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(54) **Title:** PROCESS FOR PRODUCING SOLID SEED PARTICLES

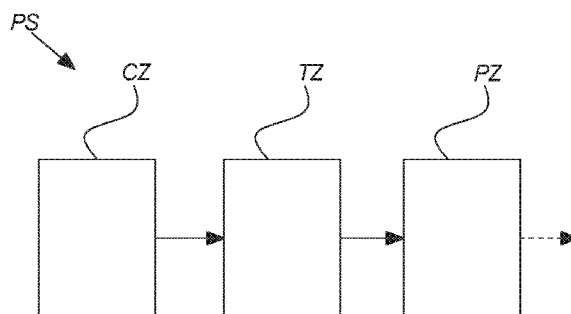


Fig. 1a

(57) **Abstract:** The invention relates to a process for producing solid seed particles comprising an edible fat, the process comprising the steps of (a) providing a flow of edible fat, the edible fat having an outset temperature (OT), (b) in a crystallization zone (CZ) performing a crystallization at a decreased temperature (DT) in a crystallization period (CP) of 1-150 seconds, (c) feeding an output from the crystallization zone (CZ) into a transformation zone (TZ), (d) in the transformation zone (TZ) performing a transformation of crystals produced in step (b) into higher melting crystal polymorphic forms at transformation temperature (TT) above said decreased temperature (DT) to obtain a transformed edible fat and (e) particulating said transformed edible fat into solid seed particles by at least cooling the edible fat processed according to step (d) to a temperature below which the edible fat solidifies.



PROCESS FOR PRODUCING SOLID SEED PARTICLES

Field of the invention

The present invention is related to industrial scale manufacturing of chocolate.

- 5 Moreover specifically the invention relates to a process of producing solid seed particles comprising edible fat.

Background of the invention

- 10 Among many process steps involved in a usual step of chocolate manufacturing is the final process which is referred to a tempering. Uncontrolled crystallization of cocoa butter typically results in crystals of varying size. This causes the surface of the chocolate to appear mottled and matte, and causes the chocolate to crumble rather than snap when broken. The uniform sheen and crisp bite of properly processed chocolate are the result of consistently small cocoa butter crystals produced by the tempering process.
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Such a tempering process may e.g. be obtained through use of well-known tempering equipment such as described in EP 1616487.

- 20 A challenge in relation to the tempering process is that the process is time consuming and that such a process requires dedicated equipment and may be considered somewhat expensive. In order to deal with the time issue a chocolate seed may be applied to speed up the overall process. Such industrial scale unit is e.g. explained and described in US 6,894,178 B1

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Challenges related to such equipment or such use of equipment are among others that the process is expensive to establish as an in-line system and the resulting chocolate product is relatively sensitive to ambient conditions, such as ambient temperature.

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Summary of the invention

The invention relates to a process for producing solid seed particles comprising an edible fat, the process comprising the steps of

- (a) providing a flow of edible fat, the edible fat having an outset temperature,
 - 5 (b) in a crystallization zone performing a crystallization at a decreased temperature in a crystallization period of 1-150 seconds,
 - (c) feeding an output from the crystallization zone into a transformation zone,
 - (d) in the transformation zone performing a transformation of crystals produced in step (b) into higher melting crystal polymorphic forms at a transformation temperature
 - 10 above said decreased temperature to obtain a transformed edible fat, and
 - (e) particulating said transformed edible fat into solid seed particles in a particulation zone by at least cooling the transformed edible fat processed according to step (d) to a temperature below which the edible fat solidifies.
- 15 The present invention has the advantage that the transformation zone may base the production of higher melting polymorphic crystals on the output of a fast producing crystallization zone given the fact that the transformation zone with relatively simple provisions may provide the required seed material in a cost efficient way.
- 20 In particular it is possible to produce seed particles, where a part of the process may be performed by relatively simple means, i.e. by increasing the temperature of the edible fat during the transformation period.

The invention relates in a further aspect to a system for production of solid seed

25 particles, the system comprising a crystallization zone, a transformation zone and a particulation zone, wherein the system comprises pumps for transferring processed edible fat from the crystallization zone into the transformation zone after a period of 1-150 seconds, the period is calculated from the time the edible fat is input into the crystallization zone.

The figures

The invention will now be described with reference to the figures where

fig. 1a and 1b illustrates some principles of the invention

- 5 fig. 2a and 2b illustrate two different applicable crystallization zones within the scope of the invention,

fig. 3a, 3b, and 3c illustrate three different applicable crystallization zones within the scope of the invention,

- 10 fig. 4a, 4b, and 4c illustrate three different applicable crystallization zones within the scope of the invention,

fig. 5 illustrates a typical chocolate manufacturing process applicable through the present inventive process,

fig. 6 and 7 illustrates endotherm melt peak positions at various stages of the inventive process and where

- 15 fig. 8 illustrates the points of the system of fig. 1 from where DSC measurements of the examples are taken.

Detailed description

As used herein, the term “fatty acid” encompasses free fatty acids and fatty acid residues in triglycerides.

5 As used herein “edible” is something that is suitable for use as food or as part of a food product, such as a dairy or confectionary product. An edible fat is thus suitable for use as fat in food or food product and an edible composition is a composition suitable for use in food or a food product, such as a dairy or confectionary product.

10 As used herein, “%” or “percentage” all relates to weight percentage i.e. wt.% or wt.-% if nothing else is indicated.

As used herein, the singular forms “a”, “an” and “the” include plural referents unless the context clearly dictates otherwise.

15

As used herein, “vegetable oil” and “vegetable fat” is used interchangeably, unless otherwise specified.

As used herein, “at least one” is intended to mean one or more, i.e. 1, 2, 3, 4, 5, 6, 7,
20 8, 9, 10, etc.

As used herein, the term “endotherm melt peak position” (also sometimes referred to as DCS melt peak position) may refer to the position of a melt peak, which may be the main endotherm melt peak or it may be a smaller melt peak.

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As used herein, the term “triglycerides” may be used interchangeably with the term ‘triacylglycerides’ and should be understood as an ester derived from glycerol and three fatty acids. “Triglycerides” may be abbreviated TG or TAG. A single triglyceride molecule, having a specific molecular formula, is of either vegetable or non-vegetable
30 origin. Some triglycerides, like for example StOSt-triglycerides, may be obtained from both vegetable and/or non-vegetable sources. Thus a fat phase comprising StOSt-

triglycerides, may comprise StOSt-triglycerides obtained solely from vegetable sources or StOSt-triglycerides obtained solely from non-vegetable sources or a combination thereof i.e. the fat phase may comprise some StOSt-triglyceride molecules obtained from vegetable sources and some StOSt-triglycerides molecules
5 obtained from non-vegetable sources.

As used herein, the term “vegetable” shall be understood as originating from a plant retaining its original chemical structure/composition. Thus, a vegetable fat or vegetable triglycerides are still to be understood as vegetable fat or vegetable
10 triglycerides after fractionation etc. as long as the chemical structure of the fat components or the triglycerides is not altered. When vegetable triglycerides are for example transesterified they are no longer to be understood as a vegetable triglyceride in the present context.

15 Similarly, the term “non-vegetable” in the context of “non-vegetable triglyceride” or “non-vegetable fat” when used herein is intended to mean obtained from other sources than native vegetable oils or fractions thereof, or obtained after transesterification. Examples of non-vegetable triglycerides may for example be, but are not limited to, triglycerides obtained from unicellular organisms, animal fat, and/or
20 transesterification.

As used herein, “transesterification” should be understood as replacing one or more of the fatty acid moieties of a triglyceride with another fatty acid moiety or exchanging one or more fatty acid moieties from one triglyceride molecule to another. A fatty acid
25 moiety may be understood as a free fatty acid, a fatty acid ester, a fatty acid anhydride, an activated fatty acid and/or the fatty acyl part of a fatty acid. The term ‘transesterification’ as used herein may be used interchangeably with ‘interesterification’. The transesterification process may be an enzymatic transesterification or chemical transesterification. Both chemical transesterification
30 and enzymatic transesterification is described well in the art. Both chemical and enzymatic transesterification may be done by standard procedures.

As used herein “partly melted” is intended to mean not totally melted and not totally solid or crystalline. Within a certain temperature range the seed product has to be melted enough to be pumpable, and may not be melted to an extent that no seed crystals
5 capable of seeding chocolate remains. In certain embodiments partly melted may be understood more narrow, for example that a certain percentage is melted and a certain percentage is non-melted, i.e. solid or crystalline. This may for example be represented by the solid fat content (SFC). Several methods for measuring SFC are known in the art.

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As used herein, the term “slurry” is a partly melted composition, where at least some seed crystals capable of seeding chocolate are present. Thus, a “slurry” may also for example be understood as a partly melted suspension, partly molten suspension or a paste.

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As used herein, the term “fraction” shall in this regard be understood to be a product remaining after a physical separation of the constituents of a natural source of a fat. This product may subsequently be subjected to a transesterification.

20 As used herein a “chocolate” is to be understood as chocolate and/or chocolate-like products. Some chocolate comprises cocoa butter, typically in substantial amounts, where some chocolate-like product may be produced low or even without cocoa butter, e.g. by replacing the cocoa butter with cocoa butter equivalent, cocoa butter substitute, etc. Also, many chocolate products comprises cocoa powder or cocoa mass, although
25 some chocolate products, such as typical white chocolates, may be produced without cocoa powder, but e.g. drawing its chocolate taste from cocoa butter. Depending on the country and/or region there may be various restrictions on which products may be marketed as chocolate. By a chocolate product is meant a product, which at least is experienced by the consumer as chocolate or as a confectionery product having
30 sensorial attributes common with chocolate, such as e.g. melting profile, taste etc.

As used herein the term “solid seed particles” is intended to mean solid particles of a seed. The particles may be in various forms, examples of which include flakes, pellets, granules, chips, and powder. The solid seed particles are for use in seeding chocolate. This may optionally be done in combination with conventional tempering steps.

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Abbreviations

Sat = saturated fatty acid/acyl-group

U = unsaturated fatty acid/acyl-group

St = stearic acid/stearate

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A = arachidic acid/arachidate

B = behenic acid/behenate

Lig = lignoceric acid/lignocerate

O = oleic acid/oleate

DSC = Differential Scanning Calorimetry

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The invention relates to a process for producing solid seed particles comprising an edible fat,

the process comprising the steps of

- 20 (a) providing a flow of edible fat, the edible fat having an outset temperature OT,
- (b) in a crystallization zone CZ performing a crystallization at a decreased temperature DT in a crystallization period CP of 1-150 seconds,
- (c) feeding an output from the crystallization zone CZ into a transformation
- 25 zone TZ,
- (d) in the transformation zone TZ performing a transformation of crystals produced in step (b) into higher melting crystal polymorphic forms at transformation temperature TT above said decreased temperature DT to obtain a transformed edible fat and

- (e) particulating said transformed edible fat into solid seed particles by at least cooling the edible fat processed according to step (d) to a temperature below which the edible fat solidifies.

5 The present invention has the advantage that the transformation zone may base the production of higher melting polymorphic crystals on the output of a fast producing crystallization zone given the fact that the transformation zone with relatively simple provisions may provide the required seed material in a cost efficient way. A large amount of edible fat crystals may be formed in the fast crystallization in the
10 crystallization zone, such as for example more than 5%, more than 10%, more than 20% or more than 30% of the final amount of crystals in the solid seed particles. Many of the crystals formed in the crystallization zone, which may comprise predominantly low melting crystal polymorphic forms, may then be transformed into desired crystal polymorphic forms in the transformation zone. Desired crystal polymorphic forms
15 may be form VI and V of a specific triglyceride, in particular it may be form VI of a specific triglyceride. The specific triglyceride may be for example StOSt. It may also for example be AOA or BOB.

In particular it is possible to produce an edible fat seed where a part of the process may
20 be performed by relatively simple means, i.e. by increasing the temperature of the edible fat during the transformation period. It should be noted that effective use of a fast crystallization step and a relatively long transformation step is partly obtained through the use of two different zones and that the processed edible fat is transferred to another part of the equipment for processing in the transformation zone.

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It should be noted that the “particulating said transformed edible fat into solid seed particles by at least cooling the edible fat” designates that the particulation may be obtained by means of cooling by itself, e.g. by the creating on edible drops which may solidify into particles by cooling. In other embodiments, the edible fat may be cooled
30 along with further mechanical processing. In one embodiment the particulation may be performed as one cooling step and then in a separate subsequent step be

mechanically particulating the cooled substance, e.g. by grinding or other subsequent mechanical processing.

It should be noted that the a great advantage in relation to the present invention is that the different established processing zones may be operated efficiently during manufacture. The most complicated process step is a relatively short part of the process and it is performed in dedicated process equipment, i.e. in the crystallization zone. Combined with the fact that the processed edible fat is transferred out of the crystallization zone when the initial crystallization has taken place, a restart of the system becomes relatively easy and may affect the following process steps in the transformation and particulation zone to a limited degree. The relatively long processing time associated to the transformation zone combined with the simple process requirements related to this step may therefore be applied as a procedural buffer for the overall process. If a malfunctioning is occurring in the crystallization zone, the process in the transformation and the particulation zone may simply proceed while a restart of the crystallization zone is performed. The process according to the present invention may be performed with little feed-back flow, if so desired, which again also makes a process restart much easier.

It should furthermore be noted that solid seed particles comprise seed particles of solidified edible fat. Solidified edible fat has a relatively high Solid Fat Content (SFC) at room temperature (e.g. 20 degrees Celsius). Typical solid seed particles may have a Solid Fat Content (SFC) of at least 50%, such as at least 60%, such as at least 70%, such as at least 80%, when measured at room temperature (e.g. 20 degrees Celsius).

A suitable decreased temperature in the crystallization zone may depend on the fat composition. The decreased temperature may be obtained by externally applied cooling, such as for example by surrounding the edible fat with a cooling jacket. When the edible fat for example comprises StOSt in an amount higher than 40% by weight, the temperature setting of the cooling jacket, which may be in the form of a scraped surface heat exchanger, may suitably be below around 21 degrees Celsius, such as for

example between -10 and 21 degrees Celsius, such as for example between -1 and 21 degrees Celsius.

The temperature below which the edible fat solidifies depends on the fat compositions.

- 5 When the edible fat comprises for example StOSt in an amount higher than 40% by weight, the temperature below which the edible fat solidifies may for example be below 35 degrees Celsius, such as below 30 degrees Celsius, such as below 25 degrees Celsius.

- 10 In an embodiment of the invention, the edible fat of the solid seed particles comprises triglycerides obtained from vegetable sources. The triglycerides obtained from vegetable sources may comprise vegetable fat selected from a group consisting of fats obtained from shea, sal, kokum, illipe, mango, mowra, cupuacu, allanblackia, pentadesma and any fraction and any combination thereof.

- 15 In an embodiment of the invention, the edible fat of the solid seed particles comprises triglycerides obtained from non-vegetable sources. By including triglycerides obtained from non-vegetable sources in the edible fat, such as for example triglycerides obtained by transesterification, it may be possible to obtain an edible fat comprising a
20 relatively higher amount of specific triglycerides, such as for example StOSt, AOA or BOB, as compared to obtaining triglycerides solely from vegetable sources.

- In an embodiment of the invention, the triglycerides obtained from non-vegetable
25 sources comprise triglycerides obtained from unicellular organisms.

The unicellular organisms may for example be selected from the group consisting of bacteria, algae or fungi, wherein fungi comprise yeast and mold.

- 30 In an embodiment of the invention, the triglycerides obtained from non-vegetable sources comprises triglycerides obtained by transesterification.

In an embodiment of the invention, the triglycerides obtained by transesterification comprises triglycerides obtained from an edible fat and a saturated fatty acid source under the influence of enzymes having 1,3-specific transesterification activity.

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In an embodiment of the process of the invention and all its embodiments, the triglycerides obtained by transesterification comprises triglycerides obtained from an edible fat and a saturated fatty acid source under the influence of an acid, a base or a non-enzymatic catalyst or any combination thereof.

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In an embodiment of the invention, the saturated fatty acid source comprises stearic acid or stearic acid esters, such as stearic acid methyl ester. Other stearic acid esters like for example stearic acid ethyl ester may be used. Stearic acid anhydride may also be used as the stearate source in the transesterification reaction. The saturated fatty acid source may as alternative thereto or in combination therewith comprise one or more from the group consisting of arachidic acid and/or arachidic acid esters, such as arachidic acid methyl ester, behenic acid and/or behenic acid esters, such as behenic acid methyl ester, and lignoceric acid and/or lignoceric acid esters, such as lignoceric acid methyl ester.

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In an embodiment of the invention, the edible fat used for transesterification comprises vegetable fat selected from the group consisting of fats obtained from shea, sunflower, rapeseed, sal, soy, safflower, palm, kokum, illipe, mango, mowra, cupuacu and any fraction and any combination thereof. Fats obtained from shea, sunflower, soy, rapeseed, sal, safflower, palm, kokum, illipe, mango, mowra, or cupuacu may contain a relatively high amount of triglycerides with an unsaturated fat like for example olein in position 2, which makes them very suitable for transesterification to obtain SatOSat-triglycerides.

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In an embodiment of the invention, the edible fat used for transesterification comprises vegetable fat selected from the group of high oleic sunflower, high oleic safflower oil, high oleic rapeseed oil or any combination thereof.

- 5 In an embodiment of the invention, the edible fat used for transesterification comprises or consists of shea olein or a shea olein fraction.

The fat phase may comprise a certain level of lower melting oils. Thus, in an embodiment of the invention, the fat phase comprises oils with a melting point below
10 25 degrees Celsius in an amount of 1.0-42% by weight, such as 3.0-35% by weight, such as 3.5-27%, such as 5-20% by weight.

In an embodiment of the invention, the fat phase comprises oils selected from the group consisting of sunflower oil, high oleic sunflower oil, soybean oil, rape seed oil,
15 high oleic rape seed oil, soy oil, olive oil, maize oil, peanut oil, sesame oil, hazelnut oil, almond oil, corn oil, or fractions or mixtures or any combination thereof .

The specific content and composition of the fat phase may vary. Thus, in an embodiment of the invention, the edible fat of the solid seed particles comprises
20 triglycerides in an amount of 60.0 – 99.9% by weight of said seed edible fat, such as 80-99.9%, such as 90-99.9%, such as 95-99%.

According to a further embodiment of the invention, the solid seed particles are substantially free of non-fat components, such as sugar or cocoa powder. Thus, the
25 solid seed particles may have a non-fat content of less than 5% by weight, such as less than 1% by weight, such as less than 0.1% by weight.

In a further embodiment of the invention, the edible fat of the solid seed particles comprises triglycerides having C18 – C24 saturated fatty acids in the *sn-1* and *sn-3*
30 positions of the triglyceride and oleic acid in the *sn-2* position of the triglyceride in an amount of 40 – 99 % by weight of said triglycerides, such as 50-99%, such as 70-99%,

such as 80-99%. It should be understood that the saturated fatty acids in the *sn*-1 and the *sn*-3 positions may not necessarily be the same, although they may be in some cases. Example of triglycerides having C18 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions of the triglyceride and oleic acid in the *sn*-2 position of the triglyceride
5 include StOSt, StOA, StOB, StOLig, AOA, AOB, AOLig, BOB, BOLig, and LigOLig-triglycerides.

The edible fat of the solid seed particles may also comprise a combination of two or more of the triglycerides StOSt, StOA, StOB, StOLig, AOA, AOB, AOLig, BOB,
10 BOLig, and LigOLig, where these triglycerides in the solid seed particles are comprised in an amount of 30.0 – 99.0% by weight of the triglycerides of said solid seed particles, such as 40.0 – 99.0% by weight, such as 50.0 – 99.0% by weight, such as 60.0 – 99.0% by weight, such as 70.0 – 99.0% by weight

15 Thus, according to an embodiment of the invention, said fat phase comprises triglycerides having C16 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions of the triglyceride and oleic acid in the *sn*-2 position of the triglyceride in an amount of between 40.0 to 99.0 % by weight of said fat phase. The triglycerides having C16 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions of the triglyceride and oleic
20 acid in the *sn*-2 position of the triglyceride are a subset of the total amount of triglycerides in the fat phase, where the triglycerides may for example constitute 60.0 – 99.9 % by weight of the fat phase. This means that, in such an example, that where the triglyceride-content in the fat phase is 90% by weight of the fat phase, and the content of triglycerides having C16 – C24 saturated fatty acids in the *sn*-1 and *sn*-3
25 positions of the triglyceride and oleic acid in the *sn*-2 position of the triglyceride in the fat phase is 70% by weight of the fat phase, there are 20% by weight of the fat phase of triglycerides other than triglycerides having C16 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions of the triglyceride and oleic acid in the *sn*-2 position of the triglyceride in the fat phase.

In an embodiment of the process of the invention and all its embodiments, the edible fat of the solid seed particles comprises triglycerides having C18 – C24 saturated fatty acids in the *sn-1* and *sn-3* positions of the triglyceride and oleic acid in the *sn-2* position of the triglyceride in an amount of 50 – 95 % by weight of said triglycerides such as
5 60.0 – 95.0%, such as 70-95%, or such as 50-90%.

The fat phase may comprise an increased amount of higher melting triglycerides compared to cocoa butter. Thus, in an embodiment of the invention, the edible fat of the solid seed particles has a weight-ratio between

- 10 - triglycerides having C18 – C24 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position of the triglyceride, and
 - triglycerides having C16 – C24 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position of the triglyceride,
which is between 0.40 – 0.99, such as 0.45 – 0.99, such as 0.50 – 0.99, such as 0.55 –
15 0.99, such as 0.60 – 0.99, such as 0.65 – 0.99, such as 0.70 – 0.99.

In the present context it should be understood that the weight-ratio of the above embodiment is the weight-ratio between Sat(C18-C24)OSat(C18-C24) triglycerides and Sat(C16-C24)OSat(C16-C24) triglycerides, wherein said Sat(C18-
20 C24)OSat(C18-C24) triglycerides are triglycerides having C18 – C24 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position, and wherein said Sat(C16-C24)OSat(C16-C24) triglycerides are triglycerides having C16 – C24 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position. Examples of triglycerides having C16 – C24 saturated fatty acids in the *sn-1* and *sn-3*
25 positions of the triglyceride and oleic acid in the *sn-2* position of the triglyceride comprise POP, POSt, StOSt, StOA, StOB, StOLig, AOA, AOB, AOLig, BOB, BOLig and LigOLig triglycerides.

According to an embodiment of the invention, the edible fat of the solid seed particles
30 has a weight-ratio between

- triglycerides having C18 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position of the triglyceride, and
 - triglycerides having C16 – C18 saturated fatty acids in the *sn-1* and *sn-3* positions and oleic acid in the *sn-2* position of the triglyceride,
- 5 which is between 0.40 – 0.99, such as 0.45 – 0.99, such as 0.50 – 0.99, such as 0.55 – 0.99, such as 0.60 – 0.99, such as 0.65 – 0.99, such as 0.70 – 0.99.

The fat phase may comprise StOSt-triglycerides. Therefore, in an embodiment of the invention, the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99% wherein St stands for stearic acid and O stands for oleic acid.

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In a further embodiment of the invention, the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-90% by weight, such as 50-90%, such as 50-80% wherein St stands for stearic acid and O stands for oleic acid.

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The fat phase may comprise AOA-triglycerides. Thus, in an embodiment of the process of the invention and all its embodiments, the edible fat of the solid seed particles comprises AOA-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90% wherein A stands for arachidic acid and O stands for oleic acid.

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The fat phase may comprise BOB-triglycerides. Therefore, in an embodiment of the process of the invention and all its embodiments, the edible fat of the solid seed particles comprises BOB-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90% wherein B stands for behenic acid and O stands for oleic acid.

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The fat phase may comprise LigOLig-triglycerides. Thus, in a still further embodiment of the invention, the edible fat of the solid seed particles comprises LigOLig-

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triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90% wherein Lig stands for Lignoceric acid and O stands for oleic acid.

5 The edible fat may in step (a) be provided as a completely melted fat. Thus, in an embodiment of the invention, the outset temperature OT is a temperature where the edible fat is completely melted prior to entering the crystallization zone CZ.

10 It should be noted that the edible fat of course may include components or even fat components which a part of the edible fat composition but as not effective components in relation to the intended seed functionality. The edible fat refers to the part of the edible fat which is subject to the use as a seed and it is therefore possible to add further components, even fat components, and still maintain the overall desired seeding properties.

15 It is nevertheless preferred that the edible fat is preferable a fat which is composed and formulated to be suitable for establishment of a seed crystals which may, when mixed with a chocolate composition functions as a seed providing at least one relatively high melt endotherm peak position.

20 The outset temperature is basically understood as the temperature at which the edible fat to be processed has when it has been prepared for the seed manufacturing process.

In a further embodiment of the invention, the outset temperature OT is at least 40 degrees Celsius.

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In an embodiment of the invention the outset temperature OT is at least 40 degrees Celsius when the edible fat comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid

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In an even further embodiment of the invention the outset temperature OT is between 40-70 degrees Celsius, such as 40 to 65 degrees Celsius or such as 40 to 60 degrees Celsius.

- 5 In an embodiment of the invention the outset temperature is OT is between 40-70 degrees Celsius, such as 40 to 65 degrees Celsius or such as 40 to 60 degrees Celsius depending on the chosen formulation. When the fat phase comprises BOB-triglycerides and AOA-triglycerides these temperatures may be elevated to ensure that lower melting point crystals are melted and also to ensure that the viscosity is
10 acceptable in the applied process equipment.

The crystallization of step (b) may be performed in various apparatuses. For example, in an embodiment of the invention, the crystallization of step (b) is performed in a heat exchanger.

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In another embodiment of the invention, the crystallization of step (b) is performed in a scraped-surface heat exchanger.

- Several different types of heat exchangers may be applied within the scope of the
20 invention in the crystallization step. Applicable types of scraped-surface heat exchangers include but are not limited to

- Rotating, tubular scraped-surface heat exchangers. In this type, the shaft is placed parallel to the tube axis, not necessarily coincident, and spins at various frequencies,
25 from a few dozen rpm to more than 1000 rpm. The number of blades oscillates between 1 and 4 and may take advantage of centrifugal forces to scrape the inner surface of the tube. Examples are the Waukesha Cherry-Burrell Votator II, Alfa Laval Contherm and Terlet Terlotherm.
- 30 - Reciprocating, tubular scraped-surface heat exchangers. In this type, the shaft is concentric to the tube and moves longitudinally without rotating. The frequency spans

between 10 and 60 strokes per minute. The blades may vary in number and shape, from baffle-like arrangements to perforated disk configurations. An example is the HRS Heat Exchangers Unicus.

- 5 - Rotating, plate tubular scraped-surface heat exchangers. In this type, the blades wipe the external surface of circular plates arranged in series inside a shell. The heating/cooling fluid runs inside the plates. The frequency is about several dozen rpm. An example is the HRS Spiratube T-Sensation.
- 10 As mentioned, other types of scraped-surface heat exchangers may be used within the scope of the invention as long as the heat exchanger is able to produce the desired edible fat crystals required for the subsequent transformation into higher melting crystal polymorphic forms.
- 15 The transformation zone may be operated in accordance with specific parameters and settings. Thus, in an embodiment of the invention, the edible fat processed in step (d) is agitated during at least a part of said transformation period TP. Agitation is in the present context understood as the act of putting the edible fat into motion by shaking or stirring.
- 20 Alternatively, static conditions, i.e. no agitation, may be used in said transformation period.
- In a further embodiment of the invention, the edible fat processed in step (d) is
- 25 processed in a transformation period TP, the transformation period TP being longer than the crystallization period CP.
- An advantage of the invention is that the processing of edible fat into a seed may be performed at least partly without the use of a relatively complex and costly heat
- 30 exchanger as used during the crystallization step. This subsequent step of

transformation has thus shown to be effective in establishing the desired crystal forms of the edible fat.

In an even further embodiment of the invention, the transformation period TP is at
5 least 1 hour, such as at least 3 hours, such as at least 12 hours, such as at least 24 hours, such as at least 36 hours.

In a still further embodiment of the invention the transformation period TP is at least
10 3 hours.

In even further embodiment of the invention the transformation period TP is at least 6 hours.

In an even still further embodiment of the invention the transformation period TP is at
15 least 12 hours.

In a further embodiment of the invention the transformation period TP is at least 18 hours.

20 In an even further embodiment of the invention the transformation period TP is at least 24 hours.

In a still further embodiment of the invention the transformation period TP is at least
25 36 hours.

In a further embodiment of the invention, the transformation temperature TT is within a range of a minimum transformation temperature TTmin and maximum transformation temperature TTmax.

In an even further embodiment of the invention, the minimum transformation temperature TT_{min} is selected to ensure that the edible fat processed can be agitated during at least a part of the transformation period.

- 5 In a still further embodiment of the invention, the minimum transformation temperature TT_{min} is selected to establish a pre-determined viscosity of the edible fat.

The minimum transformation temperature TT_{min} depends on the specific triglyceride content and composition of the edible fat of the solid seed particles. Thus, in a further
10 embodiment of the invention, the minimum transformation temperature TT_{min} is 39 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises StOSt-triglycerides.

For example, in an embodiment of the invention the transformation temperature is
15 between 35 and 45 degrees Celsius, such as is between 37 and 43 degrees Celsius, such as is between 39 and 40.5 degrees Celsius when said edible fat comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid.

- 20 In an embodiment of the process of the invention and all its embodiments, the minimum transformation temperature TT_{min} is 44 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises AOA-triglycerides.

25 For example, in an embodiment of the invention the transformation temperature is between 40 and 50 degrees Celsius, such as is between 40 and 48 degrees Celsius, such as is between 42 and 45 degrees Celsius when the edible fat comprises AOA-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90%, wherein A stand for arachidic acid and O stands for oleic acid.

In an embodiment of the process of the invention and all its embodiments, the minimum transformation temperature TTmin is 49 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises BOB-triglycerides.

5

For example, in an embodiment of the invention the transformation temperature is between 45 and 55 degrees Celsius, such as is between 47 and 53 degrees Celsius, such as is between 48 and 50 degrees Celsius when said edible fat comprises BOB-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%,
10 such as 70-90%, wherein B stand for behenic acid and O stands for oleic acid.

The maximum transformation temperature TTmax depends on the specific triglyceride content and composition of the edible fat of the solid seed particles. Thus, in a further embodiment of the invention, the maximum transformation temperature TTmax is 43
15 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises StOSt-triglycerides.

For example, in an embodiment of the invention the maximum transformation temperature TTmax is 45 degrees Celsius, such as 44 degrees Celsius, such as 43
20 degrees Celsius, such as 42 degrees Celsius or such as 41 degrees Celsius when the edible fat comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid.

It should be noted that the maximum transformation temperature TTmax of 43 degrees
25 Celsius is somewhat theoretical in the sense that this refers to a pure StOSt triglyceride edible fat. In practice, the edible fat may comprise less than 100% of StOSt-triglycerides thereby in practice reducing the applicable maximum transformation temperature TTmax. Such an optimization may be performed when considering the specifically chosen fat compositions.

30

In a further embodiment of the invention, the maximum transformation temperature TTmax is 41.5 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises StOSt-triglycerides.

- 5 When applying an edible fat comprising at least 70% by weight of StOSt-triglycerides the maximum transformation temperature TTmax should be kept below about 41 degrees Celsius in order to ensure that the desired crystals are not melted during the transformation period.
- 10 In an embodiment of the process of the invention and all its embodiments, the maximum transformation temperature TTmax is 48 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises AOA-triglycerides.
- 15 For example, in an embodiment of the invention the maximum transformation temperature TTmax is 50 degrees Celsius., such as 49 degrees Celsius, such as 48 degrees Celsius, such as 46 degrees Celsius or such as 45 degrees Celsius when the edible fat comprises AOA-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90%, wherein A stand for arachidic acid and O
- 20 stands for oleic acid.

It should be noted that the maximum transformation temperature TTmax of 48 degrees Celsius is somewhat theoretical in the sense that this refers to a pure AOA-triglyceride edible fat. In practice, the edible fat may comprise less than 100% of AOA-triglycerides thereby in practice reducing the applicable maximum transformation temperature TTmax.

In an embodiment of the process of the invention and all its embodiments, the maximum transformation temperature TTmax is 45 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises AOA-triglycerides.

In an embodiment of the process of the invention and all its embodiments, the maximum transformation temperature TTmax is 53 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises BOB-triglycerides.

For example, in an embodiment of the invention the maximum transformation temperature TTmax is 55 degrees Celsius, such as 54 degrees Celsius, such as 53 degrees Celsius, such as 52 degrees Celsius or such as 51 degrees Celsius when said edible fat comprises BOB-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, such as 70-90%, wherein B stand for behenic acid and O stands for oleic acid.

It should be noted that the maximum transformation temperature TTmax of 53 degrees Celsius is somewhat theoretical in the sense that this refers to a pure BOB-triglyceride edible fat. In practice, the edible fat may comprise less than 100% of BOB-triglycerides thereby in practice reducing the applicable maximum transformation temperature TTmax.

In an embodiment of the process of the invention and all its embodiments, the maximum transformation temperature TTmax is 50 degrees Celsius. This may be especially applicable when the edible fat of the solid seed particles comprises BOB-triglycerides.

Moreover, the invention relates to a system for production of solid seed particles, the system comprising a crystallization zone CZ, a transformation zone TZ and a particulation zone PZ, wherein the system comprises pumps for transferring processed edible fat from the crystallization zone CZ into the transformation zone after a period of 1-150 seconds, the period is calculated from the time the edible fat is input into the crystallization zone CZ.

In the present context pumps designates any kind of suitable process equipment which is able to transfer flowable edible fat from one zone to another.

5 In a further embodiment of the invention, the pumps are automatically controlled by a control unit.

In an even further embodiment of the invention, the system for production of solid seed particles comprises a crystallization zone CZ, a transformation zone TZ and a particulation zone PZ, wherein the system comprises pumps for transferring processed
10 edible fat from the crystallization zone CZ into the transformation zone after a period of 1-150 seconds. This period is calculated from the time the edible fat is input into the crystallization zone CZ and the system is operated according to the process in any of its embodiments.

15 The invention further relates to a chocolate product comprising the solid seed particles manufactured according to the process of any of the embodiments described above.

The invention also relates to use of the solid seed particles, manufactured according to the process of any of the embodiments described above, for production of chocolate
20 products.

The invention further relates to use of the solid seed particles, manufactured according to the process of any of the embodiments described above, for production of chocolate products, in which the solid seed particles is used as a seed. By applying the method
25 of the present invention to an edible fat and using the so obtained solid seed particles as an ingredient, such as a seeding agent, in the manufacture of confectionary products, such as chocolate or chocolate-like products, the manufacturing process of the confectionary products may be simplified and/or the confectionary products may obtain improved properties with respect to, for example, bloom stability and sensory
30 parameters both during production and/or over time especially at elevated temperatures, such as temperatures above the melting point of the chocolate. When,

for example, the transformation temperature is between 35 and 45 degrees Celsius, such as between 37 and 43 degrees Celsius, or such as between 39 and 40.5 degrees Celsius, and when said edible fat comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, or such as 70-99%, the solid see particles may be particularly suitable for seeding a chocolate, since the melting point of the seed is above the melting point of the chocolate fat phase, and will thus retain its seeding capabilities, even when the chocolate is exposed to temperatures above the melting point of the chocolate fat phase, such as for example temperatures above 36 degrees Celsius, 37 degrees Celsius or 38 degrees Celsius.

10

Fig. 1a and 1b illustrate some basic principles according to an embodiment of the invention. A processing system PS is illustrated in fig. 1a and comprises a crystallization zone CZ, a transformation zone TZ and a particulation zone PZ.

Fig. 1b will be referred to when illustrating a process temperature at a time t during the process performed in the processing system illustrated in fig. 1a.

The crystallization zone CZ is fed with a flow of edible fat (not shown). Possible compositions of the edible fat will be described below. The edible fat has an outset temperature OT prior to or at the time of entering the crystallization zone CZ.

The basic operation during the crystallization process in the crystallization zone CZ is that the edible fat is temperature regulated to grow crystals at decreased temperature DT. The function of the crystallization zone CZ is basically to produce low melting crystals form(s) over a very limited period of time, a crystallization period CP. The crystallization zone may comprise different types of crystallization equipment known in the art such as the two exemplary embodiments shown and explained below in fig. 2a and 2b. A crystallization zone may in some contexts be regarded as a part of a scraped surface heat exchanger where crystals of edible fat are grown.

30

An important feature of the present invention is that the crystallization period CP is very short, i.e. 1 to 150 seconds before the processed edible fat is transferred to the transformation zone TZ of the process equipment. Within this time period all or the majority of the final amount of crystals will be formed, the majority of these being in lower melting crystal polymorphic forms. The transformation zone will process the inputted edible fat at an elevated transformation temperature TT when compared to the decreased temperature DT. The transformation is performed over a relatively long transformation period TP, when compared to the crystallization period. The transformation period TP may e.g. be more than 1 hour, 5 hours 10 hours or even longer than 24 hours. In the transformation zone TZ, the lower melting crystal polymorphic forms generated in the crystallization zone is transformed into higher melting crystal polymorphic forms thereby generating an edible fat which may form basis for a subsequent use as a seed for chocolate. The equipment used in the transformation zone for the relatively long transformation period may be relatively simple and may reduce the use of more complicated machinery as in the crystallization zone during the relatively short crystallization period to a minimum.

It should however be noted that the crystallization in other embodiments of the invention may take place simply by cooling the edible fat without the need for scrapers or shear as illustrated above. It may however in such an embodiment be difficult to obtain the required amount of crystals in the required operation of 1 to 150 seconds of the crystallization zone.

The present invention benefits from the fact that the desired and required transformation is obtained through simple measures and that the process may easily be integrated into different already established types of production lines.

The transformation zone TZ may be established by means of different suitable equipment, where two of several applicable embodiments are described in fig. 3a and 3b.

The transformed edible fat will then be fed into a particulation zone PZ where the transformed edible fat is processed into solid seed particles at a temperature, which is below the transformation temperature TT applied in the transformation zone TZ.

- 5 The particulation zone PZ is broadly referring to the parts of the processing system PS, where the received transformed edible fat is both brought into a solid state and particulated into solid seed particles. The combined particulation and solidifying step by cooling does not necessarily need to be performed in one and the same step although it may be preferred in relation to the possibilities of obtaining a process suitable for
10 industrial automated use.

The particulation of a partly melted transformed edible fat into solid seed particles may be performed by means of different types of particulation zones PZ. Two of several applicable embodiments are described in fig. 4a and 4b.

15

The obtained seed particles may subsequently be transported or transferred to another location for use in a chocolate seeding process.

- It should be noted that the temperature curves of fig. 1b are shown for illustrative
20 purposes only and does not necessarily illustrate a real-life temperature development thought-out the system of fig. 1a. The temperature may vary, but the principles of a relatively high outset temperature OT which is decreased in or before the crystallization zone CZ to a decreased temperature DT when compared to the outset temperature OT; the decreased temperature DT being raised to a transformation
25 temperature TT before or in the transformation zone TZ, when compared to the decreased temperature DT; the cooling of the transformed edible fat as a part of the process to obtain solid seed particles comprising edible fat, all these principles are maintained at least through a part of the time the edible fat is processed in the individual zones of the processing system PS.

30

It should also be noted the temperature curves of fig. 1b are in no way restricted to reflect the specific time or place on or in which the processed edible fat are heated or cooled. The illustrated temperature may rather refer to an illustration of an averaged temperature of the relevant zone or a temperature effective of providing the desired
5 properties of the produced solid seed particles.

Fig 2a and 2b illustrate two possible implementation of a crystallization zone CZ according to an embodiment of the invention.

10 The crystallization zone CZ provided in fig. 2a or fig. 2b may be used and applied in the system of fig. 1 in order to create seed crystals of predominantly lower melting crystal polymorphic forms in the inputted edible fat composition.

The purpose of a scraped surface heat exchanger 1 is to heat and/or cool a continuously
15 moving edible fat composition by removing fouling layer from a heat transfer surface. Furthermore, a scraped surface heat exchanger 1 increases the turbulence inside a tube and thereby ensuring a homogeneous mixture of the edible fat.

Fig. 2a illustrates a crystallization zone CZ established by means of a so-called a
20 scraped surface heat exchanger using a set of scrapers.

The scraped surface heat exchanger 1 comprises a heat transfer tube 2 wherein the floating edible fat is processed. The heat transfer tube 2 is enclosed in a temperature regulating tube 3 that further encloses a temperature regulating fluid 9. The regulating
25 fluid could comprise water, brine, ammonia, glycol or similar fluids suited for heating and/or cooling.

Inside the heat transfer tube 2 a shaft 4 comprising a set of scrapers 6 is rotating. The scrapers 6 are positioned in such a way that they scrape the inner surface of the heat
30 transfer tube 2, when the shaft is rotating.

In one embodiment, the scraped surface heat exchanger 1 is used to generate crystals in edible fat compositions 8 by feeding the scraped surface heat exchanger 1 with an edible fat composition 7. The edible fat composition 7 is feed into the heat transfer tube 2. Inside the heat transfer tube 2, the edible fat composition 7 that comes in contact with the inner surface of the heat transfer tube 2, gets scraped off by the rotating scrapers 4 and further transported through the heat transfer tube 2. The edible fat composition 7 that is transported inside the heat transfer tube 2 will obtain a specific temperature, a decreased temperature DT obtained by the temperature regulating fluid 9 that surrounds the heat transfer tube 2. It should be noted that the decreased temperature DT is not necessarily constant during the process flow. Typically the temperature would fall between the input of the scraped surface heat exchanger 1 and the output of the scraped surface heat exchanger 1 or a position within the scraped surface heat exchanger 1.

In another embodiment the scraped surface heat exchanger 1 comprises a spiral scraper 5 as illustrated in fig. 2b. The spiral scraper 5 moves the edible fat composition 7 along the tube, while continuously scraping the surface of the heat transfer tube 2 thereby performing the same functionality as the set of scrapers illustrated in fig. 1a

In one embodiment the heat or cooling medium can be divided into several sections along the heat transfer tube 2, enabling the edible fat to be both heated and cooled while moving though the scraped surface heat exchanger 1.

It should be noticed that a kneading unit, such as a pin rotor machine, may in some embodiments be implemented e.g. right father the scraped surface heat exchangers.

Fig 3a and 3b illustrate two possible implementation of a transformation zone CZ according to an embodiment of the invention.

The transformation zone CZ provided in fig. 3a or fig. 3b may be used and applied in the system of fig. 1 in order to transform lower melting crystal polymorphic forms

created in the preceding crystallization zone CZ into higher melting crystal polymorphic forms in the inputted edible fat composition. This may typically be a transformation of form I, II, III and IV into form V and VI. The “seed crystal-enriched” edible fat is also referred to as a transformed edible fat. The transformed edible fat may typically predominantly comprise form V and form VI crystal polymorphic forms.

Fig. 3a shows a transformation zone TZ working in batch mode.

Flowable edible fat received from a previous crystallization zone CZ is poured into a large container or tank 31. Flowable edible fat may elsewhere be referred to as a slurry reflecting or illustrating the nature of the edible fat, namely that the edible has obtained an increased viscosity fat due to the presence of crystals in the fat composition. The container or tank 31 is temperature controlled by a surrounding jacket 34. Other temperature control means may of course be applied within the scope of the invention as long as the desired elevated transformation temperature TT is obtained at least partly through the process.

The edible fat 32 contained in the container or tank 31 is agitated by means of a stirrer 33 during at least a part of the time during which the edible fat is undergoing the desired transformation at an elevated transformation temperature TT. The temperature must be carefully controlled not to exceed the temperature at which the highest and/or second-highest melting crystal polymorphic forms are completely melted. The temperature of the edible fat 32 should have a minimum temperature ensuring that the applied stirrer is able to agitate the edible fat 32.

The stirrer 33 may of course be supplemented by further stirrers or modified stirrers. The stirring may occur partly or during the entire transformation period.

The obtained transformed fat is typically flowable and may be transferred as to a subsequent process step for particulation in a particulation zone PZ.

Fig. 3b shows a transformation zone TZ working in continuous mode.

Flowable edible fat received from a previous crystallization zone CZ is guided into an inlet of a long tube 37. The tube 37 is temperature controlled by means of a surrounding jacket 35. Other temperature control means may of course be applied within the scope of the invention as long as the desired elevated transformation temperature TT is obtained at least partly through the process.

The edible fat fed through the tube 37 is agitated by means of a number of stirrers 36 during at least a part of the time during which the edible fat is undergoing the desired transformation at a transformation temperature TT. The temperature must be carefully controlled not to exceed the temperature at which the highest and/or second-highest melting crystal polymorphic forms are completely melted. The temperature of the edible fat should have a minimum temperature ensuring that the applied stirrer is able to agitate the edible fat. The stirrers may also serve as a feeding mechanism by means of which the edible fat is moved through the tube 37.

The stirrers 36 may of course be supplemented by further stirrers or modified stirrers. The stirring may occur partly or during the complete transformation period.

20

The tube may have different cross sections, diameters, volume etc. as long as the transformation period is sufficiently long to ensure that enough form V and/or form VI crystals are formed and/or that an endotherm melt peak position of the transformed edible fat is raised sufficiently to be applicable as seed material for e.g. chocolate seeding.

25

The obtained transformed edible fat may be transported to a subsequent particulating zone PZ.

30 The obtained transformed fat is typically flowable and may be transferred as to a subsequent process step as a flowable substance.

Fig. 3c shows a transformation zone TZ working in batch mode.

Flowable edible fat received from a previous crystallization zone CZ is poured into a
5 large container or tank 31. The container or tank 31 is temperature controlled by a
surrounding jacket 34. Other temperature control means may of course be applied
within the scope of the invention as long as the desired elevated transformation
temperature TT is obtained at least partly through the process.

10 The edible fat 32 contained in the container or tank 31 is undergoing the desired
transformation at an elevated transformation temperature TT. The temperature must
be carefully controlled not to exceed the temperature at which the highest and/or
second-highest melting crystal polymorphic forms are completely melted.

15 The elevated transformation temperature TT in this embodiment is selected to ensure
that the desired transformation is taking place and that the transformed edible fat 32 is
gradually becoming a solid block. In other words, the illustrated embodiment of the
invention partly includes a particulation zone whereas the other embodiments of fig.
3a, fig. 3b, fig. 4a and fig. 4b clearly illustrated physical separate zones. The solidified
20 block of transformed edible fat may then be removed from the container 31 and
transferred to a subsequent processing step of the last part of a particulation zone, PZ,
e.g. as described and explained in fig. 4c.

Fig. 4a illustrates an alternative implementation of a particulation zone PZ according
25 to a further embodiment of the invention.

The seed particles may be produced with different weight and sizes suitable for the
purpose.

30 The illustrated particulation arrangement comprises a depositor 51 which dispenses
non-solidified transformed edible fat 53 from container (not shown) on a rotating

cylinder 50. The rotating cylinder 50 is cooled by a suitable cooling arrangement (not shown).

The dispensed transformed edible fat may e.g. be produced in a transformation zone
5 as illustrated in fig. 3a or fig. 3b.

Due to the cooling of the rotating cylinder 50, the dispensed fat will solidify on the cylinder 50 and it may then fall of the cylinder as seed particles in the form of flakes 55. Alternatively, the dispensed transformed edible fat may stick to surface of the
10 cylinder and form a layer 54. This layer 54 may, while the cylinder 50 is rotating, be scraped by means of a scraper 52 and form flakes 55.

Downstream the seed particles in the form of flakes may be collected and moved to the packaging line or fed directly to a subsequent chocolate manufacturing line where
15 the seed particles may be applied for the purpose of seeding chocolate.

Fig. 4b illustrates an alternative implementation of a particulation zone PZ according to a further embodiment of the invention.

20 The seed particles may be produced with different weight and sizes suitable for the purpose.

The illustrated line comprises a depositor 12, a belt 11, on which transformed edible fat is deposited as edible fat deposits 14 and a cooling tunnel 13. The deposited
25 transformed edible fat is flowable and may e.g. originate from a tank (not shown) associated to the equipment or it may be transferred directly as a liquid from a previous process step.

The depositor 11 is located upstream of the line and has horizontal piston (not shown)
30 dosing the edible fat as deposits 14 on the belt. Weight of the deposits can be changed by varying the travel of the pumping pistons via suitable electronic control.

The deposits 14 on the belt 11 then moves into the cooling tunnel 13. The cooling tunnel may be divided into two or more independent temperature regulation areas (not shown).

5

The deposits are after passage through the cooling tunnels now individual solid seed particles at the downstream end of the belt 11 and the seed particles may be collected and moved to the packaging line or fed directly to a subsequent chocolate manufacturing line where the seed particles may be applied for the purpose of seeding chocolate.

10

Fig 4c illustrates an implementation of a part of a particulation zone PZ according to an embodiment of the invention.

15 The particulation zone may in the present embodiment produce edible fat seed particles and may be applied within the scope of the invention in a system as described and explained in relation to fig. 1.

In a previous part of the particulation zone PZ (not shown) transformed edible fat has been solidified into a block and a transformed edible fat has been formed into a solidified block 15 of transformed edible fat. An example of an overlapping particulation zone and a transformation zone has been illustrated in fig. 3c. In other words, it should here be noted that the transformation zone and the particulation zone in some embodiments may be overlapping, i.e. performed in the same equipment

25

The solidified block 15 of transformed edible fat, i.e. the edible fat obtained from the transformation zone TZ of fig. 1 is positioned in an input guide 16 of the flaking arrangement and is laterally movable.

30 The lateral movement of the solidified block 15 may be controlled actively or simply obtained through gravity. A rotating flaker 17 is positioned at the lower end of the

input guide 16. The rotating flaker 17 comprises a number of cutters 18. When the flaker 17 is rotating the cutters will produce solid seed particles in the form of flakes of the solidified block 15.

- 5 The seed particles may be collected and moved to the packaging line or fed directly to a subsequent chocolate manufacturing line where the seed particles may be applied for the purpose of seeding chocolate.

Fig. 5 illustrates a possible process flow in relation to manufacture of chocolate.

10

A processing system PS according to the invention and e.g. as described in fig. 1A and fig. 1B is used to produce chocolate seeds and the chocolate seeds are distributed to a chocolate manufacturing site CMS via a distribution link DL.

- 15 The distribution link DL may typically be obtained through suitable logistics adapted to transport the particulated chocolate seeds to the chocolate manufacturing site CMS.

The chocolate manufacturing site CMS may typically be where the final chocolate is seeded and processed into the final chocolate product. The seeded chocolate may
20 typically be produced by the application of the solid seeds particles produced according to an embodiment of the invention and the chocolate which is seeded may be produced locally at the chocolate manufacturing site CMS or it may originate from a separate manufacturer.

- 25 The resulting seeded chocolate product has the benefits of well-tempered chocolate and the seeding process at the chocolate manufacturing site CMS may be flexible and it may utilize different types of suitable seeds, depending on the application, e.g. dark or milk chocolate, or depending on the geographically or nationally specified requirements.

30

Examples

Analysis of slurry samples

In the following examples, slurry samples were analyzed by Differential Scanning
 5 Calorimetry (DSC). This was done by a METTLER TOLEDO DSC 823e with a
 HUBER TC45 immersion cooling system. 40 +/- 4 mg of slurry samples were
 hermetically sealed in a 100 microliter aluminum pan, with an empty pan as reference.
 Slurry samples were heated from 32.0 degrees Celsius to 50.0 degrees Celsius at a rate
 of 3 degrees Celsius per minute to produce a DSC melting thermogram.

10

Analysis of particulated samples

In the following examples, flake samples were analyzed by Differential Scanning
 Calorimetry (DSC). This was done by a METTLER TOLEDO DSC 823e with a
 HUBER TC45 immersion cooling system. 10 +/- 1 mg of flake samples were
 15 hermetically sealed in a 40 microliter aluminum pan, with an empty pan as reference.
 Samples were heated from 20.0 degrees Celsius to 44.0 degrees Celsius at a rate of 3
 degrees Celsius per minute to produce a melting thermogram.

Shea Stearin IV 36

20 Triglyceride composition (most abundant):

Triglyceride	Amount in weight % of the total triglyceride content
StOSt	67%
POSt	8%
StOA	4%
StOO	6%
StLiSt	7%
Others	8%

Table 1: Content of most abundant triglycerides, given in % by weight of the total triglyceride content. St denotes Stearic acid, O denotes Oleic acid, P denotes Palmitic acid, A denotes Arachidic acid, Li denotes Linoleic acid.

The total content of SatOSat is about 80% of the triglyceride content, where Sat denotes saturated fatty acids, and O denotes Oleic acid.

- 5 The edible fat employed according to embodiments of the invention may have other triglyceride compositions than Shea Stearin IV 36, examples of which are given below:

Triglyceride	Amount in weight % of the total triglyceride content			
StOSt	41%	61%	85%	91%
Others	59%	39%	15%	9%

Triglyceride	Amount in weight % of the total triglyceride content			
AOA	62%	71%	78%	87%
Others	38%	29%	22%	13%

Triglyceride	Amount in weight % of the total triglyceride content			
BOB	55%	67%	74%	88%
Others	45%	33%	26%	12%

10

Example 1

- Two samples S-1 and S-2 of Shea Stearin IV 36 were subjected to a crystallization zone CZ according to fig. 1 and as illustrated in fig. 8, where the crystallization zone was provided in a Scraped Surface Heat Exchanger to obtain a sample S-3 and S-4, respectively, at the crystallization zone output. The Scraped Surface Heat Exchanger has an initial feed tank, from where each of the samples S-1 and S-2, respectively, is fed through three subsequent temperature zones, A1, A2, and A3 (not depicted in the figure). The parameters and settings of the Scraped Surface Heat Exchanger and measured slurry temperatures are listed in table 2.
- 15
- 20

Sample reference	S-3	S-4
Input sample	S-1	S-2
Feed tank temperature (degrees Celsius)	62.3	64.2
Product flow (kilogram per hour)	80	80
Total retention time in Scraped Surface Heat Exchanger	25.8	25.8
Scraped Surface Heat Exchanger rotational speed (Rotations per minute)	800	800
Temperature of cooling jacket of A1 (degrees Celsius)	10	20
Slurry temperature at outlet from A1 (degrees Celsius)	29.3	32.7
Temperature of cooling jacket of A2 (degrees Celsius)	0	15
Slurry temperature at outlet from A2 (degrees Celsius)	22.6	26.9
Temperature of cooling jacket of A3 (degrees Celsius)	Off/20	10
Slurry temperature at outlet from A3 (degrees Celsius)	25.7	26.3

Table 2: Settings of the Scraped Surface Heat Exchanger. Note that “Off” denotes no active temperature control in the given step, where ambient temperature was about 20 degrees Celsius.

- 5 A test sample was extracted from the crystallization zone output for each of samples S-3 and S-4 and analyzed according to “Analysis of slurry samples” to produce a DSC melting thermogram. The produced DSC melting thermogram corresponding to sample S-3 is illustrated as the solid line in fig. 6, where the x-axis refers to temperature and the y-axis is given in Watt per gram. DSC peak positions are identified as in table

10 3.

Sample reference	S-3	S-4
DSC peak position (degrees Celsius)	37.9	37.7

Table 3: DSC peak positions of obtained samples.

As seen from table 3, samples giving DSC peak positions of about 37.7-37.9 degrees Celsius were obtained after a relatively short total retention time of 25.8 seconds in the crystallization zone (comprising in this case temperature zones A1, A2, A3).

The endotherm melt peak positions are typical for lower melting crystal polymorphic forms of StOSt, such as form II, II and IV.

Example 2

The obtained samples S-3 and S-4 from example 1 from the crystallization zone output were subjected to a transformation zone TZ according to fig. 1 and as illustrated in fig. 8 to obtain samples S-5 and S-6, respectively, of transformed edible fat. The transformation zone TZ comprised a transformation tank, a stirrer, and a temperature controller. The crystallization zone was operated according to the parameters and settings as given in table 4.

Sample reference	S-5	S-6
Input sample	S-3	S-4
Transformation tank capacity (liters)	30	30
Transformation tank stirring speed (Rotations per minute)	35	35
Transformation tank temperature (degrees Celsius)	39.5	40.0
Retention time in transformation zone (hours)	25	23

Table 4: Settings of the Transformation Zone TZ.

A test sample was extracted from each of samples S-5 and S-6 and analyzed according to "Analysis of slurry samples" to produce a DSC melting thermogram. The produced DSC melting thermogram corresponding to sample S-5 is illustrated as the dashed line in fig. 6. Endotherm melt peak positions from sample S-5 and S-6 are listed in table 5.

Sample reference	S-5	S-6
DSC peak position (degrees Celsius)	43.4	43.0

Table 5: DSC melt peak positions of obtained samples.

As seen from table 5, samples giving DSC peak positions of about 43.0-43.4 degrees Celsius were obtained after a total retention time of 23-25 hours in the transformation zone.

- 5 The endotherm melt peak positions are typical for higher melting crystal polymorphic forms of StOSt, such as form V and VI. In particular, an endotherm melt peak position around 42-44 degrees Celsius, such as for example around 43 degrees Celsius indicates the presence of StOSt form VI crystals.

10 Example 3

The samples S-5 and S-6 of transformed edible fat extracted from the transformation zone output in example 2 were subjected to particulation in a particulation zone PZ according to fig. 4a and as illustrated in fig. 8 to obtain samples S-7 and S-8, respectively, of solid seed particles in the form of flakes. The particulation zone PZ
15 comprised a drum having a controllable drum surface temperature. The particulation zone PZ was operated according to the parameters and settings as given in table 6.

Sample reference	S-7	S-8
Input sample	S-5	S-6
Flaker capacity (kilogram per hour)	10	10
Flaker drum surface temperature (degrees Celsius)	-14	-14
Temperature of HSC slurry immediately prior to flaking (S5 , S6) (degrees Celsius)	39.5	40.0
Contact time slurry on flaker (seconds)	3	3

Table 6: Settings of the particulation zone PZ.

- 20 A test sample was extracted from the particulation zone PZ output for each of samples S-7 and S-8 and analyzed according to “Analysis of flake samples” to produce a DSC melting thermogram. The produced DSC melting thermogram corresponding to sample S-7 is illustrated as the solid line in fig. 7. DSC peak positions for S-7 and S-8 are listed in table 7.

Sample reference	S-7	S-8
DSC peak position (degrees Celsius)	38.6	39.0
DSC peak position (degrees Celsius)	42.0	42.1

Table 7: DSC peak positions of obtained samples. Two peaks were identified for each sample.

As seen from table 7, two peaks were identified for each sample. A first peak at 38.6 – 39.0 degrees Celsius indicating the presence of lower melting StOSt triglyceride crystal polymorphic forms, such as form II, III, and IV, and a second peak at 42.0 – 42.1 degrees Celsius indicating the presence of higher melting StOSt triglyceride crystal polymorphic forms, such as form V and VI. In particular, an endotherm melt peak position around 42-44 degrees Celsius, such as for example around 43 degrees Celsius indicates the presence of StOSt form VI crystals.

Claims

1. Process for producing solid seed particles comprising an edible fat,
the process comprising the steps of
 - 5 (a) providing a flow of edible fat, the edible fat having an outset temperature (OT),
 - (b) in a crystallization zone (CZ) performing a crystallization at a decreased temperature (DT) in a crystallization period (CP) of 1-150 seconds,
 - (c) feeding an output from the crystallization zone (CZ) into a transformation
10 zone (TZ),
 - (d) in the transformation zone (TZ) performing a transformation of crystals produced in step (b) into higher melting crystal polymorphic forms at transformation temperature (TT) above said decreased temperature (DT) to obtain a transformed edible fat and
 - 15 (e) particulating said transformed edible fat into solid seed particles by at least cooling the edible fat processed according to step (d) to a temperature below which the edible fat solidifies.
2. The process according to claim 1, wherein said edible fat of the solid seed particles
20 comprises triglycerides obtained from vegetable sources.
3. The process according to claim 1 or 2, wherein said edible of the solid seed particles fat comprises triglycerides obtained from non-vegetable sources.
- 25 4. The process according to any of claims 1-3, wherein said triglycerides obtained from non-vegetable sources comprise triglycerides obtained from unicellular organisms.
- 30 5. The process according to claim 4, wherein said unicellular organisms is selected from the group consisting of bacteria, algae or fungi, wherein fungi comprise yeast and mold.

6. The process according to any of claims 1-5, wherein said triglycerides obtained from non-vegetable sources comprises triglycerides obtained by transesterification.
7. The process according to claim 6, wherein said triglycerides obtained by transesterification comprises triglycerides obtained from an edible fat and a saturated fatty acid source under the influence of enzymes having 1,3-specific transesterification activity.
8. The process according to claim 7, wherein said saturated fatty acid source comprises stearic acid or stearic acid esters, such as stearic acid methyl ester.
9. The process according to any of claims 1-8, wherein the edible fat used for transesterification comprises vegetable fat selected from the group consisting of shea, sunflower, rapeseed, sal, soy, safflower, palm, kokum, illipe, mango, mowra, cupuacu and any fraction and any combination thereof.
10. The process according to any of claims 1-9, wherein the edible fat used for transesterification comprises vegetable fat selected from the group of high oleic sunflower, high oleic safflower oil, high oleic rapeseed oil or any combination thereof.
11. The process according to any of claims 1-10, wherein the edible fat used for transesterification comprises or consists of shea olein or a shea olein fraction.
12. The process according to any of the claims 1-11, wherein said fat phase comprises oils with a melting point below 25 degrees Celsius in an amount of 1.0-42% by weight, such as 3.0-35% by weight, such as 3.5-27%, such as 5-20% by weight.
13. The process according to any of the claims 1-12, wherein said fat phase comprises oils selected from the group consisting of sunflower oil, high oleic sunflower oil, soybean oil, rape seed oil, high oleic rape seed oil, soy oil, olive oil, maize oil, peanut

oil, sesame oil, hazelnut oil, almond oil, corn oil, or fractions or mixtures or any combination thereof.

14. The process according to any of claims 1-13, wherein said edible fat of the solid
5 seed particles comprises triglycerides in an amount of 60.0 – 99.9% by weight of said seed edible fat, such as 80-99.9%, such as 90-99.9%, such as 95-99%.

15. The process according to any of claims 1-14, wherein said edible fat of the solid
10 seed particles comprises triglycerides having C18 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions of the triglyceride and oleic acid in the *sn*-2 position of the triglyceride being in an amount of 40 – 99 % by weight of said triglycerides, such as 50-99%, such as 70-99%, such as 80-99%.

16. The process according to any of claims 1-15, wherein the edible fat of the solid
15 seed particles has a weight-ratio between

- triglycerides having C18 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions and oleic acid in the *sn*-2 position of the triglyceride, and
- triglycerides having C16 – C24 saturated fatty acids in the *sn*-1 and *sn*-3 positions and oleic acid in the *sn*-2 position of the triglyceride,

20 which is between 0.40 – 0.99, such as 0.45 – 0.99, such as 0.50 – 0.99, such as 0.55 – 0.99, such as 0.60 – 0.99, such as 0.65 – 0.99, such as 0.70 – 0.99.

17. The process according to any of claims 1-16, wherein the edible fat of the solid
seed particles has a weight-ratio between

- 25 - triglycerides having C18 saturated fatty acids in the *sn*-1 and *sn*-3 positions and oleic acid in the *sn*-2 position of the triglyceride, and
- triglycerides having C16 – C18 saturated fatty acids in the *sn*-1 and *sn*-3 positions and oleic acid in the *sn*-2 position of the triglyceride,

which is between 0.40 – 0.99, such as 0.45 – 0.99, such as 0.50 – 0.99, such as 0.55 –
30 0.99, such as 0.60 – 0.99, such as 0.65 – 0.99, such as 0.70 – 0.99.

18. The process according to any of claims 1-17, wherein the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99% wherein St stand for stearic acid and O stands for oleic acid.

19. The process according to any of claims 1-18, wherein the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-90% by weight, such as 50-90%, such as 50-80% wherein St stand for stearic acid and O stands for oleic acid.

20. The process according to any of claims 1-19, wherein the outset temperature (OT) is a temperature where the edible fat is completely melted prior to entering the crystallization zone (CZ).

21. The process according to any of claims 1-20, wherein the outset temperature (OT) is at least 40 degrees Celsius.

22. The process according to any of claims 1-21, wherein the outset temperature (OT) is between 40-70 degrees Celsius, such as 40 to 65 degrees Celsius or such as 40 to 60 degrees Celsius.

23. The process according to any of claims 1-22, wherein the crystallization of step (b) is performed in a heat exchanger.

24. The process according to any of claims 1-22, wherein the crystallization of step (b) is performed in a scraped-surface heat exchanger.

25. The process according to any of claims 1-24, wherein the edible fat processed in step (d) is agitated during at least a part of said transformation period (TP).

26. The process according to any of claims 1-25, wherein the edible fat processed in step (d) is processed in a transformation period (TP), the transformation period (TP) being longer than the crystallization period (CP).
- 5 27. The process according to any of claims 1-26, wherein the transformation period (TP) is at least 1 hour, such as at least 3 hours, such as at least 12 hours, such as at least 24 hours, such as at least 36 hours.
28. The process according to any of claims 1-27, wherein the transformation
10 temperature (TT) is within a range of a minimum transformation temperature TTmin and maximum transformation temperature TTmax.
29. The process according to any of claims 1-28, wherein minimum transformation
15 temperature TTmin is selected to ensure that the edible fat processed can be agitated during at least a part of the transformation period.
30. The process according to any of claims 1-29, wherein minimum transformation temperature TTmin is selected to establish a pre-determined viscosity of the edible fat.
- 20 31. The process according to any of claims 1-30,, wherein the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid, and wherein the minimum transformation temperature TTmin is 39 degrees Celsius.
- 25 32. The process according to any of claims 1-31, wherein the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid, and wherein the maximum transformation temperature TTmax is 43 degrees
30 Celsius.

33. The process according to any of claims 1-32, wherein the edible fat of the solid seed particles comprises StOSt-triglycerides in an amount of 40-99% by weight, such as 60-99%, such as 70-99%, wherein St stand for stearic acid and O stands for oleic acid, and wherein the maximum transformation temperature TTmax is 41.5 degrees Celsius.

34. System for production of solid seed particles, the system comprising a crystallization zone (CZ), a transformation zone (TZ) and a particulation zone (PZ), wherein the system comprises pumps for transferring processed edible fat from the crystallization zone (CZ) into the transformation zone after a period of 1-150 seconds, the period is calculated from the time the edible fat is input into the crystallization zone (CZ).

35. System according to claim 34, wherein the pumps are automatically controlled by a control unit.

36. System according to claim 34 or 35, wherein the system is operated according to any of the claims 1- 33.

37. Chocolate product comprising the solid seed particles manufactured according to the process of any of the claims 1-33.

38. Use of the solid seed particles manufactured according to the process of any of claims 1-33 for production of chocolate products.

39. The use according to claim 38, wherein said solid seed particles is used as a seed.

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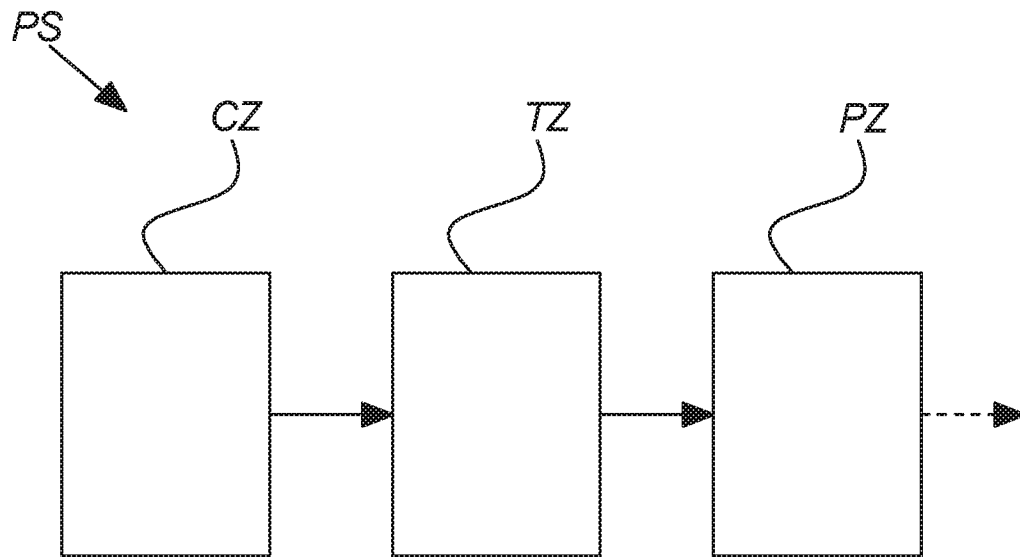


Fig. 1a

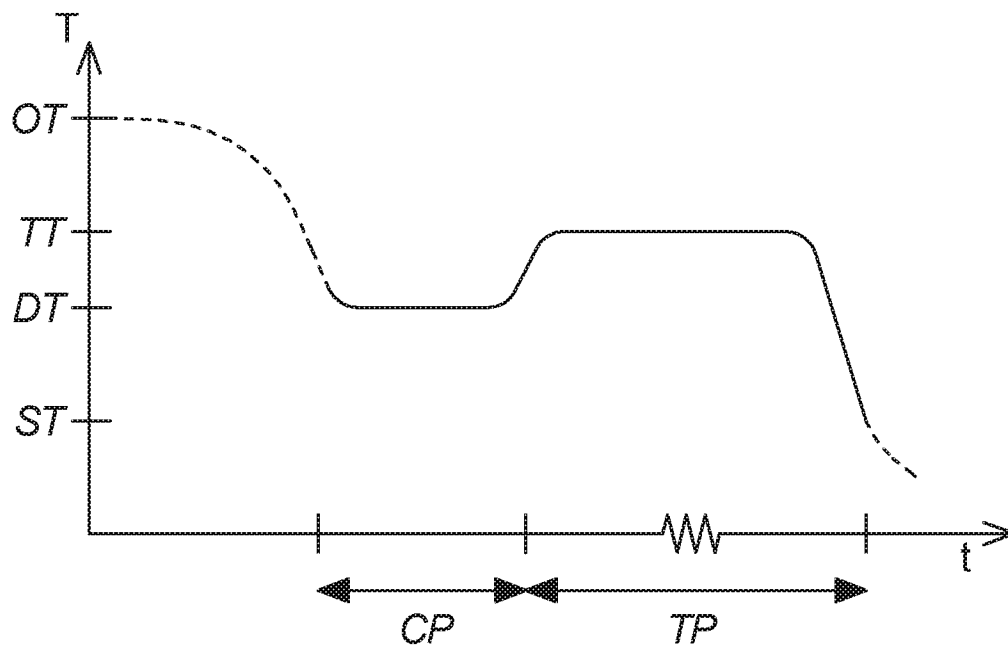


Fig. 1b

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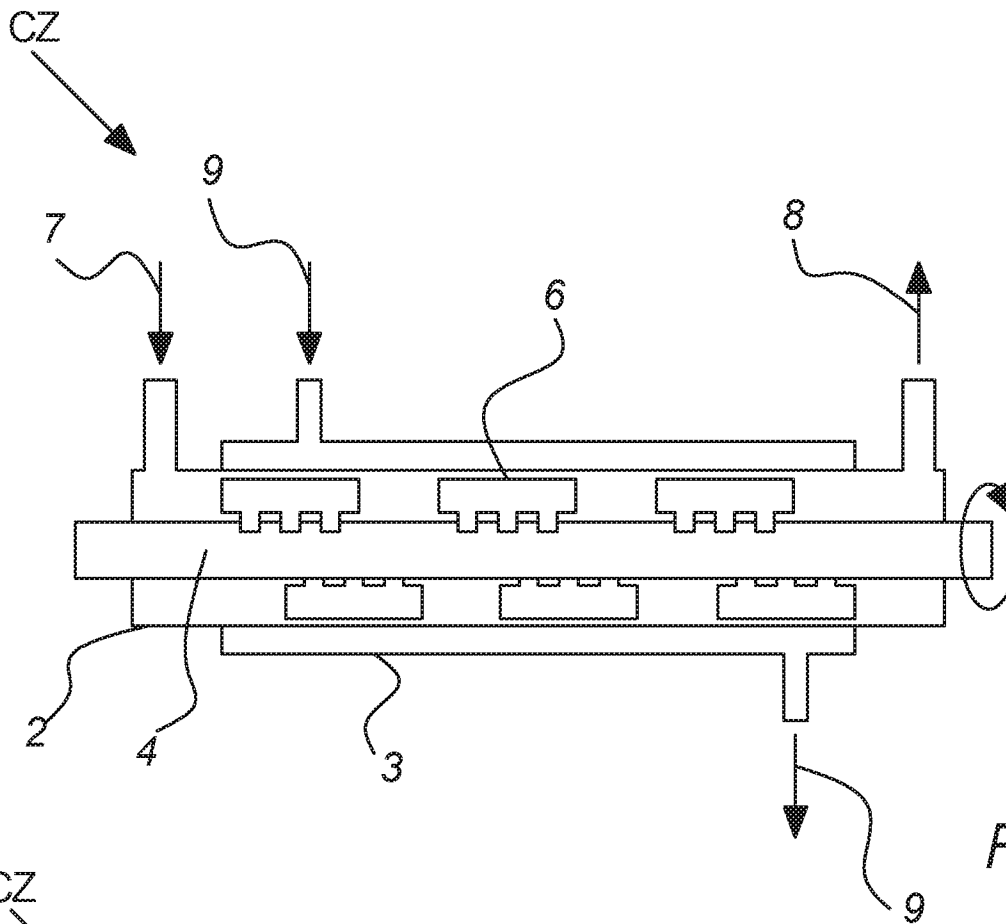


Fig. 2a

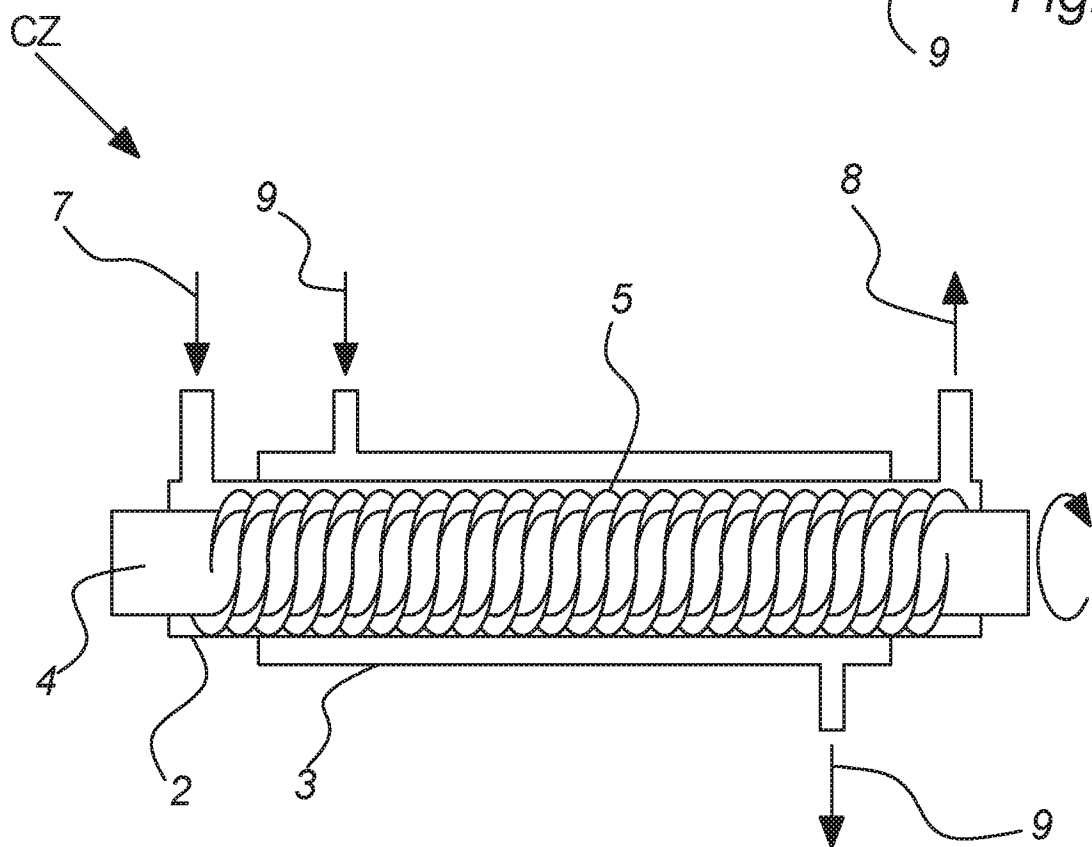
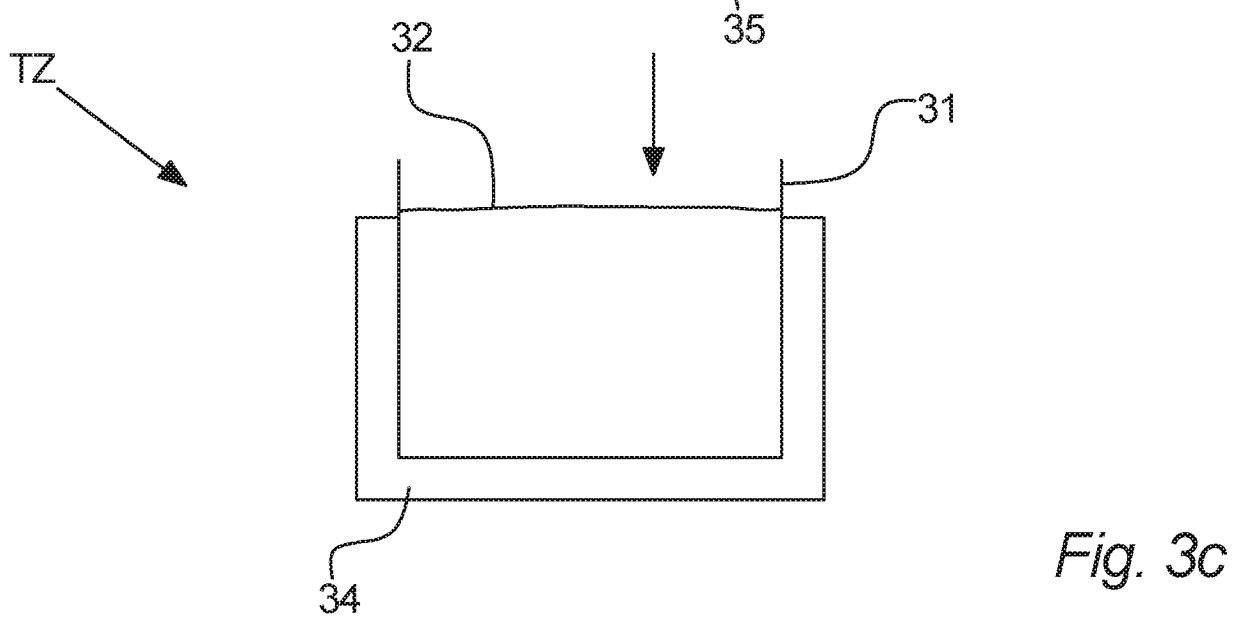
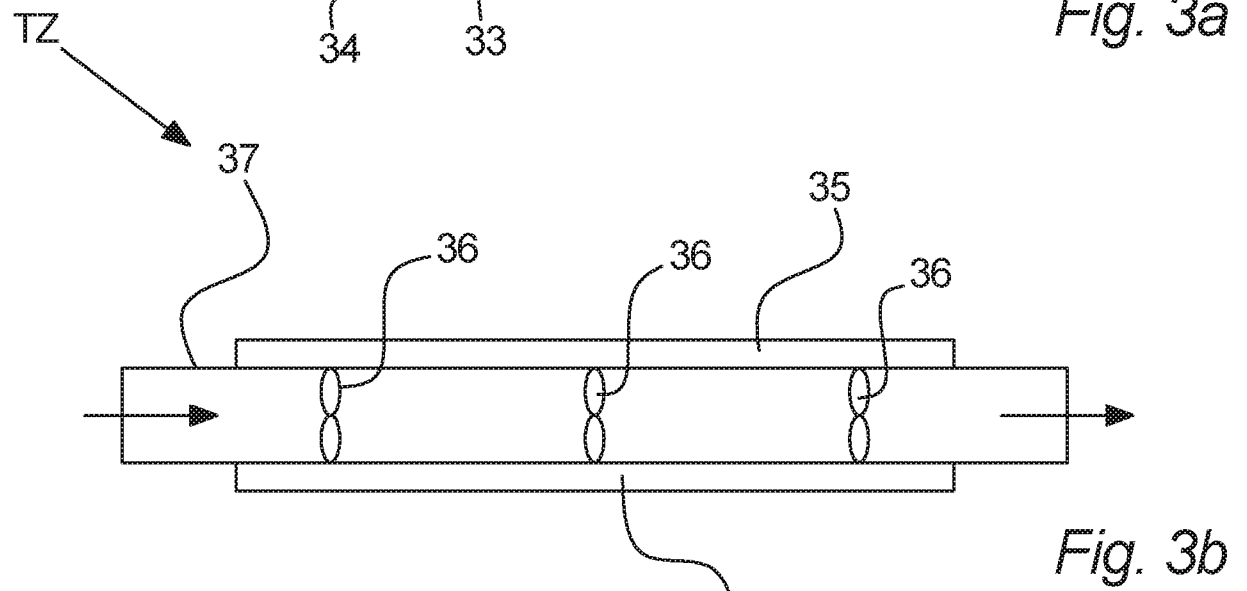
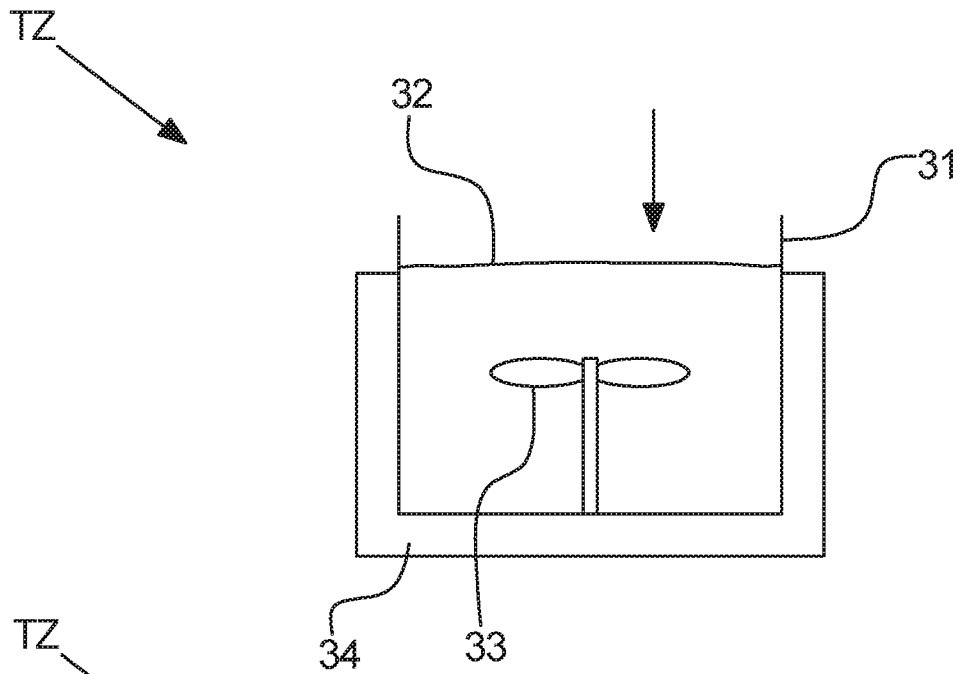


Fig. 2b

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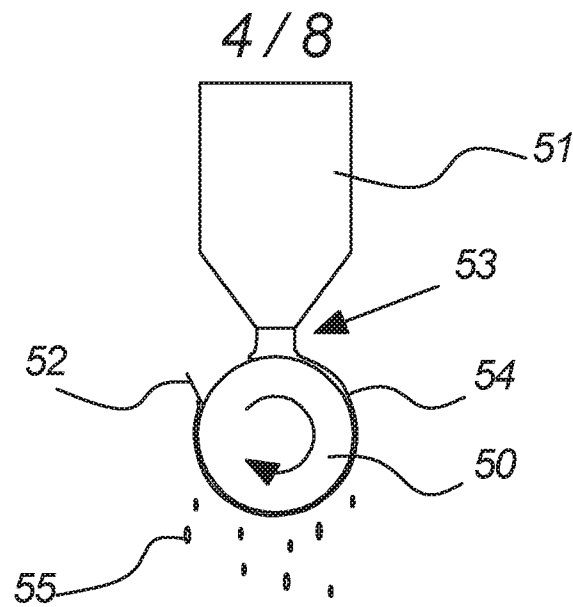


Fig. 4a

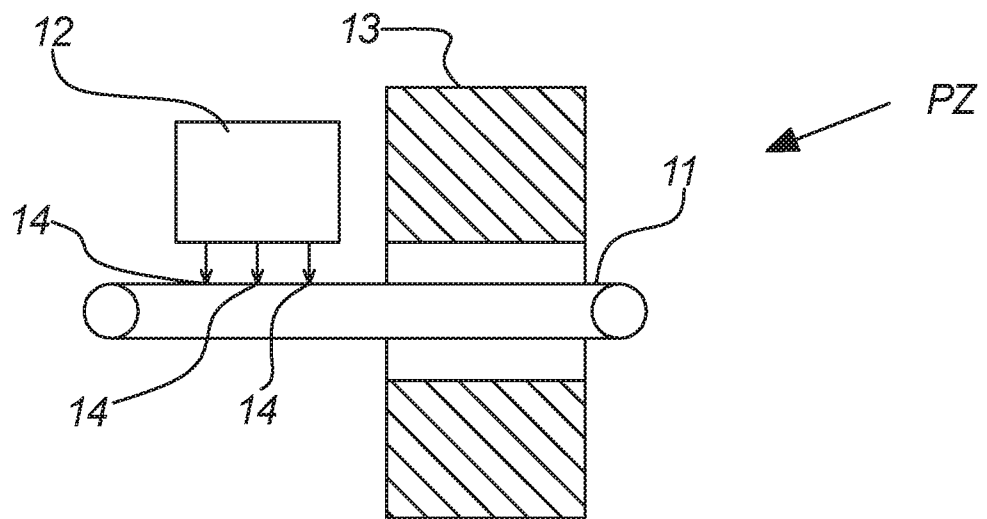


Fig. 4b

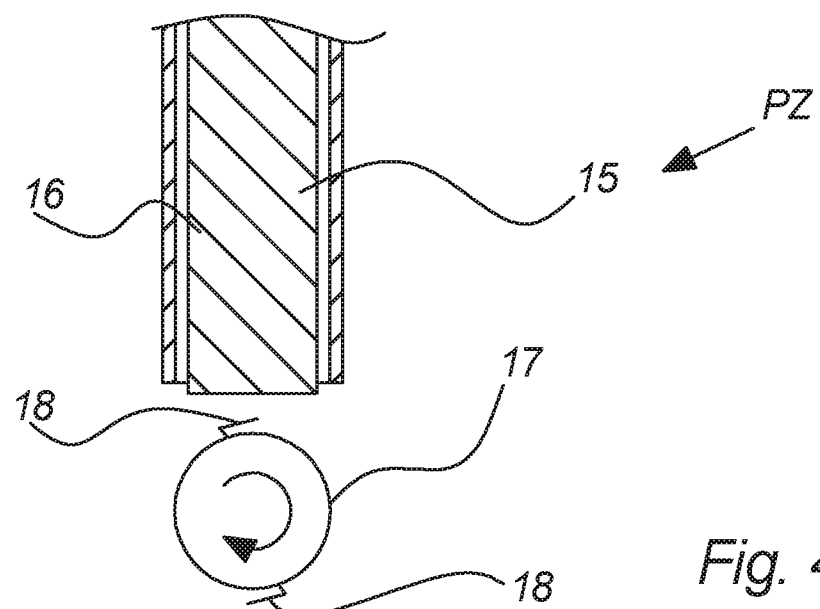


Fig. 4c

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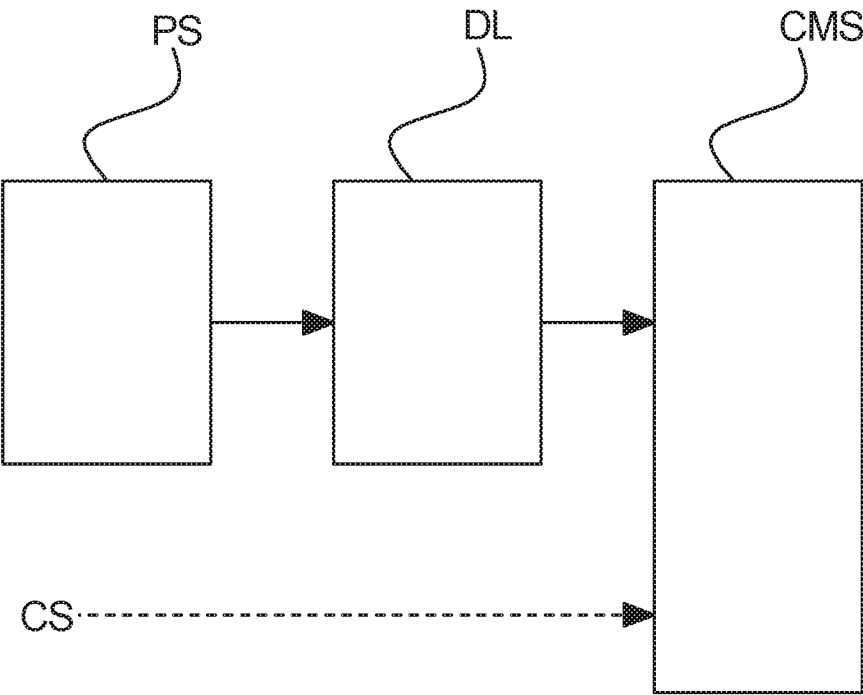


Fig. 5

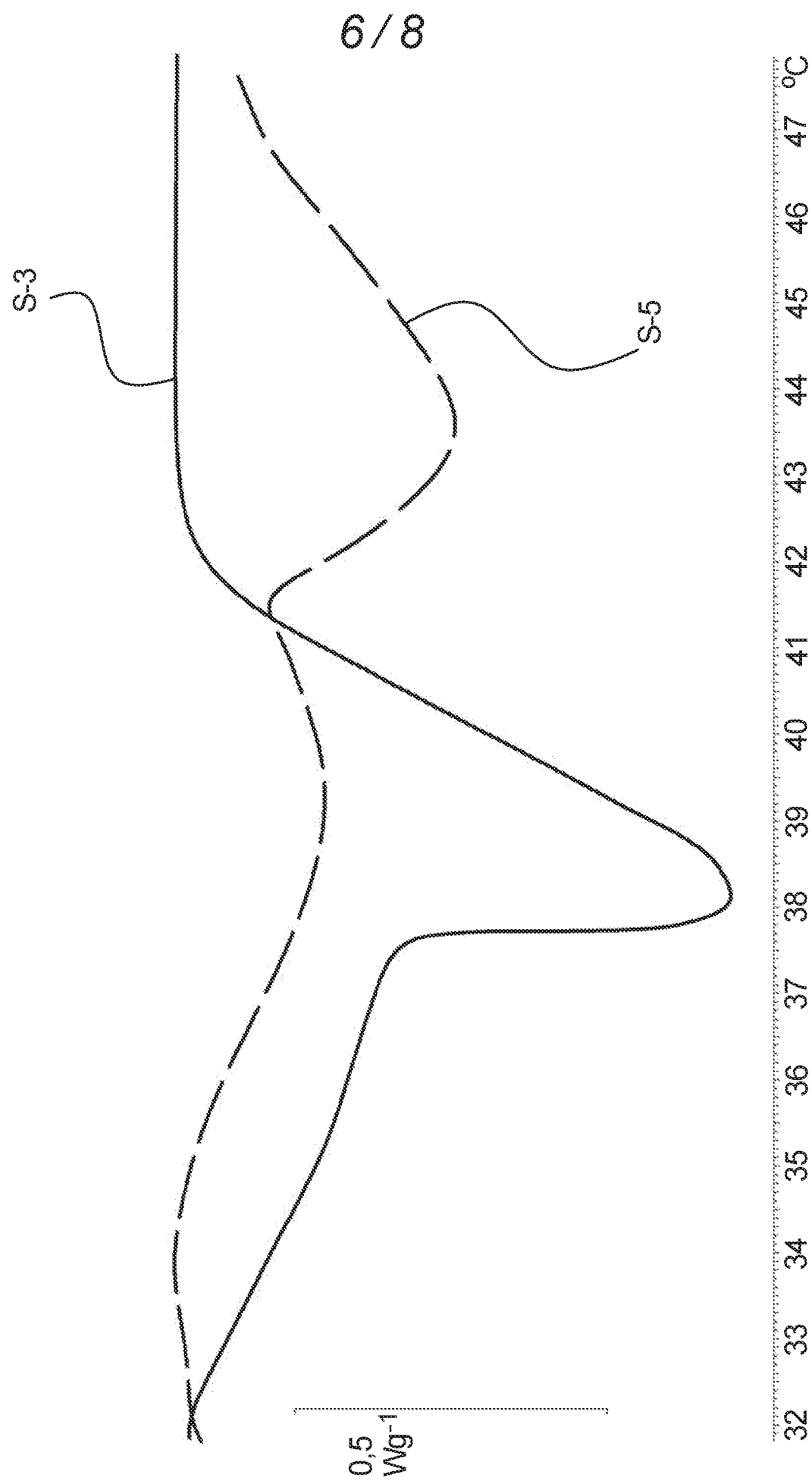


Fig. 6

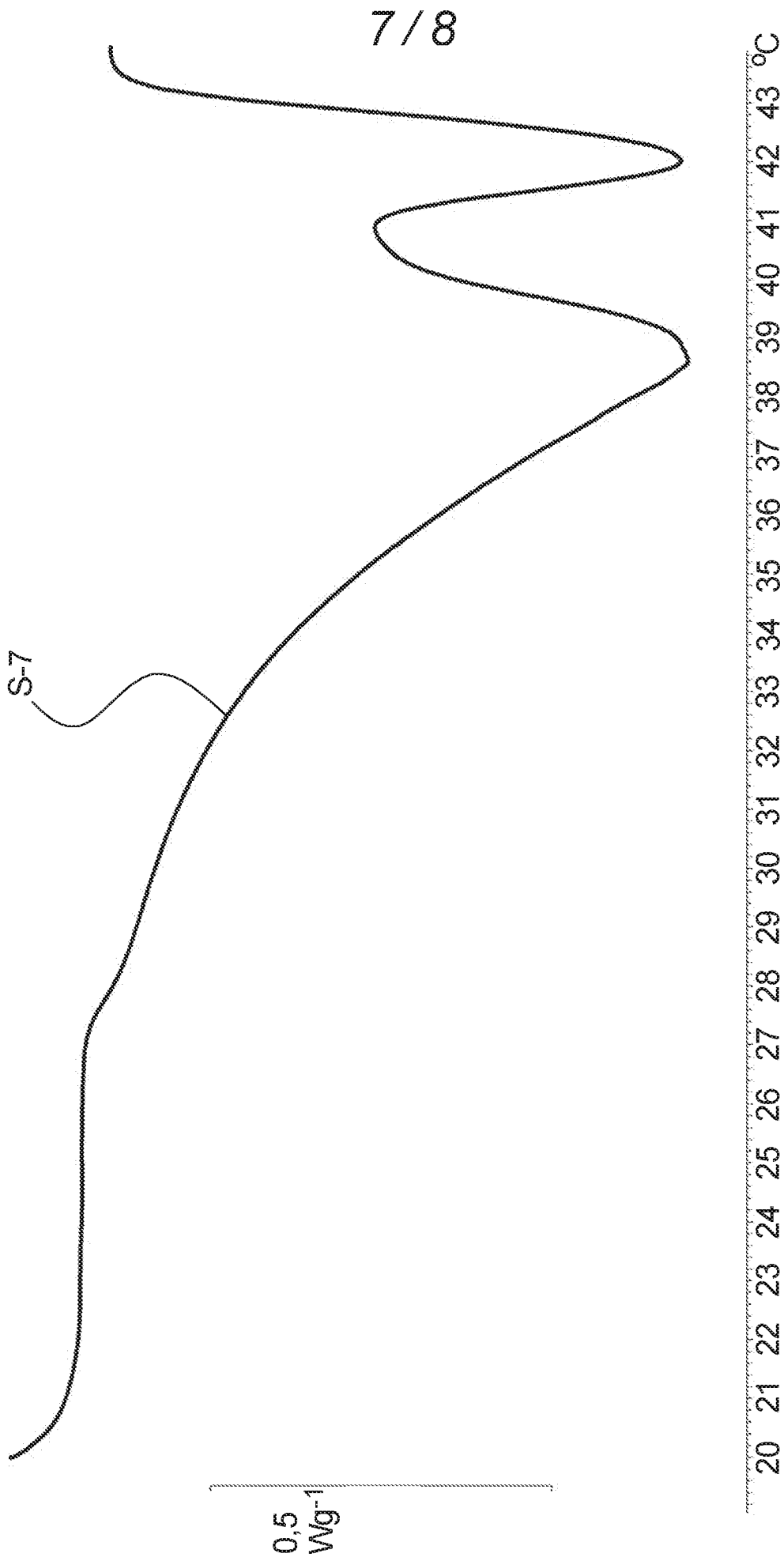


Fig. 7

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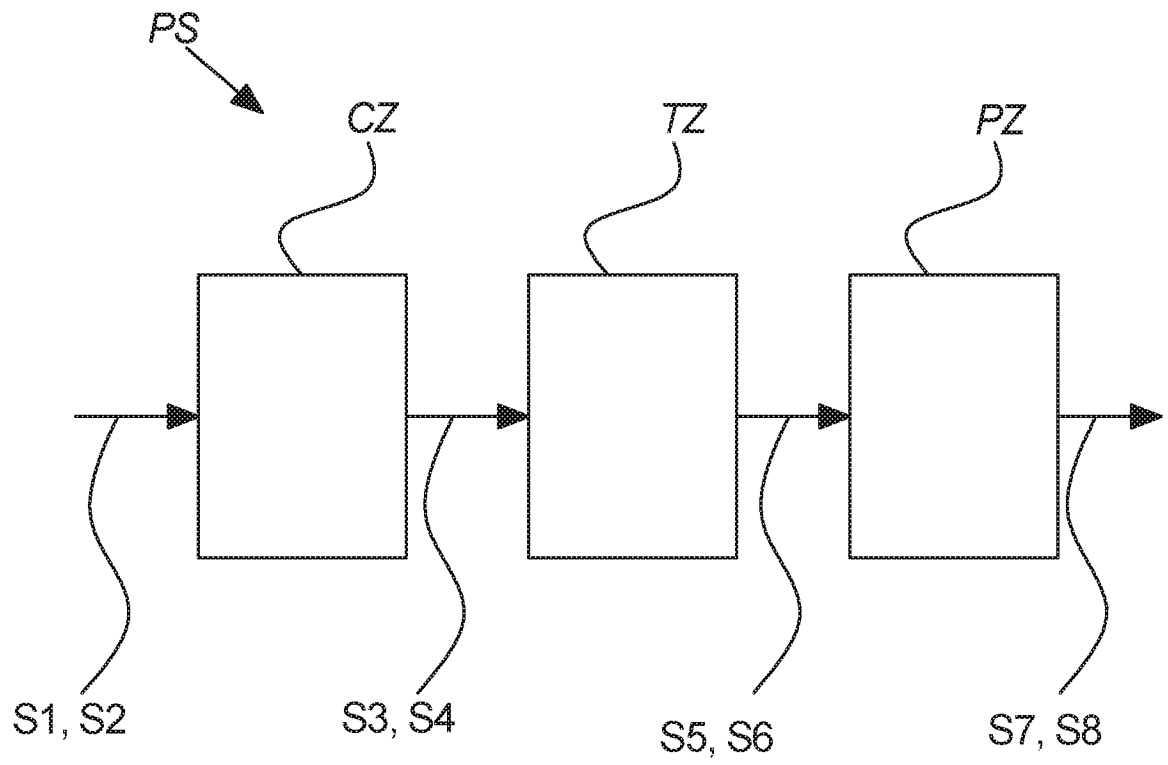


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050553

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A23D, A23G, C11B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data, BIOSIS, CHEM ABS Data, COMPENDEX, EMBASE, INSPEC, MEDLINE, PUBCHEM, IBM-TDB

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	US 3892880 A1 (GROLITSCH ERHARD), 1 July 1975 (1975-07-01); column 1, line 17 - column 1, line 26; column 3, line 13 - column 3, line 18; column 3, line 22 - column 3, line 25; column 3, line 30 - column 3, line 41; figure 1 --	1-36

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

22-08-2016

Date of mailing of the international search report

30-08-2016

Name and mailing address of the ISA/SE

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2016/050553

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	US 20060141110 A1 (FAGES JACQUES ET AL), 29 June 2006 (2006-06-29); column 1, paragraph [0003] --	1-36
A	US 20110159159 A1 (FICHTL PETER ET AL), 30 June 2011 (2011-06-30); column 1, paragraph [0001] --	1-36
A	US 6894178 B1 (WINDHAB ERICH ET AL), 17 May 2005 (2005-05-17); whole document -- -----	1-36

Continuation of: second sheet**International Patent Classification (IPC)****A23D 9/02** (2006.01)**A23G 1/36** (2006.01)**C11B 15/00** (2006.01)

INTERNATIONAL SEARCH REPORT

Information on patent family members

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PCT/SE2016/050553

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