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(54) Benævnelse: **Fremgangsmåde til fremstilling af et med længere fibre fyldt polymermateriale**

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DESCRIPTION

The present invention relates to a method according to the preamble of claim 1 and to the use of an apparatus to perform the method according to claim 14.

Filling materials are mixed in various ways and with different carrier materials. As common carrier materials, for example, thermoplastics are known from background art.

One filling material which is used more and more for different applications is natural wood in the form of wood flour or short chipped wood. Furthermore, also paper and cellulose fibers are being used as filling materials to change the characteristics of plastics or resins. These wooden materials are currently used with a consistent fiber length of less than 2 mm.

Alongside those filling materials or fibers, basically there exist also industrially produced wood fibers such as, for example, fibers gained from palm trees, fibered grass like bamboo, hemp, sisal, etc.. Hereby, wood is only to be understood in the figurative sense. Those industrially produced fibers have greater lengths and consistently have a length of over 5 mm, preferably even a fiber length between 10 and 20 mm. There exist various different methods for producing such technical fibers in a uniformly reproducible, as well as cost-saving manner.

The advantage of greater fiber length can be seen in that these longer fibers generally possess better mechanical characteristics for, for example, finished products like profiles, panels, etc., than would be the case with short wood fibers with a length below 2 mm. Thus, there exists a practical demand for preparing products from materials with possibly longer fibers.

Such materials with long fibers, however, cannot be produced easily. While at the production of carrier material with short fibers of below 2 mm, there are no technological difficulties occurring on a regular basis, neither during extrusion, the addition of longer fibers of, for example, a length of more than 5 mm into the

extruder leads to a very poor feeding or dosing performance by the extruder, for example, with single screw extruders or double-lead screw extruders. Either, this leads to output limitations, or it could be made wholly impossible to insert appreciable amounts of long fibers into the carrier material.

The addition of fibers can be desirable within a range of 10 to 90 weight percent, which may vary according to their application. If no thermoplastic polymer is being used, or cannot be used as carrier or binding material and if a duroplast or resin is being used as carrier material, there are cases, wherein application of those materials demands a fibrous percentage of more than 70 %, especially between 80 and 90 %. It is precisely in this case, where such large amounts of long fibers are being used, that feeding into the extruder is extremely critically, and at poor feeding performances efficiency is derogated until infeasibility is reached.

A further problem lies in that moisture (water) is introduced into the system together with the fibers. Like any other filling material, fibers have a relatively bigger surface on which accordingly large amounts of residual moisture can settle onto.

A high content of residual moisture will have an extremely hindering effect during the concluding densification at increased temperature, for example, during extrusion, and limits and decreases output and product quality. Therefore, for example when extruding wood flour-fed carrier material, the wood flour has to be dried intensively and extensively beforehand in order to yield, for example with double-lead screws, at all sufficient outputs. If the degree of moisture is too high, the extruder degasification is overstrained which can lead to a loss of material or a complete machine stop.

In this regard, there lies an additional problem in processing hygroscopic und/or hydrolytic degradation sensitive carrier material, for example polycondensates such as polyesters, especially PET. In using those carrier materials, an overly high degree of residual moisture within the receiving container, particularly at an

increased temperature, will then lead to a hydrolytic degradation of polymer chains and a decrease in quality in the receiving material or the final product. On this account, the moisture level has to be maintained particularly low in this case.

However, one must also consider that every pre-drying consummates time as well as energy.

On the other hand however, it has to be taken into account as well that the residual moisture present on the fibers is quite important, and acts as a lubricant or maintains a high degree of the fibers' flexibility. This is crucial for processing. If, for example, fibers are dried up too much or almost completely before they are added or processed, the fibers become very brittle und tend to break very easily already during minor mechanical wear, i.e. during treatment in the cutting compressor, at the very latest however, during extrusion. This leads to a decrease of fiber lengths, and qualitative characteristics of the final product, because percentages of long fibers, for example of fibers shorter than 5 mm, are dramatically diminished, or to merely short fibers below 2 mm in length being present within the final product.

The degree of residual moisture of the used crude fibers must therefore not be too high, as this, during extrusion at the latest, would result in a negative impact on the carrier material, or the polymer, or extrusion performance. On the other hand though, the residual moisture must not be too low either, as this would lead to fibers breaking during processing, and would yield only short fibers once again thus resulting in a final product of lower-quality.

Hence, it lies within the obligation of the invention to provide a method for producing a polymer material filled with longer fibers of a certain minimal length, wherein the process provides, at the same time, high output rates and a high-quality final product in which particularly the originally greater fiber length will be preserved.

This task is met by the characteristic features of claim 1.

By this method relating to the invention for producing polymer material filled with longer fibers, in which the fibers having a certain residual moisture of approximately 5 to 8 % with a minimal length of over 2 mm, and the carrier material are mixed together and heated in a reactor, receiving container, or cutting compressor while constantly agitated, and optional shredding of the carrier material, and while constantly maintaining pourability or lumpiness.

Movement is important, because it prevents agglomeration or agglutination of the material. Especially with thermoplastics, intensive movement is required, as plastic materials warm at an increased temperature and become tenacious, and would agglutinate or agglomerate, if it wasn't for continuous mixing and stirring. Thus, mixing also serves to maintain pourability and lumpiness of the raw material within the receiving container or reactor even at increased temperatures.

An increase in temperature on the one hand serves to putting the carrier material into a more softened, tenacious state, whereby coupling of the fibers to the carrier material is enhanced. Usually at this point, no fusing is conducted yet. Thus, an increase in temperature ensures a better mixing between fibers and carrier material, and the mixture will also be prepared more extensively for subsequent densification, especially for extrusion.

Additionally, an increased temperature results in a certain drying process of the carrier material as well as the fibers, which, as is described above, is necessary to guarantee the extruder's output performance and ensure product quality. Thus, by increasing the temperature, a certain amount of residual moisture is removed and the fibers are dried up.

The applicant realized that in order to guarantee a successful process, special conditions have to be set within the reactor.

Fibers as well as the carrier material should on the one hand be dried up until they only contain as low a degree of residual moisture as possible. This drying, however, has to be stopped in good time and must not lead to a complete dehydration of the fibers, but may only be performed to such a degree that the fibers remain sufficiently flexible and elastic, so that they will not break during processing in the reactor nor during an optional subsequent densification in the extruder.

Thus, it is ensured that the fibers are relatively dry and will not insert any disruptive moisture into the extruder, but remain sufficiently flexible to prevent them from breaking. Thereby, their lengths are preserved and the desired final products display all the qualitative benefits that are only achievable through longer fibers.

Therefore, a thorough balancing of those two requirements is needed, for one, this relates to drying and on the other hand, to fiber length. The applicant realized that this problem, already known in the background art, can be solved in this manner and through compliance with the above characteristics of the process and apparatus.

Through the method according to the invention, it is also possible to treat the fibers directly within the reactor, i.e. in a single processing step, and simultaneously with the carrier material so that mixing and drying can be performed in a single processing step. Thus, the requirement for drying crude fibers in a separate step beforehand is being eliminated, enabling the process to be carried out more efficiently and energy-saving.

By this inventive way, there is the possibility to safely control, within an efficient process, how the fibers need to be dried and when the end of the drying process is reached and thus, the extent of the drying process can be correlated with the intensity of the mixture and the setting of the required temperatures in order to yield advantages.

By the method according to the invention, the fibers are inserted into the carrier material as gently as possible while maintaining their length and without breaking during the process. In this way, it is possible through this advantageous method to obtain carrier material in which long fibers are embedded, wherein the fibers are distributed consistently throughout the carrier material, and in which the fibers are present as wholly as possible, not as fragments or fractions thereof.

Further advantageous arrangements of the method arise from the features of the dependent claims:

According to an advantageous development of the method, it is intended to dry the fibers to contain a residual moisture between 1 and 2 %. Thus, even less moisture remains within the product, the fibers however remain sufficiently flexible.

It is especially advantageous to intend to apply a mixing and/or shredding tool for mixing and heating carrier material and/or fibers within the reactor, that is arranged on at least one and optionally on various superimposed planes, preferably revolving or rotating about a vertical axis, with working edges providing a mixing of the product, and optionally a shredding effect, in which heating is conducted at least partially, preferably completely, by impinging mechanical energy or friction onto the material. By using such an apparatus, parameter settings can be controlled particularly well.

According to a further development of the method, it is advantageous if the mixing tools stuff or force-feed the carrier material or the mixture in a filling way into a discharge unit housing directly connected to the reactor or cutting compressor, preferably into a conveyor spiral, barrel extruder or double-lead screw while constantly maintaining pressure or density as well as the material's pourability and lumpiness. If, for example, you would feed into an open funnel, this would, on one hand, decrease density, and the material would agglomerate immediately. Therefore, a constant feed into the extruder could not be ensured any more.

In a surprising way it appeared that the method according to the invention can be performed in a particularly preferred manner by using a cutting compressor-extruder-combination known from the prior art, wherein the extruder is directly connected to the lower part of the reactor. By using such an apparatus, fibers with great length can be inserted gently and without breaking into a carrier material. Thereby, several advantages of this combined system are leveraged. For example, the extruder is force-fed by the mixing tools in the reactor. Depending on the application case, the subsequent screw can be one of the complete-extrusion-screw-type which transfers the processed material, according to its mixture, either into granules or into a final product, for example, a plate, or a profile. By using this apparatus, not only a thorough mixing of fibers and carrier material is ensured, but also that the mixture is subjected to a certain pre-densification. By maintaining pourability and pressure at the same time, a consistent feeding of the directly connected extruder is ensured, and also, partial idling will be prevented. By reducing moisture contents, a further densification up to the point of transport into a bubble-free melt is possible.

Generally, for maintaining pourability it is advantageous that a complete fusing of the carrier material does not occur. However, carrier materials must allow softening to a certain degree in order to guarantee a thorough mixing with the fibers.

Preferably, polymeric or macromolecular material, especially a natural polymer, for example cellulose or lignin, or a synthetic polymer, plastic for example, preferably a thermoplastic or non-crosslinked or non-hardened duroplastic, or a natural or synthetic resin is used as carrier material. Possible carrier materials can also include, for example, paraffines, waxes, oils, etc.

An advantageous treatment of polymeric carrier material, especially of thermoplastic material, inside the reactor or cutting compressor is performed at a temperature higher than glass transition temperature and below the melting range, preferably at a temperature at which the material is in a softened state. Thereby, the material is simultaneously crystallized, dried and/or purified, or optionally

even viscosity can be increased. Preferably, the material is heated to a temperature within the VICAT softening point range. The VICAT softening point temperature can be determined according to DIN ISO 306. The fibers are then added and stirred into the polymeric material that was pretreated this way. If the plastic material is available in a softened state in which the material has not melted yet, and the flakes are still present individually, then the surface is softened already and pores are opened. In this manner, the carrier material has a very high surface, and fibers can invade more easily into the polymeric material rendering the mixture more consistent.

If a thermoplastic polymer is used as carrier material, processing of the synthetic material should be performed advantageously at a temperature of 70 ° to 240 °C, preferably at 130 ° to 210 °C, optionally at vacuum conditions of ≤ 150 mbar, preferably of ≤ 50 mbar, more preferably of ≤ 20 mbar, most preferably between 0.1 to 2 mbar, and the plastic materials usually remain in the reactor for a mean retention time of 10 mins to 200 mins, especially 40 mins to 120 mins.

Also, not yet hardened duroplastic polymer or resin can be used as carrier material, with such resins being used especially when the amount of contained fibers should be substantial, especially more than 70 weight percent, preferably between 80 and 90 weight percent. At such fiber contents in particular, feeding into the extruder is critically.

Fibers and carrier material can be fed into the reactor in any particular successive order, wherein it is advantageous with dusty, finely-ground fibers, if the fibers are added after the carrier material. Alternatively, fibers and carrier material can be added simultaneously.

Also, such starting material can be added which already comprises strongly amalgamated carrier material and fibers, or which contains both of them in a joint starting product. This is especially the case for wood fibers, as the carrier material in the form of lignin, and optionally also cellulose and/or pectines, is al-

ready adhering to the wood fibers. Often, a synthetic polymer, e.g., PP, is added to such material in the extruder upon finalization.

According to another advantageous processing step, the material is treated inside the reactor at vacuum conditions, especially within the range of low vacuum (approx. 300 to 1 mbar), or of medium vacuum (approx. 1 to 10^{-3} mbar). This supports the drying process and the temperature can, optionally, be maintained at a lower level, whereby the process can be performed under more gentle conditions.

According to another, further advantageous development of the method it is possible, to either submit fibers and carrier material simultaneously into the reactor, and only then subsequently increase the temperature and agitate the mixture. It is also possible however, to preheat the carrier material inside the reactor, and, for example, to induce a softened and more tenacious state of its surface, wherein one has to be careful to still maintain lumpiness of the material. Thus, a formation of dust during the addition of fibers can be prevented which is especially advantageous in the event of noxious fibers. In this case, immediately after addition, the fibers will adhere to the tenacious surface of the material. In this regard, it can also be intended to be advantageous to add fibers into a part that is located below the level or mixing vortex of the revolving material.

For example, inorganic or organic fibers are used as fiber materials.

Fiber length imparts decisive mechanical characteristics onto the final product. Thus, it is advantageous to the final product's mechanic characteristics if fiber length is greater than 2 mm, preferably 5 mm, and especially between 10 and 20 mm.

Usually, fibers are being used in an amount from 10 to 90 % w/w, based on the mixture's total weight.

Fiber dosage into the reactor can be volumetric or gravimetric. Discharge of the mixture from the reactor to the screw can be unregulated or regulated by a subsequent melt pump, or by a filling level measurement inside the cutting compressor. The discharge screw's and/or extruder's rotational speed are then altered either by the primary pressure prior to the melt pump, or by the filling level of the cutting compressor in such a way that the pressure and/or filling level remain unchanged.

When processing fibers with poor flow characteristics, it turned out to be advantageous to perform a gravimetric dosing inside the cutting compressor as well as a defined extraction from the cutting compressor. Especially when a final product is being manufactured from it, or when a subsequent extruder is being fed with the condensed material.

Thereby, various embodiments are possible:

On one side, densification and feeding of an external extrusion system is possible. At this, a condensed, pourable product with fiber lengths as long as possible is yielded. If required, lubricants or other filling materials and additives can be added. This condensed good is transported, without any loss to its densification properties to, e.g., a double-lead screw. There, it will be stirred into a polymer, e.g., polypropylene, in a defined mixing ratio. Then, a profile or panel, for example, will be directly extruded. The material can also be extruded into an open form, and be molded into the desired shape by means of a press.

On the other side, a direct extrusion or granulation by a system from a reactor or cutting compressor, and an extruder is also possible. The mixture from the cutting compressor or reactor already constitutes an extrudable mixture *per se* and/or already corresponds to a great extent to the final formulation. The material can now be finalized into a single strand, and granulated, or a continuous profile can be generated from it.

According to the invention, the particular use of the apparatus previously mentioned for performing said process is also intended. This apparatus comprises a reactor and/or cutting compressor, und a discharge unit directly connected to it, preferably a conveyor spiral, barrel extruder or double-lead screw, or the like, in which a mixing and/or shredding tool for mixing and heating material within the reactor is arranged on at least one and optionally on various superimposed planes, preferably revolving or rotating about a vertical axis, with working edges providing a mixing, or optionally a shredding effect on the product. Heating is conducted at least partially, preferably completely, by impinging mechanical energy or friction onto the material. The mixing and/or shredding tools stuff or force-feed the carrier material or the mixture in a filling way into the housing of the discharge unit directly connected to the reactor or cutting compressor while constantly maintaining pressure or density as well as the material's pourability and lumpiness.

Surprisingly it appeared, that by using such an apparatus and at compliance with process parameters, the desired results can be achieved.

It is known, that fibers with a length of over 5 mm lead to a very poor feeding and/or dosing performance of the extruder. If, according to an advantageous development, the pre-compacted mixture from the cutting compressor is force-fed into a connected screw, and if the temperature just prior to the extruder or within the extruder is increased to approx. 160 °C, the carrier material will obtain the necessary flow characteristics that will render the material kneadable and/or formable. Through this process, it is possible to achieve a consistent, three-dimensional fiber structure with a corresponding number of coupling sites between the fibers inside the work piece. This structure is crucial for several applications, for example, in photovoltaics, in fire safety for window profiles, in the automotive industry, or in aerospace technologies. Resins serve as adhesive sites between the individual fibers.

Furthermore, it is possible to conduct the process in a single step within a single reactor, or in the feeding area of the extruder, or, in a way that the synthetic ma-

terial which, optionally, was already mixed with filling material, is heated, dried, crystallized, and purified in one single process step, especially in a single reactor, and/or in a way that the process is performed with or without pre-drying, and/or with or without pre-crystallization of the synthetic material.

Moreover, it is also possible to conduct the process in several stages, especially in two stages, wherein two or more receiving containers or reactors are arranged in series and/or parallel to each other, and in which the synthetic material to be treated that was optionally already mixed with filling material passes through these containers sequentially, wherein preferably the process conditions according to the prior claims are applied to at least one, preferably to the container that was fed first, or to the pre-treatment, wherein the plastic material is preferably heated to a temperature that is especially close to the process temperature of the main treatment during a prioritized pre-treatment.

Furthermore, it is possible that the plastic material is subjected to a pre-treatment during first stage, especially at vacuum conditions, by impinging mechanical energy onto it, by which it is heated and dried at an increased temperature, and is optionally crystallized simultaneously, and that subsequently, after a second stage preceding an optional plastification or fusing, a main treatment of the synthetic material is performed at which the plastic material, especially at vacuum conditions, is dried through reiterated impingement of mechanical energy while agitated, and is further crystallized, where this main treatment is preferably performed at increased temperatures compared to the pre-treatment, and wherein the main treatment temperature is preferably maintained below plastification temperature or melting temperature of the synthetic material.

The fibers can be added into the first container, as well as into the second container. The finished mixtures are then continuously transported into an additional container, where mixing, heating to operating point temperature, and feeding into the extruder is performed.

Additionally, it is possible to subject the synthetic material to pre-treatment in a continuous flow, and/or that the process is conducted continuously, or discontinuously, or as a batch process.

The moisture content of the fibers can be regulated by a water injection built into the cutting compactor. The pressure level and torque of the discharge screw act as feedback for this. At an overtly high moisture content, the discharge screw's torque becomes instable. Because of occurrent vapor bubbles hindering transport, a consistent fiber transport is no longer sustainable. If the moisture content is too low, torque is increased because of the lower conveying activity induced by decreasing kinetic friction, and pressure on the tools is also increased due to a decrease of anti-friction properties in the tools.

In the following, the invention will be described by means of examples and whilst not being limited by them, by two especially preferred application examples:

Example 1:

Wood fibers with polypropylene

The process is performed in a cutting compressor-extruder-combination long since known in the background art, for example, in a VACUREMA®-plant. In this connection, a generally cylindrical receiving container or cutting compressor is designated that comprises cutting and mixing tools inside of it which are revolvably arranged around a vertical axis providing stirring and optional shredding of the container's content. At the lowest area, just above the container bottom or in line with the lowest mixing tools, an extruder for fusing the polymer is arranged. The mixing tools are thereby arranged and operated in such a way that the material is force-fed into the extruder. Thus, within the cutting compressor, the material is mixed, heated – although without being fused – and will remain there for a certain retention time.

In this case, the mixing tool rotates at a speed of approx. 1500 rpm. Temperature within the cutting compressor is approx. 140 °C, wherein the temperature is induced into the material via the friction of the mixing tools. Therefore, the polypropylene is in a softened state, close to its VICAT softening temperature. However, the material is still lumpy.

Wood fibers in a length of 15 mm and containing a residual moisture of 6 weight percent are added from above and stirred in thoroughly.

Polypropylene (polypropylene can appear as grinding stock of thickly-walled products, fibers, mats of fibers, or even films) as well as wood fibers are constantly added at a polypropylene-throughput of approximately 500 kg/h, and a wooden fiber-throughput of approximately 200 kg/h. Retention time of the material within the cutting compactor is approximately 20 mins. In that time, the moisture content of the fibers decreases to 1.5 %. Subsequently, the thoroughly mixed material is being crammed into the extruder and fused. After that, processing for obtaining the desired final product can be performed.

An analysis of the material has shown that only a very small percentage of fibers was broken, and more than 95 % of the fibers still had a length of more than 15 mm. Furthermore, product quality of the synthetic matrix was very high, in particular there was no formation of bubbles and/nor a change in color.

Example 2:

Wood fibers in wood (lignin) with polypropylene

The process is conducted in the same apparatus as in Example 1. Shredded wood containing lignin and wood fibers, amongst others, are continuously fed into the reactor at a throughput rate of approximately 60 kg/h, and processed at a temperature of 124 °C to 128 °C, at a rotational speed of the mixing tools of approximately 1900 rpm for a retention time of approx. 15 mins. The fibers are dried without breaking.

This treated material is continuously crammed into the extruder, and mixed into fused polypropylene.

Finally, this created a polypropylene filled with wood fibers in which more than 92 % of all fibers still retained a length of over 15 mm.

Patentkrav

1. Fremgangsmåde til fremstilling af et med længere fibre fyldt polymermateriale, hvorved fibrene, som har en vis restfugtighed på ca. 5 til 8%, og som har en mindstelængde på over 2 mm, og et bæremateriale, blandes og opvarmes i en reaktor eller skærekompressor under konstant bevægelse, og eventuel findeling, af bærematerialet og under konstant opretholdelse af risledygtigheden eller evnen til at forblive i stykker, **kendetegnet ved,** at betingelserne, især temperaturen, i reaktoren eller skærekompressoren indstilles således, at fibrene tørres til en så vidt muligt lav restfugtighed, ved hvilken fibrene lige netop endnu er tilstrækkeligt fleksible, at de hverken ved bearbejdningen i reaktoren eller skærekompressoren eller en eventuelt tilknyttet komprimering, f.eks. en ekstrudering, brydes.

2. Fremgangsmåde ifølge krav 1, **kendetegnet ved,** at fibrene tørres til en restfugtighed på imellem 1 og 2%.

3. Fremgangsmåde ifølge krav 1 eller 2, **kendetegnet ved,** at der til blandingen og opvarmningen af bærematerialet og fibrene i reaktoren eller skærekompressoren indsættes et især omkring en lodret akse rundtgående drejeligt blande- og/eller findelingsværktøj, som eventuelt er anbragt på flere oven over hinanden beliggende planer, og som har arbejdskanter, som virker blandende og eventuelt findelende på materialet, hvorved opvarmningen foregår i det mindste delvis, fortrinsvis fuldstændigt, ved påvirkning af materialet med mekanisk energi eller friktion.

4. Fremgangsmåde ifølge et af kravene 1 til 3, **kendetegnet ved,** at blande- og/eller findelingsværktøjerne stopper eller ved hjælp af kraft-fødning indtrykker bærematerialet eller blandingen spartelagtigt under konstant bibeholdelse af trykket eller massefylden samt risleevnen eller opretholdelsen af stykker i materialet i et hus i forbindelse med en udføringsenhed, som er tilsluttet reaktoren eller skærekompressoren direkte, fortrinsvis en transportsnekke, en ekstrudersnekke eller en dobbeltsnekke.

5. Fremgangsmåde ifølge et af kravene 1 til 4, **kendetegnet ved,** at der som bæremateriale anvendes mindst et polymermateriale eller makromolekylært materiale, især en naturlig polymer, f.eks. cellulose eller ligning, eller en syntetisk polymer, f.eks. en plast, fortrinsvis en termoplastisk plast eller en ikke-tværbundet duroplastisk plast eller en naturlig eller syntetisk harpiks.

6. Fremgangsmåde ifølge et af kravene 1 til 5, **kendetegnet ved,** at fibrene og bærematerialet tilføres efter hinanden i reaktoren eller skærekompressoren, hvorved fibrene fortrinsvis gives til det allerede foropvarmede, især blødgjorte bæremateriale.

7. Fremgangsmåde ifølge et af kravene 1 til 5, **kendetegnet ved,** at fibrene tilføres og behandles samtidigt med bærematerialet i reaktoren eller skærekompressoren, hvorved især et allerede med fibre fyldt bæremateriale tilføres, idet bærematerialet og fibrene allerede foreligger sammen eller sammenblandet, f.eks. træ, cellulose, lignin eller pectin, hvori der er indeholdt træfibre.

8. Fremgangsmåde ifølge et af kravene 1 til 7, **kendetegnet ved,** at især, når der som bæremateriale anvendes en termoplastisk polymer, foregår materialets behandling i reaktoren eller skærekompressoren ved en temperatur over glasovergangstemperaturen og under smelteområdet, fortrinsvis ved en temperatur, ved hvilken materialet foreligger i en blødgjort tilstand, fortrinsvis i området af VICAT-blødgøringspunktet (ifølge DIN 306 A, 10N, 50 K/h), og materialet derved fortrinsvis krystalliseres, tørres og/eller rengøres, især under et enkelt fælles trin.

9. Fremgangsmåde ifølge et af kravene 1 til 8, **kendetegnet ved,** at fibrene anvendes i en mængde på fra 10 til 90 vægt%, set i forhold til blandingens totale vægt, hvorved, når der som bæremateriale anvendes en ikke-hærdet duroplastisk harpiks eller et ikke-hærdet duroplastisk polymermateriale, fibrene tilføres i en mængde på mere end 70 vægt%, især imellem 80 og 90 vægt%.

10. Fremgangsmåde ifølge et af kravene 1 til 9, **kendetegnet ved,** at behandlingen i reaktoren eller skærekompressoren foregår under vakuumbetingelser, især i området grov- eller finvakuum.

11. Fremgangsmåde ifølge et af kravene 1 til 10, **kendetegnet ved,** at der som fibre anvendes uorganiske fibre, f.eks. glas eller grafit, og/eller organiske fibre, f.eks. træfibre, især fibre fra palmer, bambus, hamp og/eller sisal.

12. Fremgangsmåde ifølge et af kravene 1 til 11, **kendetegnet ved,** at fibrene har en længde på over 5 mm, fortrinsvis på imellem 10 og 20 mm.

13. Fremgangsmåde ifølge et af kravene 1 til 12, **kendetegnet ved,** at blandingen afsluttende bliver bragt ud under konstant opretholdelse af trykket eller massefylden samt risledygtigheden eller evnen til at bære stykkerne ud af reaktoren eller skærekompressoren og underkastes en yderligere komprimering, f.eks. en ekstrudering.

14. Anvendelse af et apparat til udøvelse af fremgangsmåden ifølge et af kravene 1 til 13 med en reaktor eller skærekompressor og en hertil tilsluttet udføringsenhed, fortrinsvis en transportsnekke, en ekstrudersnekke eller en dobbeltsnekke, hvorved der i reaktoren eller skærekompressoren til blandingen og opvarmningen af materialet er anbragt mindst et, især om en lodret akse rundtgående, drejeligt blande- og/eller findelingsværktøj, som eventuelt er anbragt på flere oven over hinanden beliggende planer, og som har arbejdskanter, der påvirker materialet blandende og eventuelt findelende, hvorved opvarmningen foregår i det mindste, især udelukkende, ved påvirkning af materialet med mekanisk energi eller friktion, og hvorved blande- og/eller findelingsværktøjerne stopper eller transporterer materialet eller blandingen spatelagtigt under konstant bibeholdelse af trykket eller massefylden samt materialets risledygtighed eller evne til at bevare stykkerne ind i den til reaktoren eller skærekompressoren sluttede udføringsenheds hus.