Krauss Maffei
PEOPLE FOR PLASTICS

COST EFFICIENCY, FLEXIBILITY AND HIGH QUALITY OUTPUT

Direct compounding with the IMC Injection Moulding Compounder

IN PARTNERSHIP WITH INDUSTRY

KraussMaffei is a premium partner for the plastics and rubber processing industries worldwide

Automotive

White goods

Construction

Life Sciences

Electrical/electronics

Whatever you aim to achieve in plastics or rubber processing, KraussMaffei is your partner. We are the only company with intensive expertise across the three main engineering fields. And we have a strong track record in integrating this expertise to develop new processes and systems.

Ready for any challenge

Our **Injection Moulding Machinery Division** supplies machinery and systems from 35 to 4,000 tonnes for standard applications and for all processing variants, together with fully automated solutions. We have a strong customer base in all the relevant industries worldwide.

Our **Reaction Process Machinery Division** supplies machines and complete systems for processing polyurethanes and other reactive materials. Completing our product portfolio, Automotive Component Systems supplies foam moulds, cutters and routers. Our customer base is wide, with a focus on the automotive, construction and white appliances industries.

Our **Extrusion Technology Division** supplies machinery and systems for compounding, for pipe, profile and sheet extrusion, physical foaming, and the production of technical rubbers and intermediates for tire production. Machinery from the company's range – from single extruders to complete extrusion lines – is used in many industries, including chemicals, pharmaceuticals, automotive, construction, furniture and packaging.

People for Plastics

We are the "people for plastics". We are your partners from the first exploratory discussion, through development to commissioning, servicing and operating your system, and final disposal. At all times, you are assured of outstanding competence in planning and engineering, as well as reliable and fast spare parts, service and support.

Adding value for customers

We put our expertise to work for your success. With machine ranges engineered for modularity, we can deliver application-specific solutions based on our wide range of standard modules and specially engineered solutions. This strategy offers customers technical and cost advantages.

Close to customers around the world

As an international company, KraussMaffei has a presence in all the major markets for the plastics and rubber processing industries and employs over 3,000 people worldwide. Our sales and service network keeps us close to all our customers around the world.

Packaging

Compounding and injection moulding integrated into a single process on one machine – the IMC Injection Moulding Compounder.

The IMC is unique in combining two value-adding processes – compounding and injection moulding – in one machine. It is an engineering innovation that supports your drive to compete on quality, cost and flexibility.

The IMC successfully teams up compounding and extrusion, a continuous process, with injection moulding, a discontinuous process. Processors benefit from the best of both worlds. The IMC Injection Moulding Compounder stands for a high return on investment, because its one-step process almost always yields parts with better properties and cuts the cost of raw materials substantially.

TRANSPARENT TECHNOLOGY

Meet the machine: take a tour of the IMC Injection Moulding Compounder

Clamp unit from a standard machine range
Proven performance, building block modularity, shortest dry cycle times for high productivity

Melt buffer
Holds continuously extruded melt during the injection and holding pressure phases

Weighing, metering and feed systems
Project-specific gravimetric metering

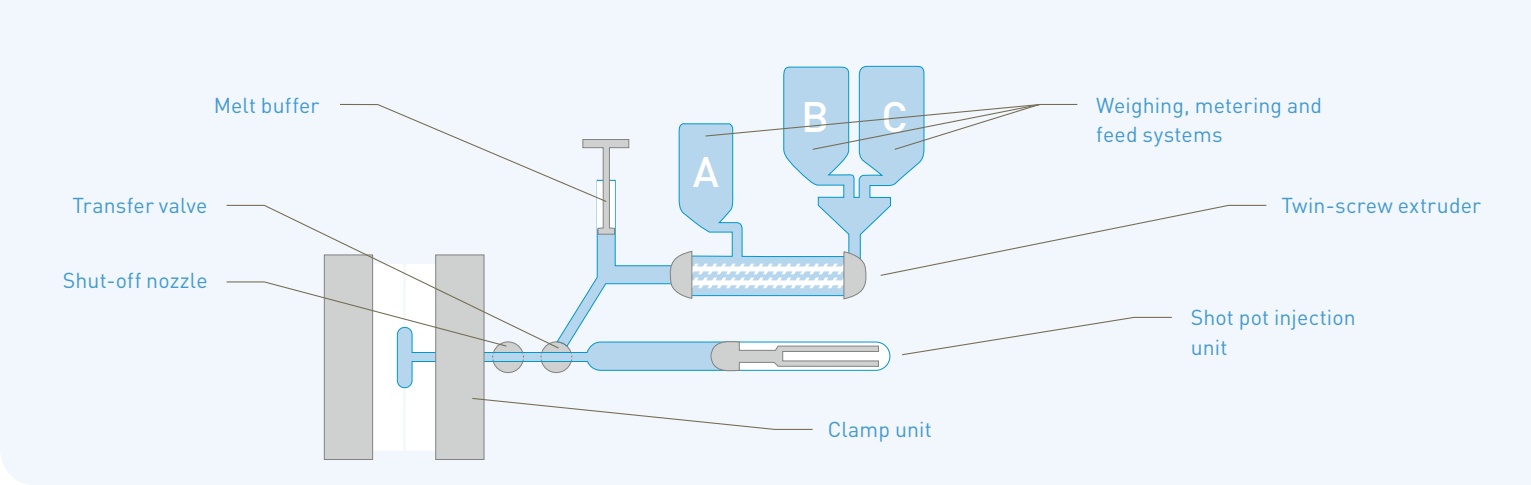
Twin-screw extruder
Corotating screws for high-performance plasticizing and mixing

Start-up valve (optional)
Start-up material is discharged and cooled in a water bath

Walkway
Easy access simplifies maintenance

Control system
Extrusion functions fully integrated for easy process set-up and monitoring

Shot pot injection unit
Injection piston for a wide range of shot weights



Main functional elements of an IMC Injection Moulding Compounder.

DESIGN BASICS

More information on the design and function of the main elements in an IMC Injection Moulding Compounder

Gravimetric metering for precise control of the formulation

Essential to the quality of the compounding process is the fact that all the constituents of the formulation are gravimetrically metered into the underfed extruder. Gravimetric metering is more exact than a volumetric system would be. Because factors such as through-put, material consistency and number of materials will differ from project to project, feed and metering systems must be engineered separately for each application.

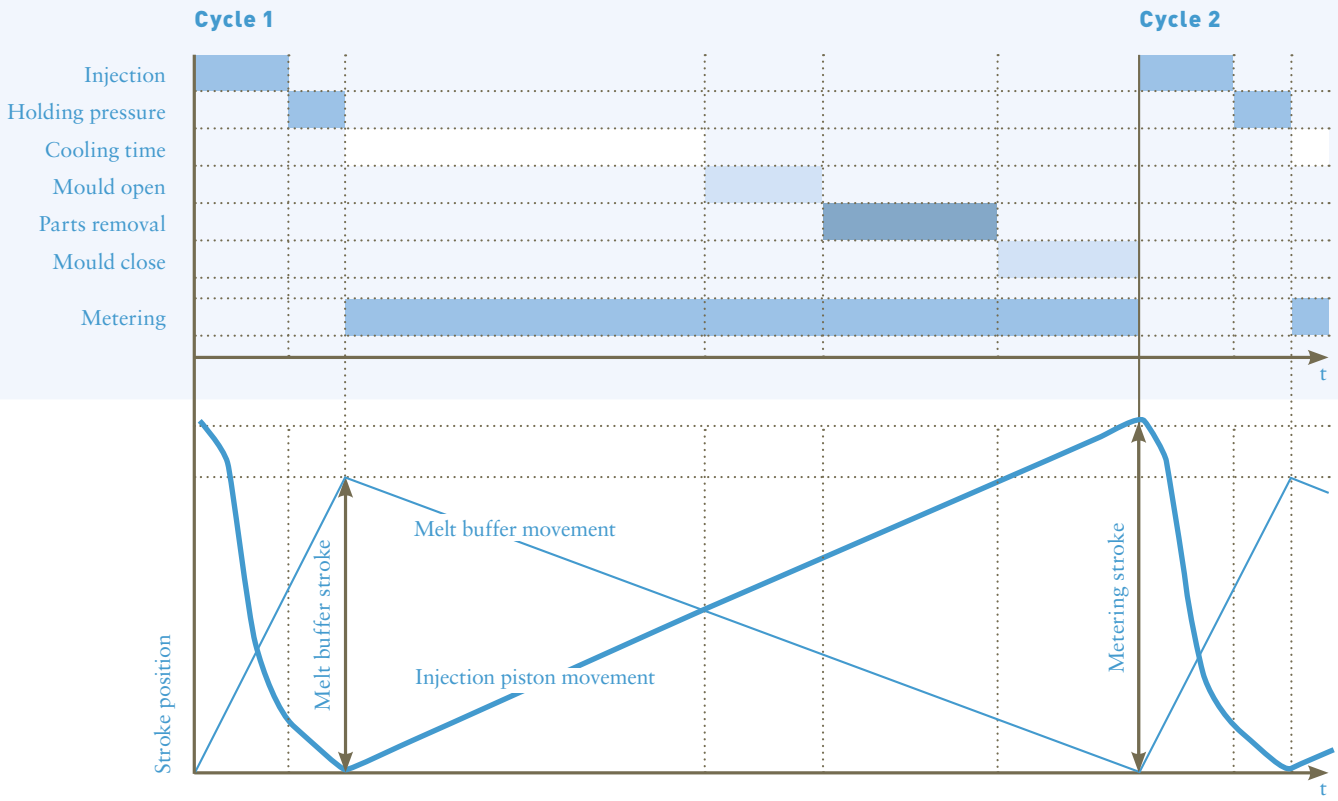
Plasticizing and injection units modified for the process

A standard injection moulding machine has a single-screw unit for plasticizing and injection; the IMC has a twin-screw extruder for plasticizing and a piston for injection. The IMC has six functional elements:

- Weighing, metering and feed systems
- Twin-screw extruder
- Melt buffer
- Shot pot injection unit
- Transfer valve
- Shut-off nozzle

Glassfibre rovings

Wood pellets



The melt buffer stores the extruded melt during the injection and holding pressure phases.

Stable process under constant conditions

How does the IMC work? The plasticized and homogenized material is moved from the extruder via a heated runner into the barrel of the injection unit. During the injection and holding pressure phases, the melt produced continuously by the extruder is diverted into the melt buffer. A transfer valve separates the high pressure and low pressure zones. Once the holding pressure ends, the transfer valve opens again and melt from the buffer is moved into the injection barrel, together with melt from the extruder. The melt buffer is completely emptied in each cycle, so that it only buffers material extruded during the most recent injection and holding pressure phases. Throughput is controlled automatically, so that the injection piston always has the full shot ready when the clamp unit is ready for injection.

2-platen clamp unit

KraussMaffei's hydraulic 2-platen clamp unit is compact, fast and low-maintenance. It is engineered to minimize mould wear and to ensure platen parallelism.

Beyond the moving platen, there is free access to the clamp, simplifying machine set-up and adjustment. The 2-platen clamp also makes it easy to implement special processes or meet special requirements. Outstanding access to the clamp make these machines ideal for the integration of automation systems.

Individual elements with a successful track record – the basis for uncomplicated processes and a high return on your investment

The IMC Injection Moulding Compounder was engineered on the basis that the more intelligent the individual elements, the simpler it is to run the process.

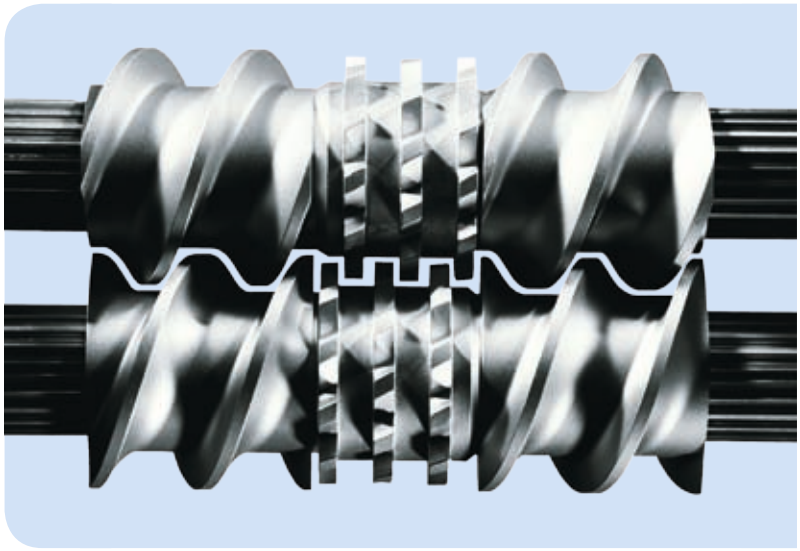
Compounding extruder with synergy benefits

With extensive knowledge of injection moulding and over 100 years' experience in extrusion processes, KraussMaffei has all the expertise for system integration available in-house.

The compounding extruder is a corotating, close-meshing (ie, self-cleaning) twin-screw extruder capable of high-performance plasticizing, gentle melting and good mixing. Both the screws and the barrel are configured from modular segments with each segment performing a specific function. In the screws, toothed discs and kneading blocks are lined up in a defined sequence for outstanding homogenization and dispersal of additives/filler. The line-up is purpose-configured for the application. The extruder has a far wider processing window than a conventional single-screw plasticizing unit. With gravimetric metering, screw speed and throughput are independent of each other. This makes it possible to control the mixing and degree of dispersion and also the melt temperature directly via the screw speed without affecting throughput.

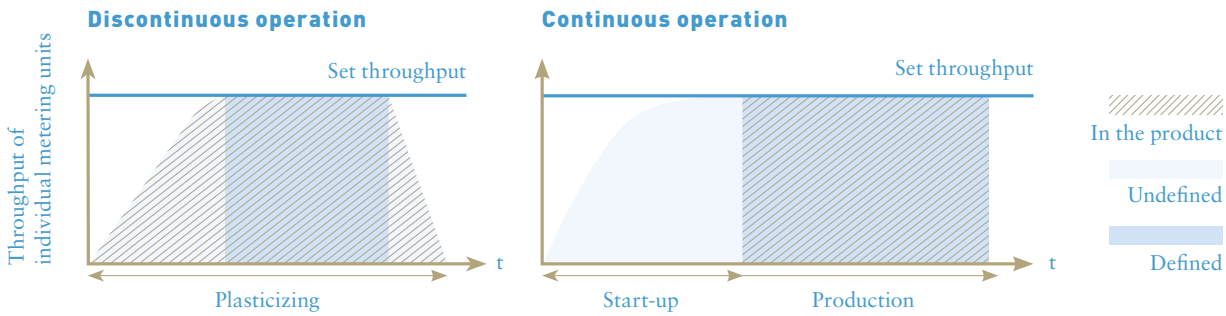
The extruder plasticizes continuously throughout the production cycle. The metering and feed systems also operate continuously. This ensures absolutely uniform feed of polymer and additives, eliminating any risk of variations in the formulation and in melt behaviour.

Segment-based screws allow rapid changes in geometry over very short distances.



Key benefits of a twin-screw extruder for direct compounding:

- Integrated venting zones instead of upstream predrying
- Smooth and reliable feed even of low density raw materials with poor flow properties
- Trouble-free conveying of powdery or "sticky" materials
- Very good plasticizing and homogenization



The continuous extrusion process ensures that the end product contains no material produced under undefined conditions.

Start-up valve removes doubtful material

The material produced during the IMC start-up phase is routed out of the system via the start-up valve. This ensures that no substandard material is incorporated in the product. An early warning system in the control software kicks in to route material which fails to meet defined tolerance thresholds out of the production process.

Melt buffer is gentle on material properties

The melt buffer holds the continuously extruded melt during the injection and holding pressure phases. The melt stream flows into the buffer at a controlled pressure. The buffer is completely emptied in each metering cycle. The intake and output channels are generously sized and rheologically optimized. The result is only minimal pressure loss. The design avoids geometries that could cause shearing and fibre-damage, and dead zones where material could form deposits.

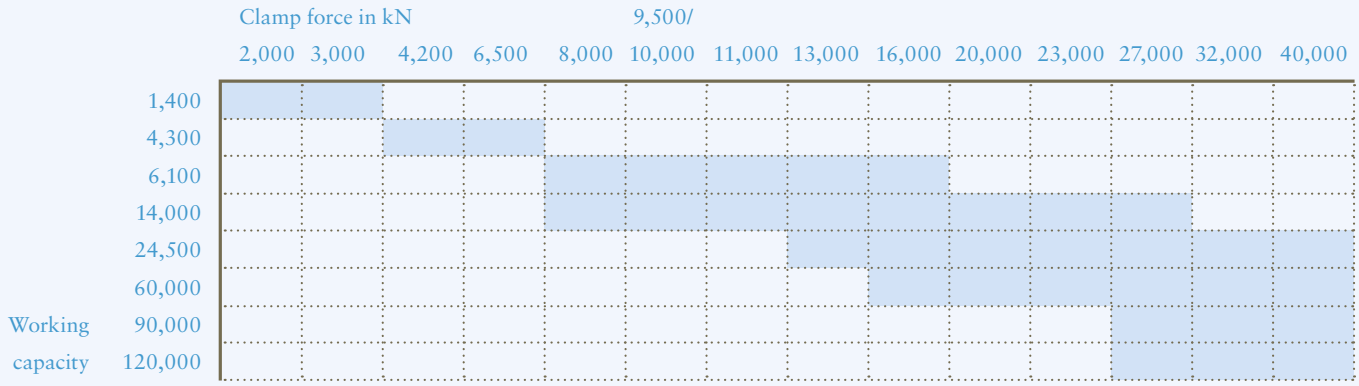
Injection unit – right for every application

The piston injection unit is engineered for high working capacity. The melt is fed to the front face of the injection piston. The shot volume is injected completely, so that there is no residue build up. All the flow channels are completely emptied in every cycle and melt dwell times are short. The transfer valve separates the melt buffer from the injection unit, so that maximum injection pressures can be built up during the shot.

Easy operation, detailed production log

With the extrusion functionalities seamlessly integrated in the control software of the injection moulding module, operating the IMC is like operating a normal injection moulding machine. To check that the product always meets specifications, the material formulation for every shot is automatically documented.

IMC Injection Moulding Compounder: working capacity/clamp force.



SOLUTIONS FOR TODAY AND TOMORROW

At home in many industry sectors, the IMC Injection Moulding Compounder is also a prime candidate for innovative applications

Think plastics, think variety. The number of different plastics products is huge. KraussMaffei's range of machinery for plastics processing is differentiated to match – and open for completely new applications.

Longer fibres and no post-processing

Adding reinforcing fibre significantly improves properties of plastics, such as flexural strength, modulus of elasticity, impact resistance, thermal stability and shrinkage characteristics. The chief technical advantage of adding fibre on the IMC is that the matrix polymer is plasticized first and the fibres are then added to the melted polymer.

A conventional single-screw machine, by contrast, processes already-compounded pellets which must be remelted during the process. As they enter the screw feed zone, still cold, they are subjected to high shear forces which cause the fibres to snap. Compaction and the continuing plasticizing process further shorten fibre length. Direct compounding on the IMC results in significantly longer fibres in the final product. While press moulding with fibre mat also preserves fibre length successfully, it has the disadvantage of requiring extensive post-mould trimming. An injection moulding process completely eliminates this requirement. The IMC can be a cost-effective option even for short glassfibre applications when shot weights are high, because it offers the prospect of optimizing materuial properties while keeping material costs low.

Great prospects for fillers

Filler content can reduce costs, as a substitute for more expensive plastics, and optimize product properties. The closely meshing twin-screw extruder is ideal for compounding fillers. It easily accepts large quantities of mineral filler, for example, and mixes and distributes them evenly throughout the molten plastic. Its mode of operation prevents the formation of agglomerate as well as bubbles of moisture or air in the melt.

Front-end carrier: Fibre reinforcment improves product properties and cuts material costs significantly.

The advantages of the IMC Injection Moulding Compounder are very clear in the case of parts with a high filler content. As soundproofing elements, damping mats contain a high content of barium sulphate, an acoustically effective filler.

PET flakes

HD-PE

HD-PE regrind

PP+glassfibre

PP+bamboo

PP+wood

Applications by industry sector

High shot weights maximize productivity
The high-performance extruder achieves high working capacity and higher injection volumes. This makes it ideal for use with stack moulds or to produce heavy, thick-walled parts. Manufacturing plastic pallets is a good example of an optimal use for the IMC. In addition to the high shot weights required for the pallets, the IMC also makes it easy to incorporate regrind or filler as an effective way of reducing raw material costs.

Automotive
- Front end supporting bracket
- Door module
- Instrument panel carrier
- Underbody casing
- Tailgate
- Spare wheel well
- Battery housing
- Bumper
- Exterior components
- Oil sump
- Sound absorber
- Fan wheels
- Wheel housing
- Parcel shelf
- etc.

Packaging
- Re-usable pallets
- Export pallets
- Transport containers
- Wood-look crates
- PET preforms
- etc.

Electrical and electronics
- Television housings
- Large parts with short fibre reinforcement
- Counterweights – high-density parts
- etc.

… and much, much more. In fact, any material compound that is moulded into a three-dimensional shape.

Built-in economic and process advantages – it's over to you to exploit them

The IMC Injection Moulding Compounder offers you totally new possibilities for formulating your own compounds before processing them in a one-stage process. You can combine a plastic with your choice of product-specific reinforcer, filler or substitute. Switch on, produce and profit.

Cut raw material costs

By mixing your compounds yourself you will be able to achieve a significant reduction in raw materials costs. Raw material costs make up a high share of total manufacturing cost, in particular if you're working with special formulations. With the IMC, you can incorporate this stage in the added-value chain into your own operation – by purchasing your raw materials separately and more cheaply and then compounding them exactly as required for your application. With lower raw material costs, your investment in an IMC Injection Moulding Compounder will pay off faster, as you can see from the typical calculation on the left.

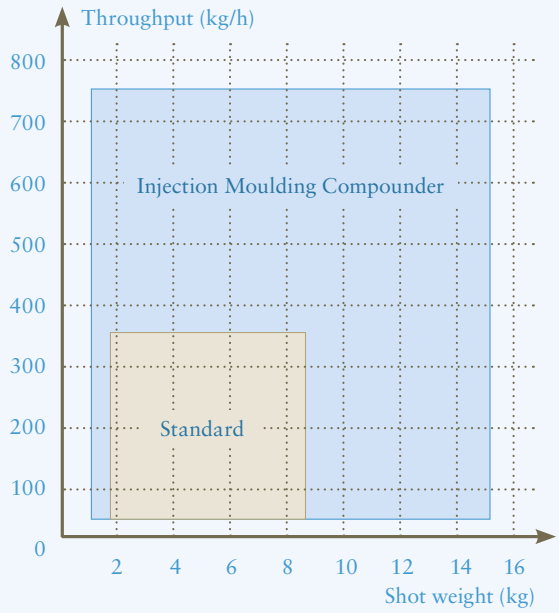
Optimize mechanical properties

Direct processing on an IMC Injection Moulding Compounder delivers higher product quality, especially in relation to fibres and fillers. With endless glass-fibre rovings, the average fibre length in the product is increased, with a corresponding increase in impact strength. Fibre distribution is extremely homogenous. You can also see savings in consumption of some additives – such as colour masterbatch – owing to more homogenous dispersal in the polymer. And the IMC process is the only way of incorporating a high proportion of some fillers – such as iron oxide and graphite.

More flexibility in your choice of materials

Anything goes: from blends and recycling materials, through genuine reinforcing materials, to any type of filler. Whatever material you are adding is fed into the extruder "downstream" of the polymer, and the feed point can be optimized for your process. Since you formulate your compound yourself, you don't face the problem of minimum order quantities. You can develop new compounds rapidly whenever you need them. And you don't need to compromise on the formulation. You'll be able to react more flexibly to changing market conditions, and you can substitute less expensive raw materials to give your products the edge on cost competitiveness.

Comparison



The processing window of the IMC Injection Moulding Compounder far exceeds that of a standard screw.

Sample calculation for PP with 30% long glasssfibre

Injection unit:

Standard	SP 24500
IMC	SP 24500

Injection diameter:

Standard	165 mm
IMC	165 mm

Plasticizing diameter:

Standard	165 mm
IMC	81 mm

Plasticizing time (as % of cycle time):

Standard	50%
IMC	100%

How you can benefit:

- Reduce raw material costs by 0.30 €/kg – 1.00 €/kg
- Better mechanical properties: longer fibres and improved homogeneity
- Absolute flexibility in choice of materials
- Enhanced material quality by eliminating cooling and reheating
- Excellent plasticizing performance
- Wide range of shot weights

Sample cost calculation*

for PP with 30% long glassfibre

IMC	Glassfibre rovings	1.30 €/kg, 30%
	PP	1.10 €/kg, 66%
	Additive package	3.50 €/kg, 4%
		1.26 €/kg
Rod granulate	PP LGF 30	**2.20 €/kg**
Saving in raw material costs		**0.94 €/kg**

*Date: 2nd quarter 2007

Boost material quality cost-effectively

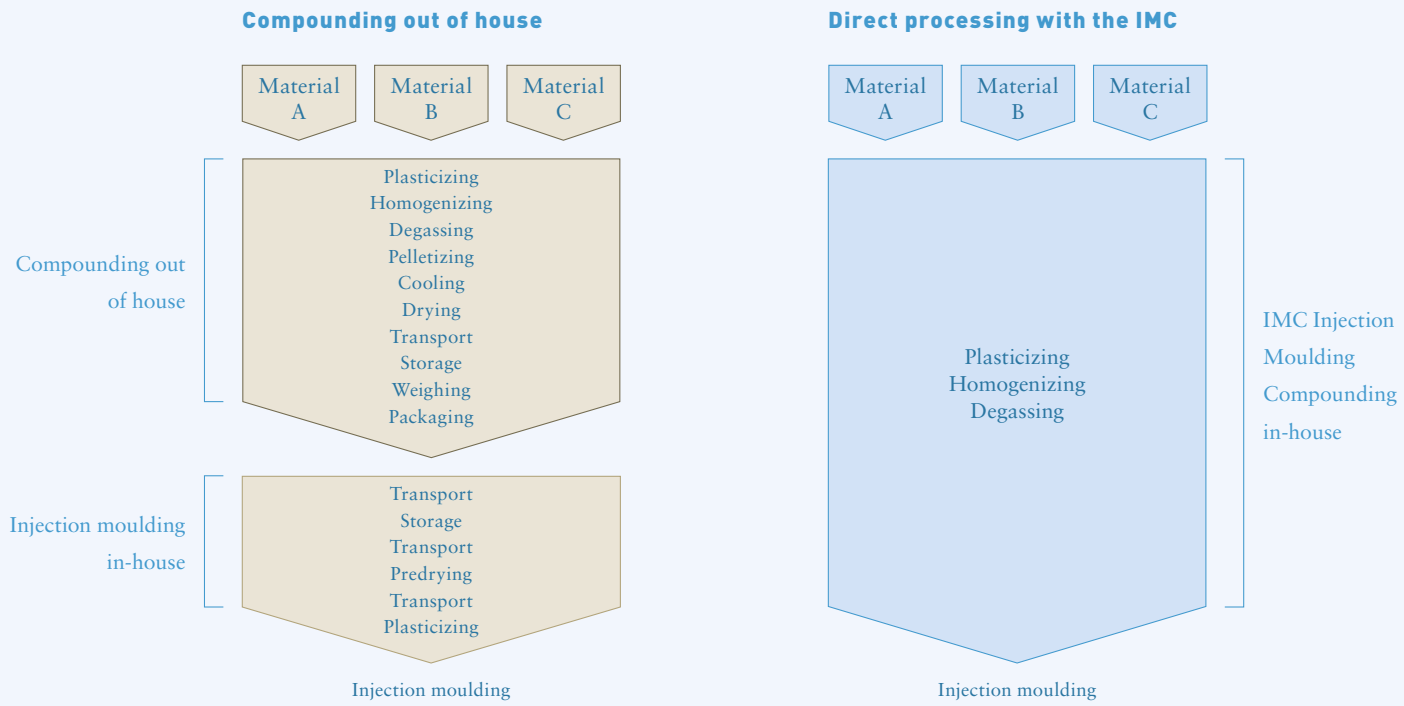
In the single-stage process, the material is treated more gently, because it is only plasticized once. The melting temperature is usually lower than in conventional plasticizing. The result is better melt quality, in the case of temperature-sensitive materials, and better quality for the end product. In some cases, cooling times are shorter.

Take advantage of excellent plasticizing performance

Twin-screw machines deliver excellent plasticizing performance even with small diameters. This results in short cycle times, because plasticizing time does not overshoot cooling time. You can also be sure of constant high material quality, since the effective screw length of the extruder does not change.

Make the most of the wide range of shot weights

Run smaller and larger shot weights on the same machine? The IMC Injection Moulding Compounder makes it possible. Since plasticizing and injection are independent of each other, the IMC can be used for a wider shot weight range and will consistently deliver high-quality melt.



IMC direct processing with fewer process steps reduces raw material costs by 0.30 to 1.00 €/kg.

SERVICE WORLDWIDE

Service, support and spare parts – when you need them, where you need them

Rely on us for a fast and competent response to all your service needs anywhere in the world. Whatever you need – from troubleshooting and training to spares or repairs – we're on the job.

We're dedicated to supplying service quality on a par with the outstanding quality of our machines and systems. We offer far more than spare parts and hotlines. We'll work with you to choose the best and most cost-effective solution for your operation. We'll help you test new applications and we'll plan customized service packages.

All-round service

Our service offering is broad. We'll configure your system, install and commission it, train your staff, plan measures to minimize your downtime risk and maximize productivity, and carry out maintenance, repairs and upgrades. You'll find us fast, reliable and competent. Our hotline is manned by highly-trained and experienced service technicians.
If necessary, we'll get a technician to you quickly. Remote diagnosis, interfacing directly with your machine's control system, can be a practical alternative. Spares for all important wear parts are available at short notice. We're continuously expanding our service network to speed up spare parts shipment. Talk to us about the right service solution for your business.

Customer trials and prototyping in our test lab

The Injection Moulding Machinery Division operates a test lab fitted with the latest machinery and equipment. We can run trials, produce prototype parts and fine-tune processes on your behalf. We can work with you to test and evaluate processes, machines and equipment in order to identify the best approach for a particular project. Our highly-qualified application engineers are there to help you.

Training with high hands-on content

Courses are held in our lab and training centre, or, optionally, on your premises. We offer clearly-structured basic and advanced training in operation, process control and maintenance for KraussMaffei injection moulding machinery. On request, we'll plan and hold special courses on topics of your choice. All participants spend a high proportion of their training working hands-on with original KraussMaffei machines. A well-structured training program produces skilled operators and technicians, which will positively impact your up-time and productivity.

At your service worldwide

Team Europe

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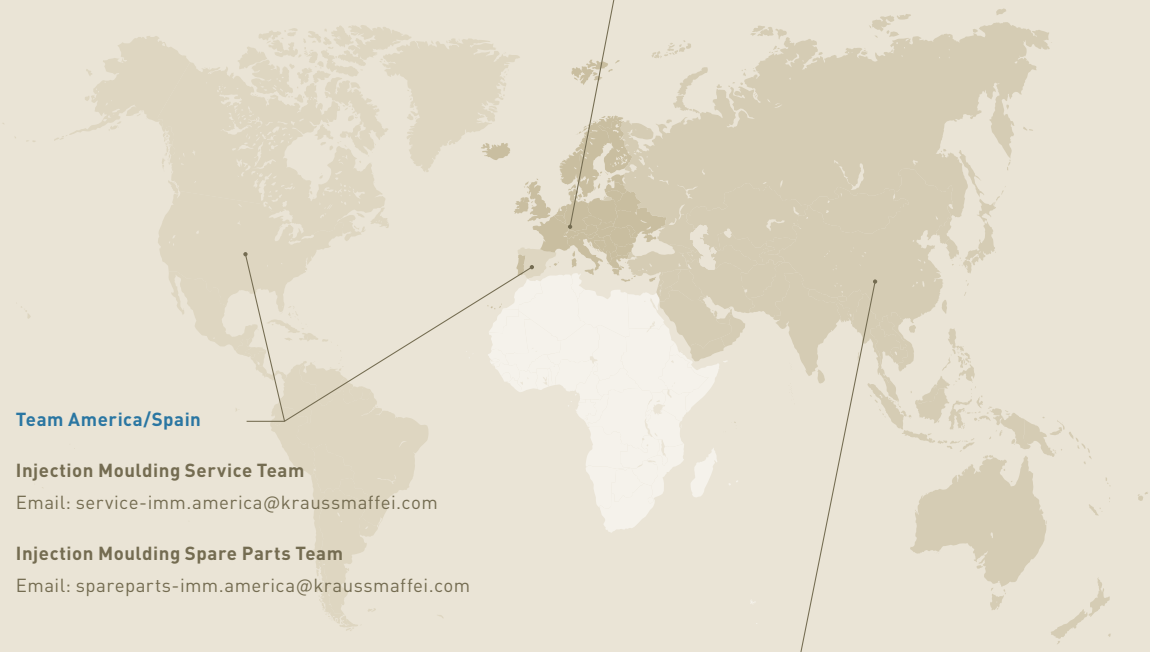

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KraussMaffei is a premium partner for the plastics and rubber processing industries worldwide. KraussMaffei machines and systems are used wherever plastics and rubber are converted into products. As a knowledge-driven technology company, we build on many decades of experience and a strong commitment to research and development.

The IMC injection moulding compounder opens up completely new prospects for processors to compound and inject their own product-specific formulations in a single-stage process. You can combine a polymer with any reinforcing material, filler or substitute material to suit product specifications. You see the biggest benefits with applications involving high filler content, high throughput or complex compounding tasks.

The IMC Injection Moulding Compounder with its innovative engineering is an assured solution with potential for high returns on your investment in any application where you want to compound your own formulation immediately ahead of injection moulding.

1.0 WE . 3rd edition 01/09 . SGM 043 C PRO 09/2007 GB ··· KraussMaffei reserves the right to make technical changes.

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