Your partner to optimize the plasticizing process

Maxi Melt screw
Barrier screw
3T mixing screw
Three-zone customized screw
Screw for thermosetting resins

Solutions for injection and extrusion

PUSHING THE LIMITS
ONLY WITH MAXI MELT
MANY YEARS OF EXPERIENCE

MAXI MELT has know how and capability to deliver custom-tailored screws that help customers to improve their process, their productivity and the competitiveness on the market place.

In the plasticizing process of plastic materials, screw and tip assembly are key factors. They provide automatic reproducibility of the production and are responsible for seamless manufacturing.

When productivity or mechanical properties of the moulded parts should be improved, but also if surface finish should be optimized, in order to reduce reject rate, screw design becomes a primary factor.

Screw design may allow in some cases the reduction of masterbatch, and, compared to a traditional three zone screw, provides lower energy consumption. In other words many aspects of the plasticizing process are optimized.

Based on the large experience in developing screw geometry, constant search for improvement and technical innovation, MAXI MELT can be YOUR PARTNER helping you to optimize your production process, in injection moulding, extrusion, blow moulding and blown-film extrusion.

We can help your company to improve its competitiveness.

We have been operating successfully for more than 30 years, first as partner of Kluin Wijhe B.V. (Netherlands) and now as independent organization Maxi Melt B.V., we continue delivering high performance machinery components for the plastic processing industry.

MAXI MELT is continuously developing new solutions to increase our quality standards, reduce production costs and reduce lead time.

In this brochure you may find more information about screw geometries different from OEM’s standard. We can offer specific solutions to improve output and keep good melt quality, at competitive price.

Should you need further information, please get in touch with our sales organization.
WHY A SPECIAL SCREW DESIGN IS NEEDED?

All plastic materials have bad thermal conductivity, so that melting a plastic granule to the core in case of fast cycling, might require quite a long time, which does not help high productivity. To overcome this issue, injection screws for fast cycling, have a higher compression ratio that produces friction heat and helps melting the granules.

Making a higher compression ratio may lead to overheating, and this causes degradation of the polymer in the compression zone; the degraded plastic build up a black deposit on the screw core, and after some time back particles start to flow in the moulded parts producing non usable parts.

On the other hand if the compression ratio is too low, in case of semi crystalline polymers, there is a high risk of filling the mould cavity with non melted granules which leads to fragility. Furthermore in the metering zone the screw cannot produce an homogeneous melt.

It is not easy to design a well balanced screw that processes all polymers correctly. OEMs often recommend a general purpose screw, but these screws in most cases do not perform in a satisfactory way. The limitations of such screws become evident as soon as fast cycling or tight process tolerances are required. Based on the knowledge of polymers processing, MAXI MELT technologists can match all these requirements. In this brochure you will find a description of our screws that will help you optimizing your production.

**SCREW WITH MAXI MELT DESIGN**

The MAXI MELT screw is a UNIVERSAL solution that can process all polymers in the best way. Well defined compression ratio, variable pitch and a dynamic mixer, deliver an homogeneous melt without overheating the granules. The resulting melt temperature may be lower than the melt obtained with a traditional screw.

**Barrier Screw**

Barrier screw has a secondary flight that separate the molten polymer from the solid granules: the channel becomes narrower along the screw and the melting will speed up.

Customers who don’t need to work with all polymers might use this type of screw.

**Screw With 3T Mixer**

This screw is a three-zone screw that has short barrier element (4 flights) in the metering zone and a short pineapple mixer at the front end. The melt quality is improved and dosing is speed up versus traditional 3 zone screw, but is not a universal screw.

**THREE-ZONE SCREW WITH CUSTOM DESIGN**

To improve the plasticization of a single polymer, a specific 3-zone design can be modified. Usually the variation is applied on the length of the feeding, compression and metering, pitch, core diameter and front and rear radius of the flights. The resulting customized screw is not universal.

**Thermosetting Screw**

The very high torque during screw rotation and the specific properties of thermostetting resins require a special screw design to avoid curing during plasticization and screw breakage.
SCREW WITH MAXI MELT DESIGN

The screw with MAXI MELT geometry is the only one really universal, it can work all type of polymers giving better control of the plasticizing process.

VARIABLE PITCH AND TAPERED CORE

The Maxi Melt screw profile was developed taking into account the polymer properties during melting process: the use of a complex algorithm allows to reproduce the same geometry on all possible screw dimensions starting from Ø14 mm up to 220 and above.

The Maxi Melt geometry has tapered core without the 3 zones (feeding, compression and metering) of most common screws. The variable pitch, shorter in feeding section and longer on the front part of the screw, allows a gentle but effective melting of the granules. The distributive mixer at the front of the screw assures the best homogeneity of the molten polymer. The compression ratio is lower versus most of the traditional screws, and this give two additional benefits: lower motor torque (less energy consumption) and lower shear stress during the melting process.

The result is a melted polymer with narrow temperature range at the desired temperature. The Maxi Melt screw melts the granules without overheating and without unmelted granules even at higher peripheral speed of the screw.

The benefit you may find by using MAXI MELT design are:

- PRODUCTIVITY INCREASE
- SURFACE FINISH IMPROVEMENT
- ENERGY SAVING
- HIGHER MECHANICAL PROPERTIES
- REJECT RATE REDUCTION
- FASTER PROCESS START UP
- LESS MASTERBATCH
**PUSHING THE LIMITS**
ONLY WITH MAXI MELT

**SCREWS WITH MAXI MELT DESIGN**

**MIXER**
The screw with MAXI MELT design has a dynamic mixer in the front section; when the melted polymer passes through the pins of the mixer, it is stirred to an homogeneous melt with narrow temperature range. The pins are cut so that no hold up spots and no restriction to the flow occurs. The result is a distributive mixer that can work also with PVC resin without any degradation and does not break glass fibre in reinforced plastics.

Maxi Melt mixers produce a very homogeneous melt and no pressure drop so that productivity is not affected; very accurate manufacturing of the pins prevents hold up spots also with shear and temperature sensitive polymers like POM, PC, PMMA and PVC; as a consequence deposit will not build up and black particles will not cause rejects.

Maxi Melt mixers are “self cleaning” because the polymer flow takes away any possible deposit at every shot. In most cases a static mixer is not necessary when using the Maxi Melt mixer. But there are many other advantages.

**PRODUCTION OF COLORED PARTS**
Using MAXI MELT mixers, it is faster to change from a colour to another, pigment distribution is better and it is often possible to reduce the amount of masterbatch used on conventional screws.

**MECHANICAL PROPERTIES OF MOULDED PARTS**
Maxi Melt mixers assure a better homogeneity of the melt together with an easier control of the processing temperatures. In this way it is possible to obtain moulded parts with better mechanical properties. When moulding polymers with glass fibres, it was observed less breaking of the fibres. This results in an increase of the mechanical properties that can be up to 20 % versus conventional three zone screws.

**FILLING PRESSURE AND SURFACE FINISH**
Thanks to a better homogeneity, the molten polymer flows more easily into the tool cavities and the pressure required to fill the mould is lower. Also the surface finish of the part looks better without splay and flashing at the cavity parting line.

**ADDITIVES**
MAXI MELT mixer has a positive effect also on the distribution of the additives in the moulded part; in case of flame retardant compounds there will be less problems to pass UL tests also for parts with thin walls.

**REGRIND**
Usually regrind is made of parts with different dimensions. During plasticizing, smaller regrind will melt first and may have a too long residence time so that degradation may occur. Larger size regrind, on the contrary, may have not enough time to melt completely delivering therefore unmelts. The Maxi Melt screw geometry and mixer can avoid both problems; it is possible to work with higher quantity of regrind without the typical dosing and cushion inconsistency. The screw retraction time remains stable and surface finish will be improved.
**PUSHING THE LIMITS**
ONLY WITH MAXI MELT

Maxi Melt screw was developed in 2002; since then it was used to process all polymers, both amorphous and semi crystalline, with major advantages compared to conventional screws. Over this period of time the basic concept remained the original one, but our Researchers have worked to improve the performance and to diversify the project in order to meet specific requirements of our customers.

**MAXI MELT PRECISION**

For technical moulding, keeping the same process parameter is the key requirement to achieve tight tolerances, but also high reproducibility is requested if process certification is needed. Maxi Melt screws fulfil these requirements also in case of high dosing strokes.

**MAXI MELT PRECISION** screw can operate also in difficult conditions with very narrow processing window, where conventional three zone screws show insufficient process stability. Having a standard deviation (distance from the mean value) of 0,05 and below, is not uncommon also for difficult polymers like PBT. On top of this **MAXI MELT PRECISION** gives a better surface finish even when shear sensitive polymers like POM, PC and PVC shall be processed.

**MAXI MELT PACK**

Injection moulding of thin wall parts in packaging applications requires fast cycling, thin cavities filling and high quality surface finish. To meet these requirements, often low viscosity polymers are used, sometimes compounded with elastomers to overcome their brittleness and added with light colour masterbatches.

The combination of low viscosity polymer, elastomer and light colour masterbatches represent an extreme challenge for the screws; in fact the molten polymer layers that build up during screw rotation, slip to each other without incorporating the elastomer and the pigments, especially when fast cycling is required.

For these reasons the **MAXI MELT PACK** has been developed. This new design increases locally the shear stress of the polymer while melting and can therefore rapidly mix the polymer and eventually the elastomer distributing the pigments homogeneously.
Among the possible geometries that a MAXI MELT screw may have, there are SPECIAL design developed to meet the processing of unconventional materials: moulding ceramic, neodymium compounds or polymers absorbable by the human body are just some examples of the many possible.

MAXI MELT SPECIAL has a profile studied to resolve the specific problem of a customer for a given application. These MAXI MELT is least suitable to be used to mould other polymers.

When moulding very tough polymers, e.g. used to produce fittings for large dimension pipelines, or technical parts with high properties, polymers with extremely high viscosity (MFR 0.2-0.8 g/10 min) are used. In such cases, the major issue for conventional three zone screws, is the overheating that occurs during screw rotation. To minimize the problem, very low screw rpm are used. Anyway sometimes it is not possible to completely avoid the overheating and high shrinkage on the moulded parts occurs; as a result it is very difficult to meet the requested tolerances.

The geometry of MAXI MELT ULTRA can manage such extreme conditions allowing the manufacturing of parts within tolerance.
BARRIER SCREW

Barrier screw design is characterized by an intermediate flight between the main flights, that separates the solid granules from the melted polymer. This separation makes the plasticization process faster, but is not suitable to process all polymers. Its major use is in packaging application.

The barrier screw, also called “transfer screw” has been developed by the Maillefer company in 1962, to optimize and speed up the plasticizing process. It is widely used for extrusion, and since the early 80’s it also used in injection moulding.

The barrier screw is basically a double flight screw. One flight has a smaller diameter and allows the molten polymer to flow over into the secondary channel. The main channel, which is conveying the solid granules, is decreasing its depth from feeding section to the front section of the screw, and so increases the shear helping the granules to melt fast. The secondary channel conveys the molten polymer to the front of the screw and its cross section is increasing accordingly. The secondary channel has only conveying function.

The barrier screw should be designed according to the polymer characteristics. The position where the secondary channel starts, the depth of the two channels and the position where it ends, have to be well defined together with the difference between main and secondary flights diameter. This geometry is suitable to process a single polymer or a limited group of polymers. It cannot be used as universal screw.

The advantages of the barrier screw versus conventional three zone screws are: increased plasticizing capacity, better temperature control and better melt homogeneity. When using this type of screw in injection moulding, it is often possible to reduce backpressure.

The main application of barrier screws is packaging, where high productivity is needed. As we already underlined this screw is not suitable for all polymers; especially shear sensitive polymers like POM, PC, PMMA and PVC may be damaged.

Based on its wide experience MAXI MELT has the know-how to develop barrier screw profiles according to your needs. Taking into account the polymer and the part you need to mould or extrude, we can offer the best solution.
3-T MIXING SCREW

The 3-T screw is a single flight screw for injection moulding ending with two dynamic mixers in front. The first mixer has a barrier design while the second one has a pineapple geometry. The combination of the two mixers increases both the shear stress and the melting of the polymer, making the plasticizing process faster and more effective if compared to traditional 3 zone screws. In some cases it may reduce the amount of masterbatch used. It is not suitable for all polymers.

A 3-T screw is basically a three zone single flight screw with two mixers on the front side:

BARRIER MIXER

The first mixer has a length of 3 to 4 times the screw diameter and is in principle a barrier design: two channels (or multiple variants 2-4), are divided by a secondary flight and allow the separation of the molten polymer. In the main channel, containing the solid granules, the volume decreases along the screw, while the secondary channel receives the molten polymer and increases its volume from the feeding to the front.

PINEAPPLE MIXER

The second mixer, placed at front end of the screw, downstream to the barrier mixer, is made of a few rows of pins (usually 3 to 6) that help the melt to become homogeneous and reduce unmelts.

This screw has been developed to reduce the plasticizing time in injection moulding. Its main application is in the packaging industry. The screw has a better homogenization of the melt if compared to a traditional three zone screw. In some cases it can reduce the amount of masterbatch.

The mixer of the 3-T screw will increase the friction in the melt, and therefore will also increases the process temperature if compared to other type of screws. This screw is not suitable to process temperature sensitive polymers like POM, PC, PMMA, PVC.

The company MAXI MELT has the know-how to develop 3-T screws to optimize your plasticizing process. Depending on the type of polymer and the moulded parts we offer optimal solutions.
3 ZONE CUSTOM TAILORED SCREW

To improve the plasticizing of a single polymer (or a group of polymers similar to each other) it is possible to develop a customized 3 zone screw by redesigning the compression ratio, the length of the 3 zones, the front and back radius etc.

Plasticizing screws with too low compression ratio risk to deliver unmelted particles in the moulded part. If the compression ratio is too high it can trigger the degradation of the polymer and generate screw deposit and consequently black particles: this means worse mechanical properties and higher reject rates due to bad surface finish.

Traditional 3 zone screws which are supplied by the moulding machine manufacturers, or as spare parts, are often screws with an average compression ratio which can work most polymers but not in a very satisfactory way.

Whether you don't need to purchase a 3-phase profile, a barrier screw or a Maxi Melt design, we can optimize your plasticizing process developing a single flight screw without mixer, customized to process one specific polymer or a group of similar polymers.

The optimization of the screw profile may modify:

1. The length of the three zones (feeding, compression and metering)
2. The height of the flights in the feeding and metering zone
3. The front and back radius of the flights.
4. The flight pitch
5. The width of the flights

The tailor made screw improves the plasticizing process of a polymer or of a group of similar polymers, but makes the screw unable to process properly all others.

For example, a screw with high compression ratio can avoid unmelts in semi crystalline polymers, but may very quickly generate screw deposit; on top of that it will overheat amorphous resins and consequently produce splays on moulded parts and deposit in the screw and in the tool cavities.

On the contrary a screw with low compression ratio is suitable to process amorphous and shear sensitive polymers, but has a bad performance with semi crystalline resins due to poor mixing, low mechanical properties and difficulty to keep tight tolerances on moulded parts.

Maxi Melt engineers have a wide experience in developing optimized screw profiles that may help you improving your production.
THERMOSETTING SCREW

When processing thermosetting resins, the plasticizing screw is exposed to a high torque; to avoid breakage during screw rotation a special geometry is needed.

In injection moulding, the temperature setting of the cylinder vary from 70°C to 100°C. In the tool's cavities they vary from 140°C to 190°C to complete the resin's curing. At temperatures up to 100°C the resin viscosity is still very high, and together with a high amount of fillers or reinforcements (up to 70%) the screw is subject to a very high torque. Furthermore high abrasive wear occurs on the front side of the screw, in fact in this zone the resin may start to harden applying a high stress on the flights. This behaviour of the thermosetting resins requires a special screw design.

A screw for thermosetting materials has the function to transport the granules from the hopper to the nozzle. There is no tip assembly and the molten mass is pushed directly into the cavities. The screw tip shall move very close to the nozzle adaptor, approximately to a distance of 0.3 mm.

Most of the thermosetting resins have an exothermic reaction during curing. It is therefore necessary to avoid hold-up spots, wear and overheating in the injection unit. For large size screws it is necessary to drill a conditioning hole along the axis of the screw for a better temperature control and so avoid overheating of the molten mass.

Screw compression ratio shall be between 1.0 and 1.2, and the length shall non exceed 15 ÷ 19 L/D. The height of the front flight shall be greater than 3.0 mm, the angle on the tip shall be 75 to 90°; the width of the flights may vary from 0.1 to 0.16 D.

Screws for thermosetting resins have similar geometries to each other. The only difference may be the length of screw, that can vary according to the shot size and the reactivity of the compound. For instance processing very reactive epoxy resins, the screw shall be short and the thermosetting mass shall have a residence time as short as possible (maximum 3 cycles); using phenolic resins the screw can be longer and bigger shots can be plasticized. Based on this the screw dimensions (length of feeding, compression and metering) shall be tailored to the process. Also pre-mixing screws (usually called Jolly) shall be defined case by case. Jolly screws are used to prepare tablets for further processing.

MAXI MELT has the know-how to optimize the plasticization of thermosetting polymers, and may help you supplying screws with the right design to obtain high torque and wear resistance.
Solutions for injection and extrusion

MAXI MELT
The best solution to fight wear

Maxi Melt B.V.
Ds. K. Terpstrastraat 5
8121 P Olst
The Netherlands
Tel: +31 (0)570 234023
sales@maximelt.com
www.maximelt.com

Maxi Melt S.r.l.
Via D. Galimberti 8B
26841 Casalpusterlengo (LO)
Italy
Tel: +39 0377 911062
info@maximelt.com
www.maximelt.com

Maxi Melt Scandinavia
Representation office
Tråddrargatan 12
33532 Gnosjö
Sweden
Tel: +46 (0)70 7382817
maximelt@telia.com
www.maximelt.com

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