteristics to pavement marking materials.

In a particularly preferred embodiment, the skid-resistant granules are ceramic spheroids of diameter from about 1.0 millimeters to 2.0 millimeters. These ceramic
20 spheroids are extremely durable and impart excellent skid-resistant characteristics to pavement marking materials.

Skid-resistant granules of at least two different colors are selected. That is, some of the granules are
25 one color, while others of the granules are a second color. The colors of each of the skid-resistant granules and of the top layer of the pavement marking material are selected to complement the substrate to which it is affixed, i.e., be substantially visually inconspicuous to
30 motorists. Illustrative examples include the selection of brown and light gray granules for concrete, and black and gray granules for asphalt. Selections of color of granules, as well as number of granules applied per area, are made to match the particular substrate. Particular
35 locations of a given type of substrate may vary. For example, one concrete substrate may be more gray than another concrete substrate.

The skid-resistant granules may be affixed to the top layer in any suitable manner, i.e., such that they are retained on the marking for a desirable period of time and provide desired skid resistance. In a preferred
5 embodiment, the granules are partially embedded in and protrude from the upper surface of the top layer. In another embodiment, the granules may be glued onto the top layer.

In preferred embodiments of the invention, the skid-resistant granules are delivered into the top layer while
10 it is still fluid. The granules may be delivered by any suitable method, for example from a hopper. The delivery system is preferably equipped with a means to control the number of granules applied. The number of skid-resistant
15 granules per area is selected to provide adequate skid-resistance while providing the desired visual effect.

In some embodiments of the invention, the skid-resistant granules 11 may be treated with a coupling agent that improves adhesion between the granules and the
20 top layer. Preferred agents are silane compounds, such as aminosilane compounds. The granules may also be treated with a surface modification agent to adjust their surface energy while in contact with the top layer while it is in a liquid state during curing or drying or in a
25 melt, allowing the granules to partially embed in and protrude from this surface. Alternatively, such agents may be included in the top layer so that the agent interacts with the granules when the granules are embedded in the top layer. Other means of treatment may
30 include a surface treatment such as corona or electrostatic treatment of the polymeric layer.

Referring again to Fig. 1, top layer 15 overlies conformance layer 16. Top layer 15 is typically substantially polymeric. Suitable top layers can be
35 readily selected by those skilled in the art. Illustrative examples of suitable polymeric materials for the top layer 15 include polyurethanes, epoxy resins,

polyamides, polyureas, acrylates, acid containing polyolefins, and polyesters. Mixtures of such materials may also be used.

5 In one preferred embodiment, the top layer is thermoplastic and comprises acidic polyolefin polymers. Illustrative examples of such copolymers include copolymers of ethylene and acrylic acid or methacrylic acid.

10 In another preferred embodiment, top layer 15 comprises a polyurethane. Polyurethanes generally are characterized by excellent adhesion to skid-resistant granules 11. Preferred polyurethanes are aliphatic polyurethanes. Aliphatic polyurethanes strongly adhere to the top layer 15, are highly cohesive, and are resistant to environmental weathering and environmental
15 contaminants such as oil.

Pigments or other coloring agents may be included in the top layer 15 in an amount sufficient to color the marking material for a particular use. For example, when
20 used as a pavement marking material, titanium dioxide is a desired pigment and filler to provide a white color whereas a mixture of other pigments or colorants may be used to provide a gray color. A grayish-white top layer with light gray granules and brown granules will provide
25 the desired visually inconspicuous appearance for many concrete substrates, whereas a black top layer with a mixture of darker color granules will provide the desired visually inconspicuous appearance for many new asphalt substrates.

30 The top layer 15 is typically from at least about 50 micrometers (μm) to about 1500 μm thick. Preferably, the top layer is from about 50 to about 500 μm thick, and more preferably from about 75 to 200 μm thick. If the top layer is too thin, it may not provide sufficient
35 bonding to skid-resistant granules subsequently embedded in the top layer, nor sufficient wear resistance. If the

top layer is too thick, the overall structure of base sheet 12 may be too rigid to achieve desired conformability characteristics. The thickness of the top layer is selected in part to achieve desired

5 conformability characteristics.

As will be understood, when viewed from relatively closer locations the surface of top layer 15 will be more visible between anti-resistant granules than at relatively longer distances where the marking is observed at high entrance angles. As a result, to optimize markings for greater inconspicuity at relatively short distances, e.g., such as might be used for intersections and other slow speed locations, selection of the color of the top layer is relatively more critical than it is for 15 markings to be used in highway and other high speed applications.

Many polymeric films that are used as top layers tend to have shiny surfaces, which when viewed with the sun or other bright light source behind them can lead to shiny glare. To reduce this effect, it may be desired to use top layers that are not flat, e.g., that are patterned in a manner similar to that used on some conspicuous markings. See, for example, U.S. Patent Nos. 4,040,760 (Wyckoff) and 4,388,359 (Ethen et al.). 20

Imparting a matte surface to the top of the top layer may also be desired. Also, utilization of relatively greater quantities of anti-skid granules may reduce such glare. 25

Referring again to Figure 1, illustrative base sheet 12 comprises an optional conformance layer 16 and a top layer 15. Conformance layers are well known and a suitable conformance layer can be readily selected by one skilled in the art. 30

Some illustrative examples of suitable conformance layers include the reduced-elasticity sheets disclosed in U.S. Patent Nos. 4,117,192 and 4,490,432 which comprise 35 unvulcanized elastomer precursors, extender resins such as hydrocarbons and chlorinated paraffin, and fillers.

In many such embodiments, the conformance layer 16 is typically from about 500 micrometers (μm) to about 1300 μm thick to provide desired conformability and strength to the pavement marking material. Preferably, the conformance layer is about 600 to about 1000 μm thick for a reduced elasticity unvulcanized elastomer conformance layer. Another example of a conformance layer is aluminum foil. Preferably, an aluminum conformance layer is from about 50 to about 100 μm thick.

Particulate fillers may also be included in the conformance layer, typically in large amounts, to provide modified properties, such as reinforcement, extending, surface hardness, and abrasion resistance.

One way that top layer 15 may be formed is by coating liquid constituent ingredients directly onto the conformance layer 16, if any, or a carrier. Top layer 15, however, may be formed separately, and then bonded to the conformance layer 16 in a laminating operation, as by interposing an adhesive layer (not shown in Fig. 1) between the top layer 15 and the conformance layer 16, or by heat lamination of layers 15 and 16. The top layer may also be coextruded with the conformance layer. In some embodiments, the top layer may be such that the overall marking (e.g., including optional adhesive) is sufficiently conformable without a separate conformance layer.

In some embodiments of the invention, the base sheet 12 is affixed to a substrate, e.g., pavement, by any suitable means, such as a mechanical means or through the use of an adhesive. Typically, an adhesive is used to affix the pavement marking to the pavement. An adhesive layer 13 may be carried on the bottom surface of base sheet 12 for application to substrate 14. Alternatively, an adhesive layer 13 may be applied first to substrate 14 after which the substrate marking material 12 is adhered over the adhesive layer 13. Many suitable adhesives are

well known and one suitable for a particular application can be readily selected by one skilled in the art.

Pressure sensitive adhesives such as those commonly used in the pavement marking industry are typically preferred.

- 5 Contact adhesives may also be used, as may be heat-activated adhesives. Some embodiments may need no adhesive in order for substrate marking material 12 to adhere to pavement surface 14.

- 10 Pavement markings of the invention may be used to provide a signal to a sensor of some type, thereby guiding a car or machine. In accordance with the invention, such pavement markings will not distract the motor vehicle driver since the pavement marking will not be visually conspicuous to the motor vehicle driver.
- 15 Illustrative examples include radar reflective pavement markings with a series of slots to interact with a radar sensing device and magnetic pavement markings. A variety of active and/or passive means for providing a signal to a sensor are known. One suitable for the desired
- 20 application can be readily selected by one skilled in the art.

EXAMPLES

- The invention will be further explained by the
- 25 following illustrative examples which are intended to be non-limiting. Unless otherwise indicated, all amounts are expressed in parts by weight.

Example 1

- 30 Pellets of gray precolored ethylene methacrylic acid copolymer, 63W15833CPC Cement Gray available from M. A. Hanna Color, Elk Grove Village, Illinois, were extruded through a flat film die onto a 50 micrometer thick
- polyethylene terephthalate carrier using a Killion single
- 35 screw extruder to produce a film 100 micrometers thick on the polyester carrier web.

The carrier with the pigmented polymer coating was carried over a hot can and heated to a temperature of 320°C. A layer of aluminum foil 75 micrometers in thickness was brought into contact with the pigmented polymer layer and laminated to the layer by passing through a roller nip with a nip pressure of 275 kilopascals. The carrier was then stripped from the layer of pigmented polymer.

A blend of ceramic anti-skid granules having two different colors was made by mixing light gray granules, CARBO LITE® Lightweight ceramic proppant 30/50 mesh size, available from CARBO Ceramics, Inc., New Iberia, Louisiana, with dark brown particles, CARBO PROP® Intermediate Strength Ceramic Particles 30/60 mesh size, also from CARBO Ceramics, Inc., at a mix ratio of 50/50 by weight. The granules were applied at a density of about 270 grams per square meter.

The foil composite with the pigmented polymer coating was carried through an oven heated to a temperature of about 200°C, sufficiently hot to bring the pigmented top layer material to a softened, nearly molten, condition. While in the oven at the elevated temperature, after one minute of residence time, small particles of ceramic anti-skid particles were sprinkled onto the hot surface of the top layer. The pigmented top layer with the particles on its surface was maintained at the high temperature in the oven for an additional three minutes so that the particles partially sank into the surface of the polymer and that the polymer crept up the sides of the particles while still in the nearly molten state. The product was allowed to cool for about one minute to re-solidify the top layer and then wound up into roll form.

Example 2

An inconspicuous conformable marking sheet was prepared similarly to Example 1, except that the aluminum foil had been die punched with an array of slots as shown in Figure 2 prior to lamination of the pigmented polymer layer to the foil and a second polyester film was carried through the nip between the aluminum foil and the backup nip roll to prevent the pigmented polymer from flowing through the slots and adhering to the nip roll during lamination. The second polyester film was then stripped from the back of the aluminum foil layer and the marking sheet completed as described in Example 1.

Various modifications and alterations of this invention will become apparent to those skilled in the art without departing from the scope and spirit of this invention.



Claims:

1. A visually inconspicuous pavement marking
5 comprising a base sheet having a top layer with an upper surface with a plurality of skid-resistant granules thereon, said skid-resistant granules selected from two or more color groups.
- 10 2. The pavement marking of claim 1 further comprising means for providing a signal to a sensor.
3. The pavement marking of claim 1 wherein said skid-resistant granules are of a composition selected
15 from the group consisting of ceramic, sand, stone, aluminum oxide, and glass.
4. The pavement marking of claim 3 wherein said skid-resistant granules are ceramic.
- 20 5. The pavement marking of claim 1 wherein the skid-resistant granules are selected from at least two of the following groups: black granules, gray granules, white granules, brown granules, blue granules, yellow granules,
25 red granules, and green granules.
6. The pavement marking of claim 5 wherein the skid-resistant granules are gray granules and white granules.
- 30 7. The pavement marking of claim 5 wherein the skid-resistant granules are gray granules and brown granules.
8. The pavement marking of claim 5 wherein the skid-resistant granules are black and gray.
- 35 9. The pavement marking of claim 1 wherein said top layer of said base sheet is selected from the group consisting of acrylic, urethane, and olefin polymers.





10. The pavement marking of claim 9 wherein said top layer is an acid-containing olefin.

5 11. The pavement marking of claim 10 wherein said acid-containing olefin is an ethylene methacrylic acid or ethylene acrylic acid copolymer.

10 12. The pavement marking of claim 1 wherein said base sheet comprises a conformance layer.

13. The pavement marking of claim 1 affixed over pre-existing pavement markings.

15 14. The pavement marking of claim 1 applied to the surface of a road.

15. A method of making a pavement marking comprising the steps of

20 1) providing a conformance layer;

 2) applying a polymeric top layer to one surface of said conformance layer; and

 3) depositing a plurality of skid-resistant granules of two or more different colors on the

25 upper surface of said top layer so as to partially embed in said top layer.

This Sheet Has Been Replaced

