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Benævnelse: Indretning og fremgangsmåde til fremstilling af en spunbonded stof-bane af filamenter

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DESCRIPTION

The invention relates to a device for producing a spunbonded nonwoven web from filaments comprising a spinneret, cooling chamber, stretching unit and a depositing device for depositing the filaments for the spunbonded nonwoven web. The invention furthermore relates to a method for producing a spunbonded nonwoven web from filaments. It lies within the framework of the invention that a spunbonded nonwoven web is manufactured by the so-called spunbond method by means of the device according to the invention or the method according to the invention. The filaments preferably consist of a thermoplastic material, preferably of polypropylene, and particularly preferably of a specially modified polypropylene. Incidentally, filaments means continuous fibres or continuous filaments, which differ considerably from the much shorter staple fibres.

Devices and methods of the aforementioned type are known in various embodiments from practice or from the prior art. Reference can be made, for example, to EP 1 340 843 A1. In many known devices or methods, the strength of the spunbonded nonwoven web produced is poor, and especially the transverse strength of the spunbonded nonwoven web transversely to the direction of the machine or transversely to the transport direction. Another problem is the diameter inhomogeneities on the deposited filaments. These involve small plastic assemblies that negatively affect the homogeneity of the spunbonded nonwoven web. Furthermore, it is frequently difficult to produce filaments with high fineness or with low titres within the framework of the known measures.

In view of this, the invention is based on the technical object of providing a device of the aforementioned type with which the previously described disadvantages can be avoided in an effective and functionally safe manner.
Further, the invention is based on the technical object of providing a corresponding method for producing a spunbonded nonwoven web.

To solve the technical problem, the invention teaches a device for the continuous production of a spunbonded nonwoven web of filaments comprising spinneret, a cooling chamber into which the process air can be introduced for cooling the filaments, a monomer extraction device arranged between the spinneret and cooling chamber, a stretching unit and a deposition device for depositing the filaments for the spunbonded nonwoven web, where the cooling chamber is divided into two cooling chamber sections, where process air from a first upper cooling chamber section can be aspirated at a volume flow $V_M$ to a monomer extraction device, where process air from the first upper cooling chamber section emerges at a volume flow $V_1$ into a second lower cooling chamber section and where the volume flow ratio $V_M/V_1$ is 0.1 to 0.35, preferably 0.12 to 0.25. Particularly preferred is a volume flow ratio $V_M/V_1$ of 0.15 to 0.2. Expediently, the volume flow rate is measured in m³/s. Incidentally, the expression process air particularly describes cooling air for cooling the filaments. Preferably, the filaments are stretched aerodynamically using the stretching unit.

It lies within the framework of the invention that the filaments are manufactured from a thermoplastic material. It is recommended that the thermoplastic material is a polypropylene or a specially modified polypropylene (further explained below). A quite particularly preferred embodiment of the invention is characterized in that the filaments are produced as mono-component filaments.

In principle however, bi-component filaments or multi-component filaments could also be produced with the device according to the invention.
The cooling chamber is expediently arranged at a distance from the spinneret or from the nozzle plate of the spinneret. As set out further below, the distance between the spinneret or the nozzle plate and the cooling chamber is adjustable according to a particularly preferred embodiment of the invention. According to the invention, a monomer extraction device is arranged between the spinneret and the cooling chamber. The monomer extraction device extracts air out from the filament formation space directly below the spinneret or the nozzle plate, whereby it is achieved that the gases escaping along with the polymer filaments, such as monomers, oligomers, decomposition products and the like can be removed from the system. Expediently, the monomer extraction device has an extraction chamber to which preferably at least one extraction fan is connected. It is recommended that the extraction chamber has at least one extraction slot towards the filament formation space. The aforementioned gases or air are preferably extracted from the filament formation space through this at least one extraction slot. The invention is based on the finding that process air is also extracted from the first upper cooling chamber section with the monomer extraction device, namely with a volume flow \( V_A \). The invention is further based on the finding that a spunbonded nonwoven web can be produced with particularly advantageous properties if the volume flow ratio \( V_A/V_I \) is adjusted as claimed or as described. The advantages achieved are particularly clearly defined if the special polypropylene explained further below is used for producing the filaments or for manufacturing the spunbonded nonwoven web according to a highly recommended embodiment of the invention.

It lies within the framework of the invention that an air supply cabin is arranged next to the cooling chamber, which air supply cabin is divided into at least two cabin
sections, where process air can be introduced from a first upper cabin section into the first upper cooling chamber section and where process air can be introduced from a second lower cabin section into the second lower cooling chamber section. It is also within the framework of the invention that process air is introduced into the first upper cooling chamber section, on the one hand, and is introduced into the second lower cooling chamber section on the other hand at different volume flows. At least two cooling chamber sections arranged vertically above one another are expediently provided below the spinneret in which the filaments are subjected to process air. Preferably, only two cooling chamber sections are arranged vertically above one another. After emerging from the spinning nozzle openings of the spinneret, the filaments are initially guided past the monomer extraction device and then first pass through the first upper cooling chamber section and then through the second lower cooling chamber section.

A recommended embodiment of the invention is characterized in that process air with a volume flow $V_2$ emerges from the second lower cooling chamber section and that the volume flow ratio of the volume flow $V_1$ emerging from the first upper cooling chamber section to the volume flow $V_2$ emerging from the second lower cooling chamber section $(V_1/V_2)$ is 0 to 0.5, preferably 0.05 to 0.5 and particularly preferably 0.1 to 0.45. It is within the scope of the invention that the filaments emerging from the second lower cooling chamber section or process air emerging from the second lower cooling chamber section are introduced into the stretching unit. A preferred embodiment of the invention is characterized in that process air emerges from the first upper cooling chamber section at a speed $v_1$ into the second lower cooling chamber section, that process air emerges from the second lower cooling chamber section exits at a speed $v_2$ and that the speed
ratio \( \frac{v_1}{v_2} \) is 0.2 to 0.5, preferably 0.25 to 0.5 and is preferably 0.3 to 0.5. According to a proven embodiment, the speed ratio is \( \frac{v_1}{v_2} \) 0.35 to 0.45 and in particular, for example, 0.4.

It lies within the framework of the invention that an intermediate channel is arranged between the cooling chamber and the stretching unit, which intermediate channel converges in a wedge shape from the exit of the cooling chamber to the entrance into a drawing-down channel of the stretching unit in a vertical section. The intermediate channel expediently converges in a wedge shape to the entrance of the drawing-down channel in the vertical section onto the inlet width of the drawing-down channel.

According to a well-proven embodiment of the invention, no air supply from outside is provided in the area of the cooling chamber and in the transition region between the cooling chamber and the stretching unit, apart from the supply of process air in the cooling chamber. In this regard, it is within the scope of the invention to work with a so-called closed system. Preferably in the area of the cooling chamber, in the area of the intermediate channel and in the area of the stretching unit no air supply from outside is provided, except for the supply of the process air in the cooling chamber.

It is recommended that at least one diffuser is arranged between the stretching unit and the depositing device. Expediently such a diffuser has a diverging portion oriented towards the depositing device or a portion with diverging sidewalls. This facilitates a functionally reliable deposition of the filaments to a random web. Incidentally, the depositing device preferably comprises an endlessly revolving foraminous deposition belt. The filaments are deposited on this foraminous deposition belt for the spunbonded nonwoven web and this web is then
expediently compacted and/or solidified. The solidification can in particular take place in a calender.

A particularly preferred embodiment of the invention is characterized in that the nozzle holes of the spinneret are arranged distributed homogeneously throughout or over the entire nozzle plate. It is within the framework of the invention in this case that the distances of the nozzle holes in the centre of the spinneret are the same as in the outer areas of the spinneret. It is recommended that all nozzle holes arranged on a straight line or on an imaginary straight line have equal distances from one another. Such a symmetrical distribution of the nozzle holes has proved particularly successful for the solution of the technical problem of the invention. As already mentioned above, the distance of the spinneret or the distance of the nozzle plate to the cooling chamber can be adjusted or varied according to the recommended embodiment of the invention. For this, the vertical height of the spinneret is expediently adjustable.

For the solution of the technical problem, the invention also teaches a method for the continuous production of a spunbonded nonwoven web of filaments of thermoplastic material, wherein the filaments are spun by means of a spinneret and are introduced into a cooling chamber past a monomer extraction device, where the filaments in the cooling chamber are cooled with process air, where the cooling chamber is divided into two cooling chamber sections, where process air is aspirated from a first upper cooling chamber section with a volume flow $V_M$ to the monomer extraction device, where process air is introduced from the first upper cooling chamber section with a volume flow $V_1$ into a second lower cooling chamber section, where the volume flow ratio $V_M/V_1$ is 0.1 to 0.3, preferably 0.12 to 0.25, where the filaments after emerging from the cooling chamber are introduced into a stretching unit and
where the filaments are then deposited on a depositing device for the spunbonded nonwoven web.

As already set out above, a polypropylene is preferably used as a thermoplastic material. Thus, the filaments produced according to the invention consist of polypropylene or substantially of polypropylene. Expediently, the polypropylene is a homopolymer or a copolymer. Preferably, the polypropylene has a melt flow rate (MFR) of, for example, 10 dg/min to 40 dg/min, preferably from 10 dg/min to 25 dg/min and particularly preferably from 10 dg/min to 21.5 dg/min. It is within the framework of the invention that the melt flow rate is measured according to the ASTM D1238 (2.16 kg, 230°C) standard. The MFR is specified in grams (g) of polymer per 10 minutes (min) or the equivalent in decigrams (dg) of polymer per minute (min).

It is recommended that a quotient $R_2$ of the dimensionless stress ratio (Stress Ratio, SR) to the loss tangent (Loss Tangent, $\tan \delta$) is preferably between 0.6 and 30, preferably between 1.5 and 30 and particularly preferably between 1.5 and 28. $R_2$ is preferably the quotient of the term ($SR \ (500 \ s^{-1}) \ \eta_0 \cdot 1/248$ and the term ($\tan \delta(0.1 \ rad/s)$).

Expediently, the value $R_2$ is implemented by examining the small amplitude oscillatory shear (SAOS) at 190°C, wherein a 25 mm cone with an angle of one degree is used on a plate configuration of a rheometer (e.g. MCR 301 of Anton Paar GmbH). The test disks within the framework of the invention have a diameter of 25 mm and a thickness of 1 mm and are preferably obtainable by pressing a pellet sample at 190°C for one minute without pressure and then for 1.5 minutes under a pressure of preferably 50 bar and then cooled for 5 minutes between water-cooled plates. By storing at 190°C for 13 minutes, thermal and/or crystalline information is
deleted in the sample. Preferably, an angular velocity range or an angular frequency range of 500 rad/s to 0.0232 rad/s with 6 measurement points per 10 rad and a stress value of 10% is passed through, which stress value lies in the linear viscoelasticity region, which viscoelasticity region can be determined by a stress test. All experiments are carried out within the framework of the invention in a nitrogen atmosphere to avoid decomposition of the sample during measurement.

It is within the framework of the invention that a zero shear rate ($\eta_0$) is defined by a frequency-dependent memory fraction ($G'$), a frequency-dependent loss fraction ($G''$) and a discrete relaxation spectrum method, which method is based on a linear regression:

$$\eta_0 = \sum_{j=1}^{M} \lambda_j G_j$$

where $M$ is the number of discrete relaxation values, which depends on the value range of the experimental angular velocities or angular frequencies. $\lambda_j$ is the discrete relaxation time of the discrete spectrum and $G_j$ is the corresponding shear module.

In the case of compositions in which the terminal zone (i.e., $G'$ is proportional to the square of the angular velocity $\omega^2$ and $G''$ is proportional to the angular velocity) has not yet been reached in the frequency range of the experiment, so that the complex viscosity $|\eta'|$ has not yet achieved a plateau value, $\eta_0$ should be determined by means of a melting creep experiment. From a quotient of the loss fraction $G''$ and the memory fraction $G'$, the loss tangent (Loss Tangent, tan $\delta$) can be calculated according to the following formula:
\[ \tan \delta = \frac{G''}{G'} \]

The loss tangent is a measure of the melt elasticity and relates to the molecular properties of the composition (e.g. the chain length distribution, the density of the molecular entanglement, etc.). Within the framework of the invention, the first normal stress difference \( N_1 \) at a permanent shear with a constant shear rate \( \gamma \) is a function of the dynamic moduli \( G' \) and \( G'' \) according to the formula:

\[ N_1(\gamma) = 2G' \left[ 1 + \left( \frac{G'}{G''} \right)^2 \right]^{0.7} \quad \text{for } \omega = \gamma \]

\( G' \) and \( G'' \) both refer to the angular frequency \( \omega \), where the temperature for the small-amplitude oscillatory shear (SAOS) and the experiments at stable or constant shear is the same. The equilibrium sheer stress \( (T_{xy}) \) is calculated from the complex viscosity \( |\eta^*| \) using the following formula:

\[ \tau_{xy}(\gamma) = \omega |\eta^*(\omega)| \quad \text{for } \omega = \gamma \]

The normalized complex viscosity is given according to the following equations by the memory fraction and the loss fraction as a function of the frequency \( \omega \):

\[ |\eta^*(\omega)| = \frac{(G'^2 + G''^2)^{1/2}}{\omega} \]

The stress ratio (SR) is defined as:
\[ SR(\dot{\gamma}) = \frac{N_1(\dot{\gamma})}{\tau_{xy}(\dot{\gamma})} \]

The dimensionless index \( R_2 \) is obtained from a quotient of the stress ratio and the loss tangent according to the following formula:

\[ R_2 = \frac{SR(500 \text{s}^{-1}) \eta_0}{\tan S(0.1 \text{rad/s})} \cdot \frac{1}{248} \]

where \( \eta_0 \) has the unit of Pascal seconds (Pa.s).

It is recommended that the polypropylene preferably has an onset temperature \( (T_{\text{c,rheol}}) \) when flowing of at least 120°C, preferably of at least 123°C and particularly preferably of at least 131°C. The onset temperature is preferably determined by means of crystallization by SAOS (Small Amplitude Oscillatory Shear) rheology. Expediently the sample is cooled from the molten state at preferably 190°C at a predetermined cooling rate. Within the framework of the invention, the sample is melted in the form of test disks with a diameter of 25 mm and a thickness of 2.5 mm without pressure and then formed under pressure for 3 minutes. The originally 2.5 mm thick test disks are then inserted into a 1.9 mm wide gap between two parallel plates. Preferably, thermal expansions of the tool will be considered when carrying out the measurements so that a constant gap distance is ensured throughout the entire experiment. Expediently, the test disks are initially heated to a temperature of 190°C and temperature-controlled for 15 minutes at 190°C in order to eliminate thermal and crystalline structural idiosyncrasies. Then, as part of the invention, starting from the starting temperature of 190°C,
the test disks are loaded with an expansion of 1% at a constant cooling rate of preferably 1°C/min and an angular velocity of one rad/sec, which is an expansion within the range of the linear viscoelasticity. A maximum torque criterion is used to end the experiment. At the beginning of the crystallization process during the rheology test, the measurement instrument goes over into an overloading state when the maximum torque is reached in such a way that the test is automatically interrupted. The crystallization is observed through a sudden increase in the complex viscosity and a sudden drop in the loss tangents, i.e. plotting the complex viscosity against the temperature and the loss tangent against the temperature exhibits a region with a sudden change of rheological properties, which rheological properties are caused by the occurrence of crystallization. The onset temperature or onset crystallization temperature ($T_{o,rheol}$) is defined as the temperature at which a steep increase in the complex viscosity and a simultaneous drop in the loss tangent can be detected.

Expediently, the polypropylene has an average, isotactic sequence length of at least 65, preferably at least 85, and preferably at least 97. The average isotactic sequence length (Average Meso Run Length, MRL) is defined by the formula $\text{MRL} = 10,000 \cdot D_{\text{total}}$. Here, $D_{\text{total}}$ is the sum of the number of stereodefects ($D_s$) per 10,000 monomer units of the polymer and the number of regiodefects ($D_r$) per 10,000 monomers of the polymer. Expediently, a tacticity of the polypropylene is determined in order to determine the average isotactic sequence length using $^{13}$C MCR, for example in 1,1,2,2, tetrachlorethane-D2 at a temperature of 140°C.

It lies within the framework of the invention that the filaments are generated as monocomponent filaments. Monocomponent filaments have been proven quite particularly
successful with regard to the solution of the technical problem according to the invention. It lies further within the framework of the invention that the filaments are stretched under the condition that filaments with a filament diameter from 0.3 to 2 den, preferably from 0.3 to 0.9 den are obtained. Expediently, the filament diameter of the filaments produced according to the invention is less than 1 den and particularly preferably significantly less than 1 den. The filament diameter is measured at the filaments deposited for the spunbonded nonwoven web.

The invention is based on the finding that spunbonded nonwovens having optimal homogeneity can be produced using the device according to the invention and the method according to the invention. Perturbing inhomogeneities such as diameter inhomogeneities at the filaments or the like can be avoided using the measures according to the invention. It should also be stressed that spunbonded nonwoven webs having exceptional strength, and in particular having exceptional strength in the transverse direction or transverse to the transport direction can be produced using the device according to the invention or using the method according to the invention. In addition, filaments having surprisingly low titres can be produced within the framework of the measures according to the invention by setting appropriate stretching conditions. Overall the device according to the invention or the method according to the invention are characterized by low cost and low effort. The previously explained advantages are, surprisingly, particularly well-defined when specially modified polypropylene is used to produce the spunbonded nonwoven.

The invention is explained in greater detail hereinafter with reference to a drawing illustrating only one exemplary embodiment. It shows the following in schematic depiction:
Fig. 1 shows a vertical section through the device according to the invention and

Fig. 2 shows an enlarged section A from the subject matter of Fig. 1.

The figures show a device for the continuous production of a spunbonded nonwoven web from filaments of thermoplastic material. The device comprises firstly a spinneret 1 with a nozzle plate 2 and nozzle holes disposed therein for spinning the filaments, that are not shown. The spun filaments are then run past a monomer extraction device 3 located below the spinneret 1. This monomer extraction device 3 is used to remove perturbing gases which occur during the spinning process, from the system. The monomer extraction device 3 comprises an extraction chamber 4 as well as an extraction fan 5 connected to the extraction chamber 4. An extraction slot 6 for extracting the gases is provided in the lower region of the extraction chamber 4. Expediently and in the exemplary embodiment, the extraction chamber 4 is located both to the right and left of the filament formation space. The left half of the extraction chamber 4 is also connected to the extraction fan 5.

A cooling chamber 7 into which process air for cooling the filaments can be introduced is disposed below the spinneret 1 and below the monomer extraction device 3. Preferably and in the exemplary embodiment, the cooling chamber 7 is divided into a first, upper cooling chamber section 7a and a second, lower cooling chamber section 7b. Expediently and in the exemplary embodiment according to the figures, an air supply cabin 8 is disposed next to the cooling chamber 7 that is recommendably and in the exemplary embodiment divided into an upper cabin section 8a and a lower cabin section 8b. Preferably and in the exemplary embodiment, process air having various volume flows can be supplied from the two cabin sections 8a and 8b. Expediently and in
the exemplary embodiment, a blower 9a and 9b for supplying process air is connected to the cabin sections 8a and 8b. It lies within the framework of the invention that the supplied volume flows of process air can be controlled. It lies further within the framework of the invention that the cabin sections 8a, 8b are disposed both to the right and left of the cooling chamber 7. The left halves of cabin sections 8a, 8b are also connected to the corresponding blowers 9a and 9b.

The invention is based on the finding that process air can be extracted or is extracted from the first, upper cooling chamber section 7a and specifically with a volume flow \( V_M \) via the monomer extraction device 3 disposed above the cooling chamber 7. The process air leaves the first, upper cooling chamber section 7a in the direction of the second cooling chamber section 7b with a volume flow \( V_1 \). According to the invention, the volume flow ratio \( V_M/V_1 \) is 0.1 to 0.3 and preferably 0.12 to 0.25. The process air leaves the second, lower cooling chamber section 7b with a volume flow \( V_2 \). The volume flow ratio \( V_1/V_2 \) is preferably 0.1 to 0.5.

It can be seen in Fig. 1 that preferably and in the exemplary embodiment, an intermediate channel 10 is connected to the cooling chamber 7. This intermediate channel 10 extends as far as the under-pulling channel 11 of the stretching unit 12. Expediently and in the exemplary embodiment according to Fig. 1, the intermediate channel 10 in a vertical section converges in a wedge-shaped manner from the outlet of cooling chamber 7 to the inlet of the under-pulling channel 11, and preferably and in the exemplary embodiment, to the entry width of the under-pulling channel 11. Preferably and in the exemplary embodiment, a laying unit 13 is disposed below the stretching unit 12. In the exemplary embodiment, this laying unit 13 has two diffusers 14, 15. It can be seen that each of these diffusers 14, 15 has a diverging shape
or is configured with diverging side walls in the lower area. Preferably and as shown in the exemplary embodiment, a continuously moving foraminous deposition belt 16 for depositing the filaments and/or the spunbonded nonwoven web is provided below the laying unit 13.

It can be seen in Fig. 1 that apart from the supply of process air to the cooling chamber 7, it is recommended that no air supply takes place in the area of the cooling chamber 7 as well as the intermediate channel 10 and the laying unit 13. Thus operation takes place with a so-called closed system. It is further indicated in Fig. 1 that the distance between the spinneret 1 or between the nozzle plate 2 and the cooling chamber 7 can be set or varied according to a recommended embodiment. Expediently and in the exemplary embodiment, the vertical height of the spinneret 1 can be adjusted.
**Patentkrav**

1. Indretning til fremstilling af en spunbonded stof-bane af filamenter, med en spindeindretning (1), et kølekanter (7), til hvilket der kan tilføres procesluft til afkøling af filamenterne, en monomerudsugningsindretning (3), der er anbragt mellem spindeindretningen (1) og kølekanteret (7), en strækningsenhed (12) og en aflægningsindretning til aflægning af filamenterne til spundbonded stof-bane, hvor kølekanteret (7) er opdelt i to kølekantermængder (7a, 7b), hvor der kan suges procesluft ud af et første øvre kølekantermængder (7a) med en volumenstrøm \( V_M \) til monomerudsugningsindretningen (3), hvor procesluft strømmer ud af det første øvre kølekantermængder (7a) med en volumenstrøm \( V_1 \) til et andet nedre kølekantermængder (7b), og hvor volumenstrømforskydningen \( V_M/V_1 \) er 0,1 til 0,35, fortrinsvis 0,12 til 0,25.

2. Indretning ifølge krav 1, hvor der ved siden af kølekanteret (7) er anbragt en lufttilførselskabine (8), der er opdelt i mindst to kabineafsnit (8a, 8b), hvor der fra et første kabineafsnit (8a) kan tilføres procesluft til det første øvre kølekantermængder (7a), og hvor der fra et andet kabineafsnit (8b) kan tilføres procesluft til det andet nedre kølekantermængder (7b).

3. Indretning ifølge et af kravene 1 eller 2, hvor procesluften strømmer ud af det andet nedre kølekantermængder (7b) med en volumenstrøm \( V_2 \), og hvor volumenstrømforskydningen \( V_1/V_2 \) er 0 til 0,5, fortrinsvis 0,05 til 0,5 og fortrinsvis 0,1 til 0,45.

4. Indretning ifølge et af kravene 1 til 3, hvor procesluften strømmer fra det første øvre kølekantermængder (7b) med en hastighed \( v_1 \) til det andet nedre kølekantermængder (7b), hvor procesluft strømmer ud af det andet nedre kølekantermængder (7b) med en hastighed \( v_2 \), og hvor hastighedsforholdet \( v_1/v_2 \) er 0,2 til 0,5, fortrinsvis 0,25 til 0,5 og foretrukket 0,3 til 0,5.

5. Indretning ifølge et af kravene 1 til 4, hvor fordelingen af dysehullerne i spindeindretningen (1) overalt eller over hele spindeindretningens (1) dyseplade er homogen.
6. Indretning ifølge et af kravene 1 til 5, hvor afstanden mellem spindeindretningen (1) og kølekammeret (7) kan indstilles.

7. Indretning ifølge et af kravene 1 til 6, hvor der i området ved kølekammeret (7) og i overgangsområdet mellem kølekammer (7) og strækningsenhed (12) ikke er nogen lufttilførsel udefra, bortset fra tilførslen af procesluft i kølekammeret (7).

8. Indretning ifølge et af kravene 1 til 7, hvor der mellem strækningsenheden (12) og aflægningsindretningen er anbragt mindst en diffusor (14, 15).

9. Fremgangsmåde til fremstilling af en spunbonded stof-bane af filamenter af termoplastisk kunststof, hvor filamenterne spindes ved hjælp af en spindeindretning (1) og indføres i et kølekammer (7) forbi en monomerudsugningsindretning (3), hvor filamenterne i kølekammeret (7) afkøles med procesluft, hvor kølekammeret (7) er opdelt i to kølekammerafsnit (7a, 7b), hvor procesluften udsuges af et første øvre kølekammerafsnit (7a) med en volumenstrøm \( V_M \) til monomerudsugningsindretningen (3), hvor procesluft fra det første øvre kølekammerafsnit (7b) med en volumenstrøm \( V_1 \) tilføres til et andet nedre køkekammerafsnit (7b), hvor volumenstrømforholdet \( V_M/V_1 \) er 0,1 til 0,3, fortrinsvis 0,12 til 0,25, hvor filamenterne efter udstømningsperioden i kølekammeret (7) indføres i en strækningsenhed (12), og hvor filamenterne derefter aflægges på en aflægningsindretning til spunbonded stof-bane.

10. Fremgangsmåde ifølge krav 9, hvor der anvendes en polypropylen som termoplastisk kunststof.

11. Fremgangsmåde ifølge krav 10, hvor polypropylenen har et smelteflowindex på 10 dg/min til 40 dg/min.

12. Fremgangsmåde ifølge krav 10 eller 11, hvor polypropylenen har en onsets-temperatur \( T_c,\text{rheol} \) på mindst 120°C og fortrinsvis på mindst 123°C.

13. Fremgangsmåde ifølge et af kravene 10 til 12, hvor polypropylenen har en gennemsnitlig isotaktisk sekvenslængde på mindst 65 og fortrinsvis på
mindst 85.


15. Fremgangsmåde ifølge et af kravene 9 til 14, hvor strækningen af filamenterne udføres med det forbehold, at der opnås filamenter med en filamentdiameter på 0,3 til 2 den, fortrinsvis på 0,3 til 0,9 den.