(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 4 282 941 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.11.2023 Bulletin 2023/48

(21) Application number: **23174935.9**

(22) Date of filing: **23.05.2023**

(51) International Patent Classification (IPC):
C11C 5/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
C11C 5/002

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(30) Priority: **24.05.2022 BE 202205403**

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(54) METHOD FOR PRODUCING SUSTAINABLE CANDLES AND SUSTAINABLE CANDLES

(57) The present invention relates to a method for producing sustainable candles, comprising the steps of: providing a side stream from a Fischer-Tropsch synthesis, from the food industry or a combination thereof; treating the side stream with activated carbon, bleaching earth and/or hydrogen peroxide at a temperature comprised between 85 and 95°C; cooling the product to a temperature comprised between 65 and 75°C; mixing the product with a paraffin wax, a vegetable wax or a combination thereof with a melting point between 35 and 45°C, at a mixing temperature comprised between 65 and 75°C; and filling the blend into a glass, plastic or aluminum receptacle.

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Description

TECHNICAL FIELD

[0001] The invention relates to a method for producing sustainable candles. The invention also relates to the sustainable candles obtained from the above-mentioned method.

PRIOR ART

[0002] Candles have been used for centuries as a source of light and for their aesthetic appeal. Paraffin wax is traditionally used to make candles, which usually consists of 80 to 100% paraffin wax. Paraffin wax is also a by-product of petroleum and is known to produce toxins, black soot and carcinogens.

[0003] Candle wax formulas based on natural materials, in particular vegetable oils, have therefore already been proposed. However, the production of candles based on these waxes has suffered from several drawbacks, including cracking, air bubble formation, product shrinkage, and a natural product odor associated with plant materials. Several soybean based waxes are known to have issues with optimal flame size, effective matching of wax and wick for an even burn, maximum burn time, lack of consistent appearance when dissolving after melting, the integration of the color of the product and/or the shelf life of the product. Beeswax can also be used as candle wax, but some users find beeswax undesirable because of its poor burning behavior. Beeswax, while considered a renewable wax, is also very expensive and therefore not cost effective for large scale candle applications. However, the use of vegetable oils and waxes in candles also directly competes with the food industry.

[0004] In addition, there are different types of candles, such as table, votive, pillar, and container candles, each of which has its own unique requirements for the wax used in the candle. For example, candles in containers, where the wax and wick are held in a container, usually made of glass, metal or similar, require a lower melting point, specific burning characteristics such as wider melt pools, and should stick to the walls of the container as well as possible. The molten wax should preferably retain a consistent appearance after dissolving.

[0005] Some manufacturers in the candle industry have started using triglycerides and fatty acids as the main ingredients of wax for candle production. However, there are several disadvantages of such renewable candle compositions, such as: unwanted visual defects due to crystallization of triglycerides and fatty acids during the phase transition from liquid to solid; pits, bubbles and/or holes in the candle composition; poor burning performance and low wax consumption as a result.

[0006] A known method for the production of candles is disclosed in US20100212214, wherein fatty alcohols and vegetable waxes are mixed for use in a candle. The fatty alcohols originate from vegetable or animal materials and must therefore first be purified therefrom. Moreover, the use of vegetable waxes in candles is in direct competition with the food industry. The use of vegetable wax in combination with paraffin wax is described in US20030091949, but does not solve the previous problems, as large amounts of paraffin wax, originating from the oil industry, or vegetable wax, competing with the food industry, are still present in the blend.

[0007] US20120015312 describes a candle wax composition consisting of esters from fatty acids and fatty alcohols. US8685118B2 also describes a candle wax composition consisting of esters, where the esters are polyol fatty acid esters obtained via a metathesis from vegetable oil. In both cases, the components must first be purified from vegetable waxes. In addition, there is no suitable method for producing sustainable candles.

[0008] EP3450529 aims to provide an alternative paraffin for solid candles and discloses a candle composition comprising a blend of C12-C22 fatty acids and C4-C22 fatty alcohols. However, these components must also first be purified from plant sources.

[0009] There is therefore a need for a method for producing sustainable candles, in which there is no or reduced competition with the food industry and also no or reduced use of paraffin wax, in which the resulting candle still meets required parameters such as: melting point, solidification point, hardness, melting profile, crystallization behavior, color, burning rate and oiliness.

SUMMARY OF THE INVENTION

[0010] The invention relates to a method for producing sustainable candles according to claim 1.

[0011] The method is a sustainable alternative to dumping or incinerating waste and side streams in an incineration plant, by using it in the production of candles. In this way, traditional, less environmentally friendly, feedstocks can be saved during the candle production process. On the one hand, by using side streams, paraffin wax can be saved. This paraffin wax now comes from the petrochemical industry as a non-renewable product and produces a net CO_2 production when burned. On the other hand, many vegetable fats are now used in the candle industry that are in direct competition with food applications, such as palm oil, rapeseed oil, sunflower oil, shea butter, corn oil, coconut oil, or soybean oil.

The method described thus produces candles with a better balance between sustainability and burning behavior.

[0012] Preferred forms of the invention are set out in claims 2 up to and including 11.

[0013] There are several benefits to using a Fischer-Tropsch side stream in combination with a vegetable wax or a paraffin wax, compared to using only paraffin and/or vegetable wax. Here are a few possible benefits:

- Improved sustainability: The use of a Fischer-Tropsch side stream as a feedstock for candle production contributes to more sustainable production because this side stream is based on renewable energy sources and recyclable materials. This allows the ecological footprint of the candle production to be reduced.
- Improved burning quality: The treatment of the Fischer-Tropsch side stream with activated carbon, bleaching earth and/or hydrogen peroxide can result in a purer end product with a better burning quality. This can contribute to cleaner combustion and less smoke and soot formation during burning.
- Better texture: The use of vegetable wax or paraffin in combination with the Fischer-Tropsch side stream can also lead to a better texture of the candle, as mixing different types of wax can lead to better homogeneity and smoothness of the final product.

[0014] In a second aspect, the invention relates to a sustainable candle according to claim 12. A preferred form is shown in claims 13-14.

DETAILED DESCRIPTION

[0015] The invention relates to a method for producing sustainable candles.

[0016] Unless otherwise defined, all terms used in the description of the invention, including technical and scientific terms, have the meanings as commonly understood by those skilled in the art of the invention. For a better assessment of the description of the invention, the following terms are explained explicitly.

[0017] In this document, "a", "an" and "the" refer to both the singular and the plural, unless the context presupposes otherwise. For example, "a segment" means one or more than one segment.

[0018] When the term "around" or "about" is used in this document with a measurable quantity, a parameter, a duration or moment in time, and the like, then variations are meant of approx. 20% or less, preferably approx. 10% or less, more preferably approx. 5% or less, even more preferably approx. 1% or less, and even more preferably approx. 0.1% or less than and of the quoted value, insofar as such variations are applicable in the described invention. However, it must be understood that the value of a quantity used where the term "about" or "around" is used, is itself specifically disclosed.

[0019] The terms "comprise", "comprising", "provided with", are synonyms and are inclusive or open-ended terms that indicate the presence of what follows, and which do not exclude or prevent the presence of other components, features, elements, members, steps, as known from or disclosed in the prior art.

[0020] The terms "contain," "containing", "consist of", "consisting of", "include", "including" are synonyms and are exclusive or closed-ended terms indicating the presence of what follows, and which preclude or prevent the presence of other components, features, elements, members, steps known from or described in the art.

[0021] Quoting numeric intervals by the endpoints includes all integers, fractions, and/or real numbers between the endpoints, including those endpoints.

[0022] The term "Fischer-Tropsch (FT) synthesis" as used in the text refers to the process by which a mixture of carbon monoxide and hydrogen or water gas is converted into liquid hydrocarbons by various chemical reactions, such as hydrogenation, hydrogenolysis, dissociation, migratory insertion, etc. These reactions take place in the presence of metal catalysts, usually at temperatures of 150-300°C and pressures of one to several tens of atmospheres.

[0023] The term "side stream from a/the FT synthesis", as used in the text, refers to a residual fraction obtained during the FT synthesis, such as certain bottom distillation fractions. These fractions contain various chemicals, such as esters, fatty alcohols and paraffins, and this produces a waxy product.

[0024] The term "paraffin", as used herein, is intended to mean a mixture of crystalline linear or branched alkanes having 17 to 57 carbon atoms and linear chains, which are solid at room temperature and obtained from petroleum fractions and brown coal tar. The general molecular formula of such linear alkanes is $CH_3(CH_2)_nCH_3$.

[0025] In a first aspect, the invention relates to a method for producing sustainable candles.

[0026] In a preferred embodiment, the method comprises the following steps:

i. providing a side stream from a Fischer-Tropsch synthesis, a side stream from the food industry or a combination thereof;

ii. treating the side stream with activated carbon, bleaching earth, hydrogen peroxide, or any combination thereof, at a temperature comprised between 85 and 95°C;

iii. cooling the product obtained in step ii. to a temperature comprised between 65 and 75°C;
iv. mixing the product obtained from step iii. with a paraffin wax, a vegetable wax or a combination thereof with a melting point between 35 and 60°C, at a mixing temperature between 65 and 75°C; and
v. filling the blend obtained in step iv. into a glass, plastic or aluminum receptacle.

[0027] The method is a sustainable alternative to dumping or incinerating waste and side streams in an incineration plant, by using it in the production of candles. In this way, traditional, less environmentally friendly, feedstocks can be saved during the candle production process. On the one hand, by using side streams, paraffin wax can be saved. This paraffin wax now comes from the petrochemical industry as a non-renewable product and produces a net CO2 production when burned. On the other hand, many vegetable fats are now used in the candle industry that are in direct competition with food applications, such as palm oil, rapeseed oil, sunflower oil, shea butter, corn oil, coconut oil, or soybean oil. The method described thus produces candles with a better balance between sustainability and burning behavior.

[0028] In an embodiment, the method is applied to a side stream from a Fischer-Tropsch synthesis, from the food industry or a combination thereof. The side stream is preferably a bottoms fraction from a (fractional) distillation. In the distillation, an input stream is separated into two fractions, namely a top distillate fraction and a bottom fraction, with the bottom fraction comprising the "heaviest" products (those with the highest boiling point) at the bottom of a distillation column.

[0029] Distillation bottom fractions, which would otherwise be destroyed, can thus replace less sustainable feedstocks in the production of candles, making production more sustainable. Distillation bottom fractions can come from the chemical industry, such as FT synthesis, as well as the food industry.

[0030] In an embodiment, the side stream comprises components selected from the list of: fats, fatty acids, fatty alcohols, esters (monoesters, diesters, triesters), paraffins, aldehydes, ketones, or any combination thereof.

[0031] In a preferred form, the side stream is provided from a Fischer-Tropsch synthesis. The side stream preferably comprises at least the following components:

- fatty alcohols, preferably with a chain length between C14 and C32,
- fatty acids, preferably with a chain length between C12 and C24,
- esters, and
- linear and/or branched paraffin.

[0032] Fatty alcohols are unsaturated or saturated aliphatic alcohols, such as octan-1-ol (C8H17OH), decan-1-ol (C10H21OH), dodecan-1-ol (C12H25OH), tetradecan-1-ol (C14H29OH), hexadecan-1-ol (C16H33OH) heptadecan-1-ol (C17H35OH), octadecan-1-ol (C18H37OH), eicosan-1-ol (C20H41OH), docosan-1-ol (C22H45OH), tetracosan-1-ol (C24H47OH), hexacosan-1-ol (C26H51 OH), octacosan-1-ol (C28H55OH), triacontan-1-ol (C30H59OH), tetratriacontan-1-ol (C32H63OH), Z-hexadec-9-en-1-ol (C16H31OH), E-hexadec-9-en-1-ol (C18H35OH), E-octadec-9-en-1-ol (C18H35OH), Z-octadec-11-en-1-ol (C18H35OH), octadecatriene-1-ol (C18H31OH). For example, fatty alcohols with a chain length between C14 and C32 comprise, but are not limited to, tetradecan-1-ol (C14H29OH), hexadecan-1-ol (C16H33OH), heptadecan-1-ol (C17H35OH), octadecan-1-ol (C18H37OH), eicosan-1-ol (C20H41OH), docosan-1-ol (C22H45OH), tetracosan-1-ol (C24H47OH), hexacosan-1-ol (C26H51 OH), octacosan-1-ol (C28H55OH), triacontan-1-ol (C30H59OH), tetratriacontan-1-ol (C32H63OH), Z-hexadec-9-en-1-ol (C16H31OH), E-hexadec-9-en-1-ol (C18H35OH), E-octadec-9-en-1-ol (C18H35OH), Z-octadec-11-en-1-ol (C18H35OH), octadecatriene-1-ol (C18H31OH), or combinations thereof.

[0033] Fatty alcohols are amphiphilic in nature (i.e. possess hydrophilic and hydrophobic properties) and thus act as non-ionic surfactants and are therefore useful emulsifiers in lipid-based environments such as a wax.

[0034] Fatty alcohols inhibit the crystallization of fatty acid in a candle composition and thereby prevent the sharp phase change (i.e. from liquid to solid) during the solidification process of the wax composition and therefore lead to a lower chance of crystallization, a lower chance of tension build-up within the wax and therefore less cracking. As a result, there are fewer visual defects during the candle manufacturing process, and less bubbling during and after burning. The production process is faster and there are less rejects and less rework, resulting in better quality candles, higher production speed and lower energy consumption.

[0035] Fatty alcohols also lower the viscosity of liquid wax. Low viscosity of liquid wax improves fuel delivery to support burning. Therefore, a candle wax component with fatty alcohol burns well and is "cleaner" with less soot. In addition, smaller wicks are needed.

[0036] The amphiphilic nature of the fatty alcohols may also contribute to the fragrances diffusing into the wax blend. Consequently, less fragrance will leak out when fatty alcohols are used in the wax composition. For example, cetylstearyl mixed alcohol can solidify large amounts of fragrance oil, resulting in a better quality candle composition obtained.

[0037] Fatty acids are organic carboxylic acids with a chain of at least two carbon atoms and a carboxy group (COOH), such as propanoic acid (C2H5COOH), propenoic acid (C2H3COOH), butanoic acid (C3H7COOH), (Z)-2-butenoic acid

(C3H5COOH), (E)-2-butenoic acid (C3H5COOH), 3-butenoic acid (C3H5COOH), pentanoic acid (C4H9COOH), (E,E)-hexa-2,4-dienoic acid (C5H7COOH), heptanoic acid (C6H13COOH), octanoic acid (C7H15COOH), nonanoic acid (C8H17COOH), decanoic acid (C9H19COOH), undecanoic acid (C10H21COOH), dodecanoic acid (C11H23COOH), tetradecanoic acid (C13H27COOH), hexadecanoic acid (C15H31COOH), (Z)-9-hexadecenoic acid (C15H29COOH), octadecanoic acid (C17H35COOH), (Z)-9-octadecenoic acid (C17H33COOH), (E)-9-octadecenoic acid (C17H33COOH), (E)-11-octadecenoic acid (C17H33COOH), (Z)-9-(E)-11-octadecadienoic acid (C17H31COOH), (Z,Z)-octadeca-9,12-dienoic acid (C17H31COOH), (Z,Z,Z)-octadeca-9,12,15-trienoic acid (C17H29COOH), (Z,Z,Z,Z)-octadeca-6,9,12,15-tetraenoic acid (C17H27COOH), eicosanoic acid (C19H39COOH), (Z,Z,Z)-eicosa-8,11-14-trienoic acid (C19H33COOH), (Z,Z,Z,Z,Z)-eicosa-5-8-11-14-17-pentaenoic acid (C19H29COOH), docosanoic acid (C21H43COOH), (Z)-doco-13-senoic acid (C21H41COOH), (Z,Z,Z,Z,Z,Z)-docosa-4,7,10,13,16,19-hexaenoic acid (C21H31COOH). For example, fatty acids with a chain length between C12 and C24 comprise, but are not limited to, dodecanoic acid (C11H23COOH), tetradecanoic acid (C13H27COOH), hexadecanoic acid (C15H31COOH), (Z)-9-hexadecenoic acid (C15H29COOH), octadecanoic acid (C17H35COOH), (Z)-9-octadecenoic acid (C17H33COOH), (E)-9-octadecenoic acid (C17H33COOH), (E)-11-octadecenoic acid (C17H33COOH), (Z)-9-(E)-11-octadecadienoic acid (C17H31COOH), (Z,Z)-octadeca-9,12-dienoic acid (C17H31COOH), (Z,Z,Z)-octadeca-9,12,15-trienoic acid (C17H29COOH), (Z,Z,Z,Z)-octadeca-6,9,12,15-tetraenoic acid (C17H27COOH), eicosanoic acid (C19H39COOH), (Z,Z,Z)-eicosa-8,11-14-trienoic acid (C19H33COOH), (Z,Z,Z,Z,Z)-eicosa-5-8-11-14-17-pentaenoic acid (C19H29COOH), docosanoic acid (C21H43COOH), (Z)-doco-13-senoic acid (C21H41COOH), (Z,Z,Z,Z,Z,Z)-docosa-4,7,10,13,16,19-hexaenoic acid (C21H31COOH), or combinations thereof.

[0038] In a specific further preferred form, the side stream from the Fischer-Tropsch synthesis comprises at least the following components:

- fatty alcohols with a chain length between C14 and C32, in an amount of 30-80 wt%,
- fatty acids with a chain length between C12 and C24, in an amount of 5-30 wt%,
- esters, in an amount of 5-30 wt%, and
- linear and/or branched paraffin, in an amount of 5-40 wt%.

[0039] In another preferred form, a side stream is provided from the food industry. In a further preferred form, the side stream comprises at least fatty acids, preferably with a chain length between C12 and C24, even more preferably in an amount of 5-70 wt%. Preferably, different side streams from the food industry are first mixed to achieve a predetermined fatty acid content.

[0040] In an embodiment, the side stream is treated with activated carbon, bleaching earth and/or hydrogen peroxide at a temperature between 85 and 95°C. In another or further embodiment, the treatment comprises the steps of: distillation, water or solvent washing, reduction with hydrides, esterification, transesterification or a combination thereof. Treatment is preferably dependent on the foreseen side stream.

[0041] When the foreseen side stream comprises a side stream from FT synthesis, the side stream is preferably treated with 1 wt% activated carbon, 5 wt% bleaching earth and 1 wt% hydrogen peroxide. The supplied side stream is purified in this way.

[0042] When the foreseen side stream comprises a side stream from the food industry, the side stream is preferably treated with 1 wt% activated carbon and 5 wt% bleaching earth.

[0043] According to a further preferred form, prior to the treatment of the side stream from the food industry, a distillation step is carried out on the side stream in order to purify the fatty acids present in the side stream from the side stream.

[0044] In a preferred form, the treatment continues for a period of time comprised between 30 and 90 minutes, preferably between 35 and 85 minutes, more preferably between 40 and 80 minutes, even more preferably between 45 and 75 minutes, even more preferably between 50 and 70 minutes, even more preferably between 55 and 65 minutes, most preferably about 60 minutes.

[0045] After the treatment (step ii.), the product is preferably cooled. In a preferred form, the product is cooled to a temperature comprised between 65 and 75°C, preferably between 66 and 74°C, more preferably between 67 and 73°, even more preferably between 68 and 72°C, most preferably between 69 and 71°C.

[0046] Further in the method, the treated side stream is mixed with a paraffin wax, a vegetable wax or a combination thereof (step iv.). Preferably, the paraffin wax and the vegetable wax have a melting point between 35 and 60°C, preferably between 36°C and 44°C, more preferably between 37°C and 43°C, even more preferably between 38°C and 42°C, most preferably between 39 and 41°C.

[0047] In a preferred form, the mixing takes place at a mixing temperature comprised between 65 and 75°C, preferably between 66°C and 74°C, more preferably between 67°C and 73°C, even more preferably between 68°C and 72°C, most preferably between 69 and 71°C.

[0048] The blend obtained after mixing in step iv. is intended to serve as wax mass for the ultimately obtained candle. For example, after mixing, the blend is filled into a receptacle, after which it solidifies and thus forms the wax mass of the candle. It will be apparent to one skilled in the art that the composition of the blend obtained from step iv. and the wax mass of the obtained candle are the same. During mixing in step iv. components are mixed in the amounts in which they appear in the final blend, based on the total mass of the blend. The mixing of a certain amount of a component corresponds to the presence of this added amount in the total blend or the total wax mass.

[0049] In a preferred form, the blend obtained from step iv. comprises the side stream in an amount comprised between 10 and 99 wt%, preferably between 20 and 80 wt%, even more preferably between 30 and 60 wt%.

[0050] In a preferred form, the blend obtained from step iv. comprises the vegetable wax in an amount comprised between 0 and 50 wt%. In a further preferred form, either no vegetable wax is added (0 wt%) or between 20 and 50 wt%, preferably between 30 and 50 wt%, is added during mixing. It is important that only this maximum amount of vegetable wax is used as it is in direct competition with its use in the food industry.

[0051] In a preferred form, the vegetable wax is selected from the list of: palm oil, rapeseed oil, sunflower oil, shea butter, corn oil, coconut oil, soybean oil or a combination thereof.

[0052] In a preferred form, the blend obtained from step iv. comprises the paraffin wax in an amount comprised between 0 and 70 wt%. In a further preferred form, either no paraffin wax is added (0 wt%) or between 20 and 70 wt%, preferably between 30 and 60 wt%, is added during mixing.

[0053] In a preferred form, the blend obtained from step iv. comprises paraffin wax and vegetable wax in a ratio between 0.1/1 and 10/1, preferably between 0.2/1 and 9/1, more preferably between 0.3/1 and 8/1, even more preferably between 0.4/1 and 7/1, even more preferably between 0.5/1 and 6/1, even more preferably between 0.6/1 and 5/1, even more preferably between 0.7/1 and 4/1, even more preferably between 0.8 and 3/1, even more preferably between 0.9 and 2/1, most preferably about 1/1.

[0054] In an embodiment, during mixing, either only paraffin wax is added to the side stream, in an amount between 50 and 70 wt%, or only vegetable wax is added, in an amount between 40 and 60 wt%, or a combination of paraffin wax and vegetable wax is added, with the weight ratio of the paraffin wax and the vegetable wax being between 0.5/1 and 2/1, preferably between 0.75/1 and 1.5/1, more preferably about 1/1.

[0055] It is important that not too much paraffin wax is used due to the non-renewable nature of paraffin wax.

[0056] In an embodiment, the paraffin wax is selected from the list of partially refined paraffin wax, fully refined paraffin wax, or a combination thereof. Fully and partially refined paraffin wax is known to those skilled in the art and the terms are intended to refer to paraffin waxes that have been completely or partially freed from impurities and decolorized by treatment with water, activated carbon or clay, respectively. Partially refined paraffin wax contains less than 3.2% oil, compared to fully refined paraffin wax, which contains less than 0.8% oil. It is water resistant and odorless. Due to the high degree of refining, the polycyclic aromatic carbon chain in partially refined paraffin wax is low and chemically stable.

[0057] In a preferred form, the blend obtained from step iv. has a nitrogen content of up to 10 ppm, preferably up to 1 ppm, even more preferably up to 0.3 ppm, and even more preferably up to 0.1 ppm. This nitrogen content can be measured using techniques known in the art for trace elements, for example according to ASTM D4629.

[0058] In a preferred form, the blend obtained from step iv. has a sulfur content of up to 10 ppm, preferably up to 1 ppm, even more preferably up to 0.3 ppm, and even more preferably up to 0.1 ppm. This sulfur content can be measured using techniques known in the art for trace elements, for example according to ASTM D5453.

[0059] The term "ppm" is defined as parts per million and is a measure of concentration. A concentration of 1 ppm indicates that there is one part of a product out of a total of one million parts (in this case, the wax mass), expressed in mass.

[0060] Fischer-Tropsch (FT) feedstocks are usually purified to remove impurities, including nitrogen-containing and sulfur-containing compounds, in order to deactivate the catalyst as little as possible and to allow the FT reaction to proceed as efficiently as possible. Therefore, the nitrogen content and the sulfur content in a FT side stream, and the resulting wax mass, is significantly lower than if a wax mass consisting only of paraffin or vegetable wax were used. Moreover, it is advantageous to have as few contaminants as possible in a candle obtained.

[0061] Depending on the specific wax composition, in a preferred form, additives are also added during mixing. Examples of such additives are dyes, fragrance oils, insect repellents, migration inhibitors, antioxidants and combinations thereof. When added, fragrance oils are typically added to the blend in amounts of about 2 to 10 wt%, although the present waxes may contain higher amounts of fragrance oils, for example up to about 15 wt% or even more. Migration inhibitors can be added in an amount between 0.1 to 2 wt%. Suitable migration inhibitors are polymerization products formed from one or more alpha-olefins having about 10 to 25 carbon atoms. Other additives may also be added during mixing, e.g. a glycerol fatty acid monoester. The addition of a glycerol fatty acid monoester can improve the ability of dyes to be distributed homogeneously in the wax and thus be retained. The blend is preferably solid, firm but not brittle, generally somewhat malleable, has no visible free oil and is particularly well suited for use in molding container candles and tealight candles. The blend is also preferably capable of imparting consistent characteristics, such as the appearance, upon cooling and dissolving (e.g. after burning in a candle) of the molten wax. The blend is desirably formulated to promote surface adhesion to prevent the candle from pulling out of the container when the candle is filled and cooled. In addition, it is desirable that the wax can be mixed with natural color additives to obtain an even, solid color distribution.

[0062] A container candle is a non-flammable receptacle filled with wax and a wick.

[0063] In a preferred form, the blend obtained from step iv. has a melting point between 35 and 60°C, preferably between 40 and 55°C. This melting point is necessary for the use of the blend as a wax mass in tealight candles and container candles.
[0064] In a preferred form, the product obtained in step ii. is dried and filtered over a filtering plate prior to cooling in step iii.
[0065] In a preferred form, the receptacle is heated to a temperature between 45 and 55°C before the blend is filled. Preferably this happens when the receptacle is a glass receptacle.
[0066] In an embodiment, the receptacle is provided with a wick positioned upright on the bottom of the receptacle. After the wax has been filled, part of the wick protrudes above the wax mass and a wick is obtained with which the candle can be lit.
[0067] In a second aspect, the invention relates to a sustainable candle.
[0068] In an embodiment, the sustainable candle comprises a receptacle provided with a wick and filled with a wax mass.
[0069] In a preferred embodiment, the wax mass comprises a side stream from a Fischer-Tropsch synthesis or the food industry, mixed with a paraffin wax, a vegetable wax or a combination thereof with a melting point between 35 and 45°C.
[0070] In a preferred form, the sustainable candle is obtained by means of a method according to the first aspect described above.
[0071] According to an embodiment, the candle is a tealight candle or a container candle.
[0072] In a preferred form, the wax mass in the candle has a melting point between 35 and 60°C, preferably between 40 and 55°C.
[0073] In a preferred form, the wax mass comprises:

- fatty alcohols having a chain length between C14 and C32, in an amount of at least 3 wt%, preferably at least 9 wt%,
- fatty acids having a chain length between C12 and C24, in an amount of at least 0.5, preferably at least 1.5 wt%,
- esters, in an amount of 0.5, preferably at least 1.5 wt%, and
- linear and/or branched paraffin, 0.5, preferably at least 1.5 wt%.

[0074] In a preferred form, the wax mass has a nitrogen content of up to 10 ppm, preferably up to 1 ppm, even more preferably up to 0.3 ppm, and even more preferably up to 0.1 ppm. This nitrogen content can be measured using techniques known in the art for trace elements, for example according to ASTM D4629.
[0075] In a preferred form, the wax mass has a sulfur content of up to 10 ppm, preferably up to 1 ppm, even more preferably up to 0.3 ppm, and even more preferably up to 0.1 ppm. This sulfur content can be measured using techniques known in the art for trace elements, for example according to ASTM D5453.
[0076] The term "ppm" is defined as parts per million and is a measure of concentration. A concentration of 1 ppm indicates that there is one part of a product out of a total of one million parts (in this case, the wax mass), expressed in mass.
[0077] Fischer-Tropsch (FT) feedstocks are usually purified to remove impurities, including nitrogen-containing and sulfur-containing compounds, in order to deactivate the catalyst as little as possible and to allow the FT reaction to proceed as efficiently as possible. Therefore, the nitrogen content and the sulfur content in a FT side stream, and the resulting wax mass, is significantly lower than if a wax mass consisting only of paraffin or vegetable wax were used. Moreover, it is advantageous to have as few contaminants as possible in a candle obtained.
[0078] In what follows, the invention is described by way of non-limiting examples illustrating the invention, and which are not intended to or should not be interpreted as limiting the scope of the invention.

EXAMPLES

EXAMPLES 1 AND 2

[0079] A side stream blend (Blend 1) of products from the Fischer-Tropsch synthesis was separated for use in candles.
[0080] Composition Blend 1:

- fatty alcohols 30-80% having a chain length between C14 and C32
- fatty acids 5-30% having a chain length between C12 and C24
- esters 5-30%
- linear and branched Paraffin 5-40%

[0081] After separation, the blend is treated to obtain the right properties and purity by treatment with:

- activated carbon (1 wt%),
- bleaching earth (5 wt%) and

- hydrogen peroxide (1 wt%).

[0082] After treatment at 90°C for 1 hour, the blend is dried and filtered over a filtering plate. This blend is cooled to 70°C to be used as feedstock for the production of the blend for candles (**Table 1**):

TABLE 1

	Blend 1	Vegetable wax with a melting point of 40°C	Partially refined paraffin wax
Example 1	40 wt%	30 wt%	30 wt%
Example 2	50 wt%	50 wt%	-

[0083] These blends (Examples 1 and 2) are filled at 70°C into a tealight cup made of aluminum or plastic or into a glass (container). If necessary, the container is heated to 50°C before filling. This ensures better adhesion of the wax to the wall. Fragrance, color and stabilizers are also added to these blends. The container is then cooled to room temperature, after which a second layer of the same or a different composition may be applied.

EXAMPLE 3

[0084] A side stream blend (Blend 2) of products from the food industry was used in which fatty acids are present. After purification, these fatty acids can be used for the synthesis of a tealight. For this purification, distillation and decolorization with activated carbon and bleaching earth are used. This ensures that, in addition to purity, the fragrance and color are also under control. This blend is cooled to 70°C to be used as feedstock for the production of the blend for candles (**Table 2**):

TABLE 2

	Blend 2	Vegetable wax with a melting point of 40°C	Partially refined paraffin wax
Example 3	40 wt%	-	60 wt%

[0085] This blend (Example 3) was filled at 70°C into a tealight cup made of aluminum or plastic or into a glass (container). If necessary, the container is heated to 50°C before filling. This ensures better adhesion of the wax to the wall. Fragrance, color and stabilizers are also added to these blends. The container is then cooled to room temperature, after which a second layer of the same or a different composition may be applied.

EXAMPLE 4

[0086] The nitrogen content of Blend 1 was measured, after the treatment at 90°C for 1 hour, according to ASTM D4629 using a TSHR 7000 Series Analyzer. The nitrogen content was found to be less than 0.3 mg/kg (ppm).

COMPARATIVE EXAMPLE 5

[0087] The nitrogen content of coconut oil (vegetable wax) was measured according to ASTM D4629 using a TSHR 7000 Series Analyzer. The nitrogen content was found to be about 50 mg/kg (ppm).

COMPARATIVE EXAMPLE 6

[0088] The nitrogen content of partially refined paraffin wax was measured according to ASTM D4629 using a TSHR 7000 Series Analyzer. The nitrogen content was found to be about 15 mg/kg (ppm).

EXAMPLE 7

[0089] The sulfur content of the blends from Examples 1 and 2 was measured according to ASTM D5453 using a TSHR 7000 Series Analyzer. The sulfur content was found to be less than 10 mg/kg (ppm).

EXAMPLE 8

[0090] The sulfur content of Blend 1 was measured, after treatment at 90°C for 1 hour, according to ASTM D D5453 using a TSHR 7000 Series Analyzer. The sulfur content was found to be less than 0.3 mg/kg (ppm).

COMPARATIVE EXAMPLE 9

[0091] The sulfur content of coconut oil (vegetable wax) was measured according to ASTM D5453 using a TSHR 7000 Series Analyzer. The sulfur content was found to be about 50 mg/kg (ppm).

COMPARATIVE EXAMPLE 10

[0092] The sulfur content of partially refined paraffin wax was measured according to ASTM D5453 using a TSHR 7000 Series Analyzer. The sulfur content was found to be about 15 mg/kg (ppm).

EXAMPLE 11

[0093] The nitrogen content of the blends from Examples 1 and 2 was measured according to ASTM D5453 using a TSHR 7000 Series Analyzer. The sulfur content was found to be less than 10 mg/kg (ppm).

Claims

1. Method for producing sustainable candles, comprising the steps of:

i. providing a side stream from a Fischer-Tropsch synthesis;
ii. treating the side stream with activated carbon, bleaching earth and/or hydrogen peroxide at a temperature comprised between 85 and 95°C;
iii. cooling the product obtained in step ii. to a temperature comprised between 65 and 75°C;
iv. mixing the product obtained from step iii. with a paraffin wax, a vegetable wax or a combination thereof with a melting point between 35 and 60°C, at a mixing temperature between 65 and 75°C; and
v. filling the blend obtained in step iv. into a glass, plastic or aluminum receptacle.

2. Method according to claim 1, wherein a side stream is provided from the Fischer-Tropsch synthesis, comprising:

- fatty alcohols with a chain length between C14 and C32, in an amount of 30-80 wt%,
- fatty acids with a chain length between C12 and C24, in an amount of 5-30 wt%,
- esters, in an amount of 5-30 wt%, and
- linear and/or branched paraffin, in an amount of 5-40 wt%.

3. Method according to any of the preceding claims, wherein the side stream is treated with 1 wt% activated carbon, 5 wt% bleaching earth and 1 wt% hydrogen peroxide.

4. Method according to any of the preceding claims, wherein the treatment continues for a period of time comprised between 30 and 90 minutes.

5. Method according to any of the preceding claims, wherein the blend obtained from step iv. comprises the side stream in an amount comprised between 10 and 99 wt%, preferably between 20 and 80 wt%, even more preferably between 30 and 60 wt%.

6. Method according to any of the preceding claims, wherein the blend obtained from step iv. comprises the vegetable wax in an amount comprised between 20 and 50 wt%.

7. Method according to any of the preceding claims, wherein the blend obtained from step iv. comprises the paraffin wax in an amount comprised between 20 and 70 wt%.

8. Method according to any of the preceding claims, wherein the vegetable wax is selected from the list of: palm oil, rapeseed oil, sunflower oil, shea butter, corn oil, coconut oil, soybean oil or a combination thereof.

9. Method according to any of the preceding claims, wherein the receptacle is heated to a temperature comprised between 45 and 55°C, before the blend is filled.

10. Method according to any of the preceding claims, wherein in step iv. the product obtained from step iii. is mixed with a paraffin wax and a vegetable wax.

11. Method according to any of the preceding claims, wherein the side stream originates from a bottom fraction of a (fractional) distillation from a Fischer-Tropsch synthesis.

12. A sustainable candle comprising a receptacle provided with a wick and filled with a wax mass, **characterized in that** the wax mass comprises a side stream from a Fischer-Tropsch synthesis, mixed with a paraffin wax, a vegetable wax or a combination thereof with a melting point comprised between 35 and 60°C.

13. Candle according to claim 12, wherein the wax mass comprises a nitrogen content of at most 10 ppm.

14. Candle according to claim 12 or 13, wherein the wax mass comprises a sulfur content of at most 10 ppm.

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EUROPEAN SEARCH REPORT

Application Number
EP 23 17 4935

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2010/212214 A1 (WU BONENG [CA] ET AL) 26 August 2010 (2010-08-26) * claims 3-6,12,17-19 * * paragraphs [0009], [0014] * * examples 1-16 * -----	1-14	INV. C11C5/00
X	EP 3 450 529 A1 (DENIS & FILS [FR]) 6 March 2019 (2019-03-06) * claims 1-16 * * paragraphs [0010] - [0013], [0089] - [0090], [0095] * -----	1-14	
A	W. P. Cottom: "Waxes", , 4 December 2000 (2000-12-04), XP055712965, DOI: 10.1002/0471238961.2301240503152020.a01 Retrieved from the Internet: URL:https://onlinelibrary.wiley.com/doi/10.1002/0471238961.2301240503152020.a01 [retrieved on 2020-07-08] * the whole document * -----	1-14	

TECHNICAL FIELDS SEARCHED (IPC)

C11C

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	13 September 2023	Heirbaut, Marc

CATEGORY OF CITED DOCUMENTS

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