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Processing Guideline Injection Molding

vibers™ BP IM Grades

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Note

For general product information, please refer to our technical datasheets. Our technical services/department is available to discuss your requirements.

Additional information

This information is intended as a guideline for the injection molding of vibers™ BP IM grades. The document contains generalized information for safety, processing guidelines and tooling. Processing and use of vibers™ BP IM is the sole responsibility of the purchaser. All legal and other regulations must be complied with. Since injection molding covers a broad range of applications and products, an experimental approach at your facility will have to determine what tooling and mode of operation will work best. Testing of the end products is also recommended in order to make sure it meets customer requirements.

Packaging

Packaging; 25 kg bags, 1000 kg octabins. Identification: Grade name, Lot nr. and production location.

Transport, storage and shelflife

vibers™ BP IM must be stored in a cool dry place, out of direct sunlight and protected against humidity. After use bags should be sealed back.
vibers™ BP IM should be maintained in a closed bag and processed within several hours after opening.

Application and properties

- vibers™ BP IM is developed for injection molding.
- Are biodegradable Miscanthus fiber filled compounds.
- Easy to process and can be converted on conventional processing equipment.
- Can be processed at low temperatures, saving energy.
- Are biobased alternatives for fossil-based plastics.

Important: do not pre-dry vibers™ BP IM before processing!

Melt processing & start up conditions

Before starting up production and introducing vibers™ BP IM, the processing system should be thoroughly cleaned and purged to prevent any polymer cross contamination. Insure that the feeding and blending equipment is properly cleaned and free from contamination and dust and all metal parts have been wiped clean. The following purging procedures are recommended for optimal removal of other polymers, in particular high melting and low MFI polymers such as PA, PP and PET.

1. Purge with low MFI (<2) PP at normal operating temperatures. Purge 10-30 minutes as necessary. Let system empty as much as possible. Clean out the hopper as much as possible.
2. Introduce a high melt flow low melt temperature PE (>5 MFI) and change to normal vibers™ BP IM grades operating temperatures.
3. Purge as long as necessary (10-30 min.). Let system empty as much as possible.
4. Stop injection mold machine and completely clean all hoppers, elbow, slide gates, dryers, hopper loaders bins, hopper loader, filters and material conveying lines of residual polymers such as PET, PA, HDPE or PP.
5. Vibers™ BP IM is preferably run without filter systems. PET and PP will not melt at normal processing temperatures for vibers™ BP IM and potentially can block the filter as such. Load Vibers™ BP IM into material handling system.
6. Transition to purge Vibers™ BP IM and purge with open nozzle until melt is clear of any contamination.
7. Immediately, after the completion of the production run, purge all vibers™ BP IM from the extrusion system, using a moderate to low melting temperature PE.

At start-up material can be metered with an open nozzle and if necessary adjustments

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to screw speed, back pressure and temperature profile can be made to arrive at even feeding. No obvious discoloration compared to pellet color should be observed and the material should exit the barrel as a uniform melt. At these settings injection strokes (with the correct shot volume) into free air can be made to assure that the combination of nozzle diameter and injection speed are correct. Discoloration of the material indicates that this combination is incorrect (leading to shear rates being too high). When metering with an open nozzle or injecting into free air, small clouds of fume (water vapor), could emerge from the nozzle. Foaming of the material is also possible. This is normal behavior for vibers™ BP IM. When during continuous production, an emergency stop occurs, it is advised to reduce the extruder barrel temperature to about 120-140°C to avoid degradation of vibers™ BP IM. During restart temperatures can be increased and injection can be started with open nozzle first to clean screw.

Degradation (hydrolysis)

Please note that vibers™ BP IM has a degradation temperature of 170-210°C. The possibility of degradation of the natural components in vibers™ BP IM exists during prolonged exposure to elevated temperatures. When the machine is idle and vibers™ BP IM is present in the barrel, idle times should not exceed 5-10 minutes. Prolonged idle times, even at the proposed temperature profile, can lead to a significant decrease of product quality. When longer idle times are foreseen, we strongly suggest purging the barrel to prevent loss of dosing properties and overall material quality. Symptoms of degradation are: chewing gum effect in the first phase, then increase of brittleness and increased discolouration or beige/brownish burning spots will occur. Preferably the feed zone is not to be overfed and cleaned out and cooled during prolonged idle times to avoid degradation and blocking of the feed zone.

Injection mold machine recommendations

vibers™ BP IM can be processed on most conventional equipment but there could be some torque limitations if the screw design has a high compression ratio. Low compression ratios of max. 2.5-3 are in general considered to be adequate for vibers™ BP IM. Most (hot) runner systems are suitable, although there can be some exceptions.

The residence time of vibers™ BP IM material in the barrel at temperatures over 170°C should be kept low. It requires to rule out the remain material in the barrel in order to avoid discoloration, decomposition, charring and plugging the die head.

Typical molding conditions are described in the next sections below. Vibers™ BP IM results in a non-transparent beige product with a natural soft feel. Properties, mechanical, thermal as well as flow properties, may depend on water content, humidity, processing and thickness. However processing will deviate from standard polyolefin conditions and specific conditions should be discussed with our technical service department. Prospective clients should evaluate vibers™ BP IM in their own laboratories to establish

Pre-treatment and drying

Vibers™ BP IM require some moisture (bonded to the thermoplastic starch) to enable melting and to ensure the flow properties during processing. vibers™ BP IM have been preconditioned during manufacturing to the correct moisture content before packaging. Therefore specific vibers™ BP IM grades are **not to be dried** for standard applications or uses. Drying will affect processing and properties. **Important: do not pre-dry vibers™ BP IM before processing!**

PG vibers™ BP IM Grades

optimal conditions for use in their processes and applications.

Temperature profile

The suggested regular temperature profile (from inlet, feed to melt zones to the die) consists in most cases of a gradually increasing temperature to higher temperatures at the die. However, the profile may depend on extruder type & design, die type & design and also on type of product made. The suggested temperature profile (from feed to zone 1 to the nozzle) consists of a gradually increasing temperature from 135°C at the first heated zone to higher temperatures at the nozzle. The feed should be kept cold, below 30-35°C for most grades. Most of the vibers™ BP IM are rather soft granulates or low Tglass and to avoid sticking in the feed it is advised to cool the feed. The optimal temperature is depending on the screw design features of the inlet zone. It is advised to avoid overfeeding the inlet zone. This is in particular important during start-up.

Typical processing conditions are tabulated below. Data presented was generated using various standard laboratory and industrial equipment. Using different machineries with differences in screw, output, smaller dies and die design can lead to differences in optimal conditions. Data are as such indicating conditions for processing. In the table below the suggested profiles for a screw with 4 heated zones are tabulated. The suggested profile is intended as a starting point. If flow and processing is good it is possible to reduce the temperature settings. If the flow of the material needs to be improved, there is the possibility to increase the temperature. We strongly recommend you to apply this increase to zones 3 and 4 first with steps of 5°C and evaluate the result. It is advised not to exceed the maximal processing temperature. Overheating of products should be avoided. Before production, make sure that all temperatures zones work correctly. During production excessive shear induced material heating should be avoided as much as possible. Do not allow material to remain hot inside the extruder for extended periods as the material can degrade. Thus: do not heat over indicated maximal process Ts for long times and not over 160°C when machine is not running. When during continuous production, an emergency stop occurs, it is advised to reduce the extruder barrel T to about 120-140°C to avoid degradation of vibers™ BP IM. During restart temperatures can be increased and further processing can be started with open die first to clean screw.

	Temperature (°c)						
Grade	Zone 1	Zone 2	Zone 3	Zone 4	Mold	Maximal Proces T	Spiral flow 2*12 mm (cm)
Standard grades							
vibers™ BP IM	135	150	160	165	25	180	>55 (170°C)

Additional equipment information

Materials described in the tables were all run on a various injection molding systems form various brands with different tonnages & sizes.

Screen or filter pack configurations, although not advised, can be used to protect the molds from incidental contamination that may occur during material handling using recyclates. Screen mesh sizes of 10-50 are generally sufficient. Finer filtration leads to excessive shear-heating with vibers™ BP IM and should be avoided. Because of the viscous nature of vibers™ BP IM some pressure build can be reduced by having a 0-10°C higher temperature at the filter compared to the mass temperature.

Materials of Construction: It is recommended that all metal parts in the extrusion process that are subjected to stagnant flow areas with molten polymer should be constructed of stainless steel to minimize corrosion. Stainless steel that is hardened is best especially for molds running full production. The mold is preferably made of Hard Chrome plated tool steel. High Temperatures, high shear or high pressure conditions, also locally, should be avoided to avoid wearing and corrosion of equipment parts and molds.

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Hot runner

When using a hot-runner system, the suggested hot-runner T is 150-185°C depending on shot volume and hot-runner dimensions. Again, as with the suggested temperature profile, these temperatures are intended as starting point. Purge hot-runners first with vibers™ BP IM. A hot-runner system designed for PET and PS is in most cases preferably used for vibers™ BP IM grades since the mold shrinkage of most vibers™ BP IM grades are low, running on PS or PET tooling can be an advantage over tooling designed for resins such as polyethylene or polypropylene.

Shot volume

The combination of shot volume and machine size should be so that there are at least 2½ shots in the barrel. If there is a large number of shots in the barrel (10 shots maximum) we recommend using lower temperatures (due to the longer residence time of the material). It is recommended to use a residence time between maximally 1-5 minutes to avoid possible degradation. The most optimal residence time for vibers™ BP IM is between 80-120 seconds.

Mold characteristics

Injection can be started with the mold at ambient temperature. As injection progresses, the mold can be cooled down to optimize cycle times. Optimal mold temperatures strongly depend on product dimensions and should be established empirically during trials. Mold T should not exceed 35°C (unless stated else) to prevent adhesion of material to the mold. From experience it is known that usual mold temperatures are around 20-25°C. When molding an open container (e.g. flower pot), a temperature difference between the two mold halves can facilitate product release (the fixed half about 5-10°C lower).

The mold should have sufficient venting to prevent condensation of moisture in the mold and with that moisture deposits on the product (leading to reduced product quality) and/or material deposit on the mold. Venting should be as much as possible, in particular at the end of the flow path. The venting should be cleaned regularly. Make sure that venting is properly adjusted to prevent pressure build up.

Since vibers™ BP IM remains relatively soft for a prolonged time, ejector pins should have a relative large surface area to prevent the pins pushing too far into or through the product. In case of a mold with a stripper plate instead of ejector pins, this is of much less concern.

Running on PS or PET tooling is recommended over resins such as PP and PE. Short time and low packing pressure is usually preferred.

Material safety data sheets

Material Safety Data Sheets (MSDS) for vibers™ BP IM grades are available. MSDS is provided to help customers satisfy their own handling, safety & disposal needs, and those required by locally applicable health and safety regulations.

Chemical control law compliance

Across the globe regulations exist for local environmental authorities to evaluate materials to assure the protection of human health & environment from any unreasonable risks associated with chemicals. Components used in vibers™ BP IM grades as supplied comply with the European Union (EINECS)/ REACH chemical inventory.

Injection

vibers™ BP IM grades can be injected through a regular sprue bush or a hot-runner system. As starting point, the injection rate can be set at 60% of the machine maximum and should be adjusted depending on mold filling results.

Mold shrinkage of vibers™ BP IM is low, so it is recommended to fill cavities on shot volume and as little holding pressure as possible to prevent the product becoming too wedged in the mold. To increase the surface quality of the product it may be needed to use holding or packing pressure. In this case, preferably use a relatively high holding pressure in combination with a relatively short holding time instead of low pressure and a longer holding time. Also because of the limited shrinkage it is favorable to have a relatively large diverging angle when using a regular sprue bush.

Prior to injection molding of vibers™ BP IM, it is most likely that the injection molding machine has to be purged because of the presence of a different plastic. Change over to PE, then purge the machine until the other plastic is removed. When purging the machine it is recommended to lower temperatures in three steps to the temperature profile of vibers™ BP IM grades. At every step, purge the screw and hot runners. After production, it is recommended to increase the temperatures in three steps to the temperature profile of PE.

When starting the injection molding process, it is likely the first few shots will not yield a fully filled product. This is also normal start up behavior. Changes in machine settings are not recommended for the first 5-6 shots.

Depending on machine and mold, it is possible that after opening the mold, some material might drool when the screw has been filled for the next shot. If this is the case, a large screw decompression after filling will reduce the internal material pressure in front of the screw tip and this can help to reduce or prevent drooling.

Re-use & compatibility

The leftover materials can be reclaimed and reprocessed if they are free from dust and contamination. Recyclability: clean waste can be shredded or re-granulated (typically up to 5-20%) and used with virgin material. However, the leftover materials should be collected, shredded and sealed quickly in order to avoid humidity absorption. Addition levels should be controlled within a reasonable and constant addition range. It is strongly recommended that the reclaiming materials will be reprocessed to grains in good time. Pre-drying to appropriate moisture levels before reprocessing would be needed if the reclaiming materials have been stored without sealing. The leftover materials should be stored sealed in a dry cold environment. The vibers™ BP IM grades are

compatible and can be mixed and can as such be used as combinations.

General characteristics & other information

The standardized MFI-tests at 190-230°C (2,16-5 kg) cannot always be accurately applied on all vibers™ BP IM grades due to the fact that processing is done at lower temperatures. Also flow in several vibers™ BP IM is facilitated by rotational movement of the screw and water as plasticizer (evaporation of water will change flow properties). Static heating alone at too high temperatures will lead to degradation and to inaccurate MFI values. The above explains why it is very difficult to provide an accurate MFI for vibers™ BP IM. In case of determining viscosity values as function of temperature or shear rates the second problem is not an issue because temperatures can be chosen below the degradation temperature. However, the first problem still exists in for instant viscometers or capillary rheometers, again making it difficult to perform accurate and reproducible measurements that have a practical value.

Storage finished products

Storage conditions: Finished products best are stored dry and cold or room temperature. It is recommended to seal goods in black PE films to protect them against moisture and UV radiation. In any case we recommend to use products as soon as possible and not to store them for long time periods (> 6-12 months). Storage time depends on processing parameters and on climate conditions in the respective area. Because of these essential and complex interacting parameters, vibers™ cannot give any shelf life guarantees for finished goods. The conditions mentioned relate to our customers' experiences. Each customer should execute individual storage tests according to product specifications and storage requirements.

Certification

Presuming appropriate processing, the composition of vibers™ BP IM grades comply with EC Plastics Regulation 10/2011 and as such has potential to be used in the EC countries for materials or articles according to article 3 of Regulation EC No 1935/2004 on materials and articles intended to come into contact with food and repealing Directives 80/590/EEC & 89/109/EEC and FDA food contact standards codes of federal regulations CFR 21. Compliance with the provisions of these regulations, especially the suitability of the articles for the given application, the effect on smell and taste of the food, and observance of any given limitations, must be ensured by the person who introduces the articles into circulation. The specific restrictions mentioned in EC Plastics Regulation No 10/2011 and amendments have to be ensured. Migration should be measured on finished articles placed into contact with the foodstuff or appropriate food simulants for a period and at a temperature which are chosen by reference to the contact conditions in actual use.

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