

WATER PERMEABLE NAIL PAINT FORMULATION

TECHNICAL FIELD

The present invention broadly lies in the field of cosmetics or paints and coatings technology. More particularly, the present invention relates to a formulation for making breathable and water permeable nail paint composition and a method for preparation of the same.

BACKGROUND ART

Nail paints or polishes or enamels form an important part of color cosmetics. These products are complex formulation of coatings with acrylic or other suitable polymer base and inorganic pigments and other ingredients. Usually, paints are densely formed coatings which are impermeable to water or water vapor. They are in fact fairly water resistant to enable longer durability on nails.

Currently, most formulations of nail lacquer are water impermeable or non-breathable. Nail paints use melamine/epoxy/acrylic/polyethylene type resin as a binder, and it results in a hydrophobic surface. Thus, water does not spread over the surface easily. There have been attempts to make breathable or water permeable nail paints in the recent past, however there is a long way to go in this field. Most of these products do not have good shine, pay off, durability, good adhesion, and toughness along with desired permeability as well as breathability.

Hence, there is a strong need to develop a nail paint formulation with improved water permeability and breathability along with good shine, pay off and toughness. The technical problem thus solved by the present invention is the development of effective, inexpensive and safe, alcohol free nail paint formulation. The inventors have developed a formulation for making water permeable nail paint formulation which shows water permeability under ambient conditions. The said nail paint formulation has excellent shine (high gloss properties), gloss, pay off and moderate durability as compared to the commercially available nail paint brands (non-Halal).

OBJECTIVE OF THE INVENTION

An important objective of the present invention is to provide a novel formulation for making water permeable and breathable nail paint.

Another important objective of the present invention is to provide a method for preparation of said nail-paint formulation.

Another important objective of the present invention is to provide a halal, water permeable nail paint formulation which is safe to use.

SUMMARY OF THE INVENTION

The present invention provides a novel formulation for making water permeable and breathable nail paint which shows water permeability under ambient conditions and its method for preparation. The nail paint formulation of the present invention is free from various harmful chemicals as well as alcohol and thus is a safe product for halal market. The formulation of the present invention allows water to pass through the paint and permeate completely within a time span of less than 60 seconds when coatings are completely dried (within 1 hour of the curing).

Various objects, features, aspects and advantages of the inventive subject matter will become more apparent from the following detailed description of preferred embodiment.

DETAILED DESCRIPTION

At the very outset, it may be understood that the ensuing description only illustrates a particular form of this invention. However, such a particular form is only an exemplary embodiment, without intending to imply any limitation on the scope of this invention. Accordingly, the description and examples are to be understood as exemplary embodiments for teaching the invention and not intended to be taken restrictively.

The details of one or more embodiments of the invention are set forth in the accompanying description below including specific details of the best mode contemplated by the inventors for carrying out the invention. The embodiments of the invention which are apparent to one skilled in the art after reading the present disclosure and on applying the common general knowledge of the technical field are within the scope of this invention.

The use of “comprise”, “comprises”, “comprising”, “contain”, “contains”, “containing”, “include”, “includes”, and “including” are not intended to be limiting. It is to be understood that both the foregoing general description and this detailed description are exemplary and explanatory only and are not restrictive.

The present invention provides a novel formulation for making water permeable and breathable nail paint which shows water permeability under ambient conditions. The present invention also provides a method for preparation of said nail paint formulation.

The present nail paint formulation has several important aspects which impart water permeability to it. The surface of the nail paint is made hydrophilic (water contact angle $< 30^\circ$). In the present invention, the surface energy of the coating is lowered, and the surface is turned into hydrophilic nature. This is done by adding certain non-ionic surfactant like molecules to the nail paint formulation. The molecules are smaller in size, highly hydrophilic at one end and at another end. Polysorbate 20 is an example of such a hydrophilic additive.

In an aspect of the present invention, voids are created in the coating to allow passage of water. The voids are created by adding specially treated micron sized ceramic particles to the coating. The ceramic particles are treated (or functionalized) with low energy, non-fluorinated hydrophobic molecules (long chain alkyl silanes). Due to extremely low energy of the hydrophobic molecules (figure 1), reactive functional groups of the resin polymer do not bind to these molecules. Instead, these molecules act as barriers to curing or polymerization processes and thus, create irregularities. The irregularities in the polymer matrix are created by obstructing the dense growth of the coating matrix, resulting in voids in the coatings. The ceramic particles are complex silicates which absorb water due to their crystal structure and microstructure. A typical example includes natural clay. Further, clay like materials also absorb and hold other solvents such as propylene carbonate which are slow in evaporation. Slow evaporation further causes voids or pores in the coatings.

In another aspect of the present invention, the water absorbent channels are created in the coating. Long chain, linear molecules with hydrophobic and hydrophilic ends, (molecular weight > 2000) are added to the formulation. These molecules are both oil and water soluble. The

molecules are thus incorporated into the matrix of the coating and these molecules absorb the water and contribute to the permeability of the nail paint. Typical examples of the molecules include Polyethylene Glycol derived molecules (Polysorbate 20 or 80).

Further, in the manufacturing process or preparation of the nail paint formulation of the present invention, these molecules are mixed with the treated clay first and then added into the rest of the formulation. Specifically, molecules which are water soluble but dissolve in water at a slow rate are selected for the formulation.

Further, untreated clay particles soaked in propylene carbonate are separately added in the final addition step to the nail paint formulation. Propylene carbonate is retained into the porous structure of the clay and thus evaporates at an extremely slow rate. As propylene carbonate is polar, it makes the clay hydrophilic and the clay with propylene carbonate complex further acts as channels for water droplets to pass through the coating.

In a further aspect of the present invention, propylene carbonate is added to the final solution of the nail paint to slow down the curing process of the final paint. The percentage of the propylene carbonate is optimized to yield dry feel of the nail paint when applied on the nails (< 6 min) while bone drying or curing process is prolonged, due to slow evaporation of this solvent. Propylene carbonate is a polar solvent thus making the coatings hydrophilic and water permeable. The proposed design imparts high permeability and breathability to the resultant nail paint formulation.

In a principal embodiment, the present invention provides a formulation for making water permeable nail paint.

In another important embodiment, said water permeable nail paint is free from various harmful chemicals as well as alcohol and thus the present nail paint formulation is a safe product for halal market.

In still another embodiment, the present invention provides a method for preparation of said nail-paint formulation.

In yet another embodiment, said formulation requires less than 60 seconds to permeate water completely after curing of the coating.

In an embodiment, the formulation of the present invention comprises acrylic resin (no alcohol formulated resin), polyethylene resin, nitrocellulose solution in ethyl acetate, color chips (mixture), nano clay, stearalkonium hectorite gel, acetyl tributyl citrate, butyl acetate, polysorbate (tween 20), ethyl acetate, propylene carbonate, hexadecyl trimethoxy silane (HDTMS).

In an embodiment of the present invention, the components of the nail paint formulation comprise acrylic resin in the range of 20 to 60% acrylic resin; polyethylene resin in the range of 1 to 3%; nitrocellulose solution in ethyl acetate in the range of 2 to 4 %; color chips in the range of 0.5 to 3.5 %; nano clay in the range of 0.1 to 0.5 %; stearalkonium hectorite gel in the range of 0.05 to 0.2 %; acetyl tributyl citrate in the range of 0.05 to 0.2 %; butyl acetate in the range of 10 to 20 %; polysorbate/Tween 20 in the range of 0.15 to 0.45 %; ethyl acetate in the range of 10 to 20 %; propylene carbonate in the range of 3 to 9 %; and hexadecyl trimethoxy silane in the range of 0.02 to 0.1 %.

In an embodiment, the present invention relates to method of making the nail paint formulation comprising the following steps:

- a) soaking 0.3 g of color chips in 2.5 ml of 3-butyl acetate for 5-7 hours preferably 6 hours until a uniform slurry is formed;
- b) adding 10 g of acrylic lacquer (acrylate based) to the color solution of step a);
- c) adding 0.5 g of nitrocellulose solution prepared in 30% by weight of ethyl acetate to the mixture of step b);
- d) adding 0.2 g of stearalkonium hectorite to the solution of step c);
- e) adding 0.3 g of polyethylene resin prepared in 10% by weight of butyl acetate to the solution of step d);

- f) adding 0.02 g of a plasticizer in the solution of step e);
 - g) adding 0.05 g of treated clay to solution of step f);
 - h) adding propylene carbonate as solvent in the solution of step g); and
 - i) adding Polysorbate 80/Tween 20 in the solution of step h) to obtain the final nail paint formulation,
- wherein the solution is stirred for 5 mins after each step of addition from a) to i) and kept in a closed container.

In another embodiment, the treated clay is prepared by:

- a) dispersing 2 g of nano clay or clay in 10 g of ethyl acetate;
- b) adding 0.02 g of HDTMS in the solution of step a) and stirring it overnight in a closed container at 25°C; and
- c) adding 0.02 g of Polysorbate 80/ Tween 20 to the solution obtained after step b) to obtain treated clay;

The nail paint formulation of the present invention was tested for its water permeability as well as durability and was found to have desired permeability as well as breathability, viscosity and durability.

The present invention is further explained in the form of the following examples. The following examples particularly describe the manner in which the invention is to be performed. However, it is to be understood that the following examples are merely illustrative and are not to be taken as limitations upon the scope of the invention.

EXAMPLES

Example 1: Preparation of the Nail Paint Formulation

Table 1 lists an exemplary nail-paint formulation in accordance with the present disclosure, wherein the ingredients are listed as weight percentage per gram per ml of the formulation.

Table 1

S. No.	Name of the component	Quantity (in gms/ml)
1.	Acrylic resin/ lacquer	10 gm

2.	Polyethylene Resin	0.3 gm
3.	Nitrocellulose Solution in ethyl acetate	0.5 gm
4.	Color Chips	0.3 gm
5.	Nano Clay	2 gm
6.	Stearalkonium Hectorite Gel	0.2 gm
7.	Acetyl Tributyl Citrate	1 gm
8.	Butyl Acetate	2.5 gm
9.	Polysorbate/Tween 20	0.02 gm
10.	Ethyl Acetate	10 gm
11.	Propylene carbonate	0.8 gm
12.	Hexadecyl Trimethoxy Silane (HDTMS)	0.02 gm

The abovementioned exemplary nail paint formulation was prepared by the following process:

Treatment of Clay

The treatment of clay is followed by dispersing of 1 g of Nano clay or clay in 10gms of ethyl alcohol Acetate and 0.02g of HDTMS was added to the solution. The obtained solution was stirred overnight under ambient conditions in a closed container. 0.1 g of PEG 40/ tween 20 was added to the solution.

Methodology

1 g of color chips (KEOL, Mumbai (Customized for specific shades)) were soaked in 3-butyl acetate for 6 hours until a uniform slurry was formed. 2 g of acrylic lacquer (preformulated acrylate based, Enclifestyle Pvt Ltd., Surat) was added to the color solution. 10 g of nitrocellulose solution (HPLC grade, Pune) was added to the above mixture (30% by wt. in ethyl acetate). 1g of stearalkonium hectorite (KEOL Mumbai) was added to the above solution. 1g of Polyethylene resin (K K India Pvt Ltd, Mumbai) in butyl acetate (10%) was then added followed by addition of 1 g of Acetyl Tributyl Citrate (AB Enterprise, Mumbai) solution. 0.5 g of treated

clay was added followed by 0.8 g of propylene carbonate along with 0.05 g of Tween20 (Local Supplier, Pune).

The resultant solution was stirred for 5 min after every step of addition of raw material and kept in a closed container.

Example 2: Water Permeability and Viscosity Test

Water permeability of the nail paint formulation was tested by measuring the time needed for a water droplet to pass through the nail paint, when nail paint is applied on a standard tissue paper. To evaluate the water permeability and viscosity of the nail paint formulation, a 2-ply tissue paper (Premium Special Face Tissue) was used as standard substrate. The nail paint prepared in example- 1 was applied on the tissue paper over an approximate area of 3 cm in length and 3 cm in width in a square shape. The water droplet of 0.2-0.3 g was gently placed on the applied nail paint at the time intervals viz. 1. after immediate drying (app. 5-7 min) and 2. after 15 min of application.

Table 2 shows the basic properties of the nail paint formulation of the present invention.

Table 2

Property	Result	Method
Color	Maroon	In-house
Water Permeability	< 50 seconds	In-house
Liquid Viscosity	600-1200	Cps (U Tube Viscometer)
Avg Durability on nails	Min 3 days	In-house

Comparative tests were performed to compare the permeability of the present composition with known formulations. Results are depicted under Table 3 below:

Table 3

Brand / Property	Water Droplet Permeability (In-House)
Present Formulation	10 seconds (on drying)
Tuesday in Love	12 seconds (on drying)

Orly Breathable	3 min (on drying)
Zara	2 min (on drying)

Example 3: Scratch Test for checking shine and toughness

The present study evaluates the shine and toughness of the nail-paint formulation by scratch test. The formulation of the present invention was found to exhibit great shine, excellent pay off and toughness. The present composition was also compared with several compositions well-known in the art, on various parameters and properties. Comparative Results are tabulated in Table 4.

Table 4

Brand / Property	Shine / Gloss	Pay off on one coat	Toughness / scratch resistance
Present Formulation	High 95 at 60°	Excellent	High
Tuesday in Love	Low 40 at 60°	Poor	Poor
Orly Breathable	High 90 at 60°	Good	Medium
Zara	High 90 at 60°	Good	High

Example 4: Cross-cut Test

The cross-cut test (ISO 2409) was performed for determining the resistance of the nail paint formulation to separate from nail surface and was further compared with several other known formulations. The edges of the cut were found to be completely smooth, and it was found that the nail paint formulation of the present invention exhibited excellent adhesion. Data is shown under Table 5 below.

Table 5

Brand / Property	Cross Cut Test Grade	Description
Present	0	Edges of the cuts are completely smooth.

Formulation		Excellent adhesion
Tuesday in Love	4	Heavy flaking of the coating. Poor adhesion
Orly Breathable	0	Edges of the cuts are completely smooth. Excellent adhesion
Zara	1	Edges of the cuts are smooth. Good. Excellent adhesion

The embodiments illustrated and discussed in the specification are intended only as exemplary and the many other feasible embodiments within the scope of the invention will be readily understood and appreciated. Nothing in the specification should be constructed as limiting scope of present invention. Many changes may be made in the above-described embodiments within the scope of disclosure of the present specification to produce a breathable and water permeable nail paint formulation, without departing from the present invention.

Advantages

The inventors have devised claimed water permeable nail paint which represents an advancement over the existing. The advances are characterized by the following features:

- (a) The formulation of the present invention is highly effective in view of water permeability and breathability.
- (b) The developed formulation is inexpensive, safe and affordable.
- (c) The formulation of the present invention has a high shelf life and can be made available as ready-to-use formulation.
- (d) The formulation of the present invention has no side effects.

We Claim:

1. A water permeable nail paint formulation, comprising acrylic resin, polyethylene resin, nitrocellulose solution in ethyl acetate, color chips, nano clay, stearalkonium hectorite gel, a plasticizer selected from acetyl tributyl citrate or Triethyl citrate, butyl acetate, polysorbate, ethyl acetate, propylene carbonate and hexadecyl trimethoxy silane.
2. The formulation as claimed in claim 1, wherein said formulation comprises the acrylic resin in the range of 20 to 60 %; polyethylene resin in the range of 1 to 3 %; nitrocellulose solution in ethyl acetate in the range of 2 to 4 %; color chips in the range of 0.5 to 3.5 %; nano clay in the range of 0.1 to 0.5 %; stearalkonium hectorite gel in the range of 0.05 to 0.2 %; acetyl tributyl citrate in the range of 0.05 to 0.2 %; butyl acetate in the range of 10 to 20 %; polysorbate in the range of 0.15 to 0.45 %; ethyl acetate in the range of 10 to 20 %; propylene carbonate in the range of 3 to 9 %; and hexadecyl trimethoxy silane in the range of 0.02 to 0.1 %.
3. The formulation as claimed in claim 1, wherein acrylic resin is selected from the group consisting of an acrylic copolymer containing at least one methacrylic acid functional group.
4. The formulation as claimed in claim 1, wherein color chips are selected from the group consisting of inorganic ceramic particles < 50 micron.
5. The formulation as claimed in claim 1, wherein nano clay is selected from the group consisting of porous ceramic silicates of magnesium, calcium and aluminum.

6. The formulation as claimed in claim 1, is free of harmful chemicals selected from the group consisting of Toluene, Dibutyl Phthalate (DBP), Formaldehyde, Formaldehyde Resin, Camphor, Ethyl Tosylamide, Xylene, parabens, animal by-products and fragrance.
7. The formulation as claimed in claim 1, is water permeable, breathable, porous, alcohol free and exhibits great shine, toughness and pay-off.
8. A method of preparing the water permeable nail paint formulation as claimed in claim 1 comprising the following steps:

- a) soaking 0.5 to 3.5 % of color chips in 10 to 20 % of 3-butyl acetate for 5-7 hours preferably 6 hours until a uniform slurry is formed;
- b) adding 20 to 60 % of acrylic lacquer/resin (acrylate based) to the color solution of step a);
- c) adding 2 to 4 % of nitrocellulose solution prepared in 30% by weight of ethyl acetate to the mixture of step b);
- d) adding 0.05 to 0.2 % of stearylalkonium hectorite to the solution of step c);
- e) adding polyethylene resin prepared in 10% by weight of 10 to 20 % of butyl acetate to the solution of step d);
- f) adding 0.02 g of a plasticizer in the solution of step e);
- g) adding 0.1 to 0.5 % of the treated clay to solution of step f);
- h) adding propylene carbonate as solvent in the solution of step g); and
- i) adding Polysorbate 80 in the solution of step h) to obtain the final nail paint formulation,

wherein the solution is stirred for 5 mins after each step of addition from a) to i) and kept in a closed container.

9. The method as claimed in claim 8, wherein the treated clay of step g) is prepared by:
 - a) dispersing 0.1 to 0.5 % of nano clay or clay in 10 to 20% of ethyl acetate;
 - b) adding 0.02 to 0.1 % of HDTMS in the solution of step a) and stirring it overnight in a closed container at 25°C; and
 - c) adding 0.15 to 0.45 % of Polysorbate 80 to the solution obtained after step b) to obtain treated clay.