Data Sheet
MGH 3737

Partially aromatic Polyamide (PPA)
Anisotropic Strontium Ferrite Polymer
Bonded magnetic Compound

MGH 3737 is an easy flowing heat stabilised co-polyamide injection moulding material with 88% by weight hard anisotropic Ferrite.

Tailor made for applications for temperatures up to 150°C. Through careful processing of the co-polymer MGH 3737 displays excellent flow characteristics for ease of use and filling of complex mould tools. It also gives very good temperature stability.

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INTRODUCTION

Polymer Bonded Magnets (PBM) is a description applied to materials that can be magnetised and are processed either by the pressing or injection moulding process. In the case of compression moulding process the polymer used, normally an epoxy resin, acts as a binder. Using the injection moulding process the polymer has multiple functions:

- Binder for the magnet raw material Permits injection moulding processing (also extrusion)
- Has improved mechanical properties compared to pressed and sintered materials
- Excellent dimensional stability
- Faster processing speeds

The higher level of polymer in injection moulding PBM's compared to compression moulding types reduces the level of magnetic properties, however the injection moulding process allows the production of parts with more complex designs compared to those produced by compression moulding. This can make part integration or reduction in components a possibility.

Injection moulding grades of PBM's open up new application possibilities. The features and benefits of injection moulding PBM products such as MGH 3737 are:

- Greater design freedom of components
- Lower shrinkage
- Higher dimensional stability
- Easy flowing
- Good surface finish
- The selection of special polymers is possible for different environmental conditions.

These features offer the following advantages:

- Post handling procedures such as grinding are not necessary
- Parts having long flow paths can be moulded
- Products with increased thermal stability are possible
- The filler makes shrinkage, sinkage and warpage less of a factor than normal injection polymers.

Injection moulding PBM products allow new design ideas to be considered which until now were not possible following the pressing method.e.g.

- Insert moulding
- Over moulding
- Part integration

For more information please contact PPTC

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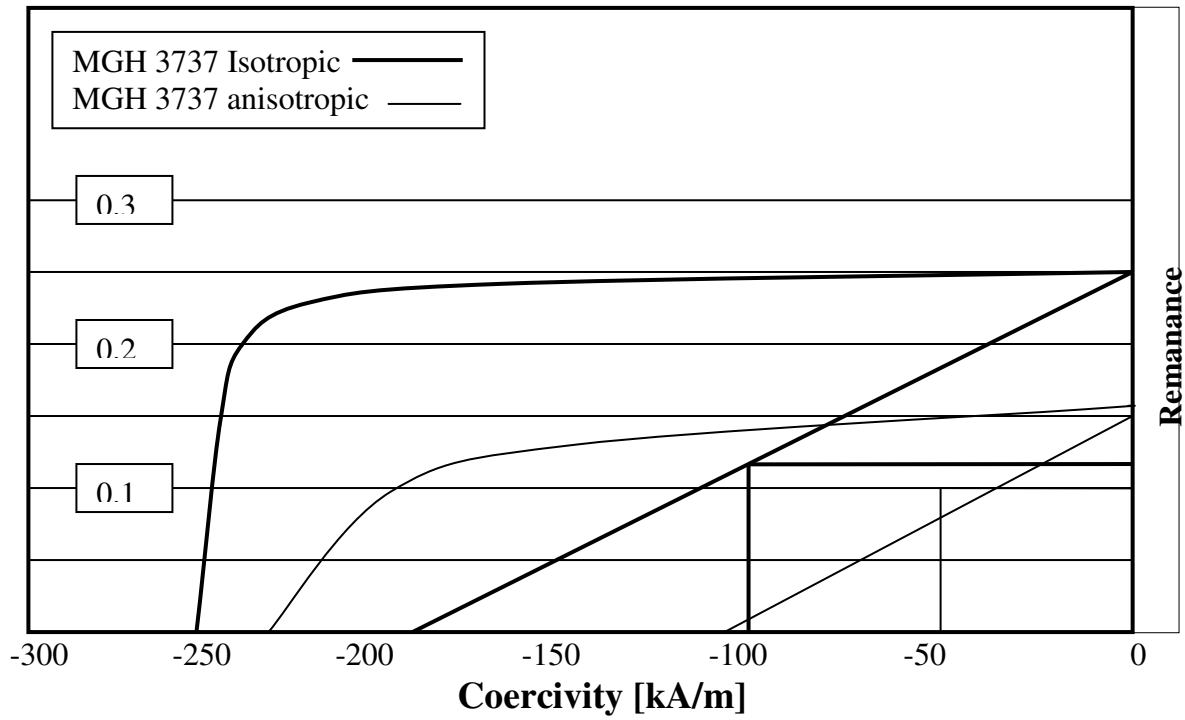

Magnetic Properties, Indicate Values

		Anisotropic MGH 37367	Isotropic MGH 3737
Remanemce B_R	T	0.25	0.18
	Gs	2500	1800
Coercivity H_{CB}	kA/m	210	120
	Oe	2100	1500
Intrinsic Coercivity H_{CJ}	kA/m	250	230
	Oe	3100	2900
Maximum Energy Product $(BH)_{max}$	kJ/m_3	11	5
	MgsOe	1.4	0.6

Product nomenclature ISO 1874 PA6T/66,MH, 12-220, MD 86 SRFEO

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GENERAL PROPERTIES

Mechanical Properties

		Standard	Unit	State	MGH 3737
Density		ISO 1183	g/cm^3	dry	3.49
Tensile E-Modulus	(1mm/min)	ISO 527	MPa	dry	22000
Tensile strength	(5mm/min)	ISO 527	MPa	dry	65
Elongation at break	(5mm/min)	ISO 527	%	dry	0.4
Impact strength	Charpy 23°C	ISO 179/1eU	kJm^2	dry	7
Notched impact strength	Charpy 23°C	ISO 179/1eA	kJm^2	dry	3

Thermal Properties

		Standard	Unit	State	MGH 3737
Heat deflection temperature HDT/A	1.80MPa	OSO 75	°C	dry	240
Long-term temperature usage	-	-	°C		150
Short-term temperature usage	-	-	°C		240
Temperature coefficient of remanemce Br	to+120°C	-	%/°C		-0.17
Temperature coefficient of coercivity H_{CJ}	to+120°C	-	%/°C		+0.09

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Processing information for the injection moulding of MGH 3737

PRE-HANDLING

MGH 3737 is delivered in 25 kg bags, pre dried ready for processing. Drying of the material is unnecessary if the packaging is undamaged and sealed.

Storage

This material can be stored for a number of years in a weather protected storage area.
During cold spells, material intended for production, should be brought into the moulding area before processing. The material should reach equilibrium temperature and so avoid condensation of moisture on the granulate upon opening the bag, which could lead to processing problems.
As a guideline, equilibrium temperature can take up to 3 days with a temperature difference of 20°C between the storage and processing areas. The process can be accelerated by storing the material in a warm area prior to use.

Storage of partly used material

In order to avoid water absorption part used material should not be left in open containers, but replaced into a can and sealed with the cap, making as airtight as possible.

Drying

MGH 3737 absorbs moisture when exposed to the atmosphere. The processing tolerance lies at 0.1% water content. This level of moisture content can be reached after only one hour exposure to the atmosphere. If during processing it is determined that the material has a too high moisture content (foaming melt), the packaging is damaged, or granulate has been exposed too long to the atmosphere, drying is required.
Note: Open granulate in warm conditions i.e. summertime or near a heat source will be more prone to moisture uptake.

Drying can be done either:

- In a vacuum oven: at 80°C (6-12 hours) or
- In a dry air dryer: at 80°C (6-12 hours) Such dryers have a sealed air circulation.

Chemicals in a cartridge within the system dehumidify the returned airflow from the dryer.

INJECTION MOULDING PROCESSING

The melt temperature should be between 320°C and 330°C. A melt temperature over 330°C and/or a long dwell time in the cylinder can lead to the danger of thermal degradation to the material .

Of importance is the constant maintenance of tool temperatures between 100°C. Choosing temperatures lower than this will result in premature solidification of the melt in the gate area. Thereby retention of an optimal post pressure is not possible. Through making a control of the component weight after moulding, it is possible to optimise the post pressure time and is therefore recommended.

RECOMMENDED PROCESSING DATA FOR MGH 3737

Melt temperature	°C	320
Tool temperature	°C	100 - 140
Post pressure	bar	350 – 800
Injection speed	- medium to high	
Screw speed	rpm	40 – 200
Back pressure	bar	5 – 15

It is recommended to use the total cooling time for the dosing of the material in order to achieve a gentle melting of the granulate.

Due to the high rigidity of MGH 3737, ejection from the mould is possible after a relatively short cooling time. The rigidity of this material, together with its low shrink characteristics, requires that the tool is designed with a de-moulding angle of 1°. The gate diameter should be designed as generously as possible with a sharp edge at the interface with the component to help with despruing of the component.

Parts having reduced mechanical properties can be the result of having too high melt temperatures, due to moisture absorption of the granulates and/or long dwell times.

Flow properties

Flow length: 240 mm

The information concerning flow behaviour of MGH 3737 was obtained from a spiral flow test. Cross section of spiral 1.5 x 10 mm:

Melt temperature	°C	330
Mould temperature	°C	100
Injection / Post pressure	bar	1000
Post pressure time	s	5
Cooling time	s	20

Shrinkage

The shrinkage measured on plates of 60 x 60 x 2 mm with a side film gate, 24 hrs after moulding:

Shrinkage length	%	0.5
Shrinkage perpendicular	%	0.6

Machine settings used to produce plates for shrinkage measurement:

Melt temperature	°C	330
Mould temperature	°C	80
Hold on pressure level	bar	600
Hold on pressure time	s	20
Cooling time	s	15

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THE INJECTION MOULDING MACHINE

MGH 3737 can be processed on all injection moulding machines which are suitable for processing Polyamides. To prevent abrasion the screw, cylinder and the nozzle, a hardness of 70 HRC should be used. This hardness can be achieved by hardening and nitriding steel. The following points should also be considered.

Screw
A universal (3 Zone) abrasion resistance treated screw with a back flow valve, length 20D, compression ratio 1.8 is recommended for processing MGH 37367

Screw diameter
(maximum shot volume)
The diameter of the screw should be such that the maximum shot volume does not exceed twice the volume of the actual shot volume (including sprue and runners). It must be assured that the metering zone (excluding decompression) is longer than the back flow. Utilisation of 80% of the metering zone is ideal.

Heating
At least three separately controllable heating zones, able to reach temperatures of 350°C are recommended. Separate nozzle heating is necessary. The cylinder flange must be temperature controllable (block cooling).

Processing interruptions
If long breaks in production are foreseen the granulate should be evacuated from the machine.

Nozzle
A free flowing needle shut-off nozzle is recommended. An axial plate shut-off nozzle is not to be recommended.
Open nozzles are simple, have a long life and allow easy flow. They have a disadvantage in that during retraction of the screw, air can be drawn into the melt and cause oxidation of the melt.

Clamping force / Hold on pressure

With the production of components with accurate dimensions the post or hold on pressure should be between 350 to 800 bar (specific pressure). As a rule of thumb the clamping force should be 7.5 kN per cm^2 of the projected surface area of the part.

MOULD TOOL

The processing of anisotropic Ferrite products requires the utilisation of a magnetic field to orientate the magnetic particles during the injection moulding process. This requires that the injection mould tool should be made using the combination of magnetic and non magnetic tool steel. The magnetic flux lines generated by electromagnets are oriented through magnetisable iron cores, the magnetisable particles within the melt will be oriented ready for the Pole distribution and magnetization process conducted at a later stage.

The mould design and construction requires special considerations in order to optimise the magnet flux line distribution so that no induction outside of the mould tool occurs.

Within the mould tool cavity a magnet field strength of 1400 kA/m (17.5 kOe) is necessary for the orientation of the particles. The higher this figure, the greater the particle alignment.

The design of the mould tool should follow the general rules for thermoplastics. Further consideration has to be given, particularly regarding moving parts within the mould tool, to the requirement of heating the tool to at least 80°C.

The general level for mechanical loading (flexing and compression) should allow for a maximum internal tool pressure of 800 bar.

For the cavity area abrasive resistant mould tool steels (full-hardened steels) are recommended which have been hardened to a level of 70 HRC. Except for the fine angled tips of treated surface areas (eroded, ground surfaces) MGH 3737 reproduces the surface of the mould form exactly. In order to obtain a glossy surface finish the tool should be polished accordingly.

Sprue / Gate
A centrally positioned conical sprue in the area of the largest wall section is conducive to good mould filling and avoiding sink marks. Pin-point gates or tunnel gates are however more economical and more usual with technical components.

To avoid premature freezing of the melt and difficult mould filling the following is recommended:

Sprue diameter = 1.4 x thickest wall section
min. 4mm max. 12mm

Gate diameter = 0.8 x thickest wall section

Also the site of the pin-point gate should lie in the position of the largest wall section (mass agglomeration).
Free flowing melts should be avoided.

CUSTOMER SERVICES
Our customer services are not only concerned with the manufacturing and supply of engineering thermoplastics but also provide technical support.

- Prototype tooling
- Material selection
- Processing support
- Mould and component design
- Manufacture of tooling
- Moulding of components

The recommendations and data given are based on our experience to date, however, no liability can be assumed in connection with their usage and processing.

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