tset

The Tset tech modules series:

Injection Moulding: Enhanced efficiency with software-based cost management

Tset tech module series: Injection moulding

July 2024

Content

Whether automotive, consumer goods or electronics - injection moulding is used as a manufacturing process in a wide range of industries.

The ability to produce complex and high-precision components makes the process particularly suitable for mass production. However, in order to guarantee high quality, various factors must be taken into account, which can quickly lead to additional costs. Another challenge is to keep an eye on CO_2 emissions at component level.

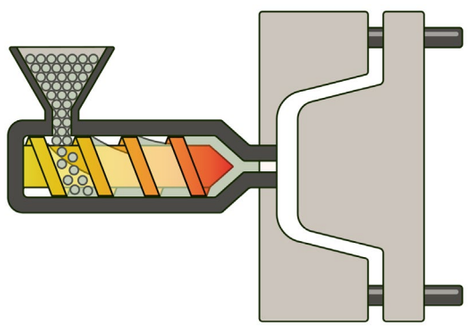
The solution: User centred cost management software.

01 Injection moulding at a glance

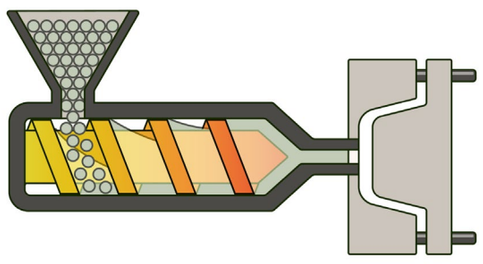
Injection moulding is a widely used manufacturing process that is particularly suitable for the production of complex and high-quality components in large quantities.

The plastic granulate is plasticised in the screw of the injection moulding machine and injected under high pressure into a mould cavity. This process offers high production efficiency, precision and the ability to produce complex and detailed components.

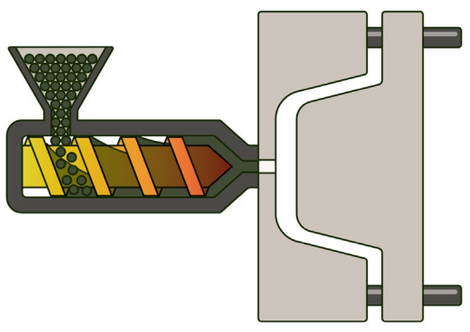
It is also cost-effective due to the fact that reworking is generally not required and enables the production of large quantities with consistent quality and low material waste.



Plastic Injection



Micro Injection

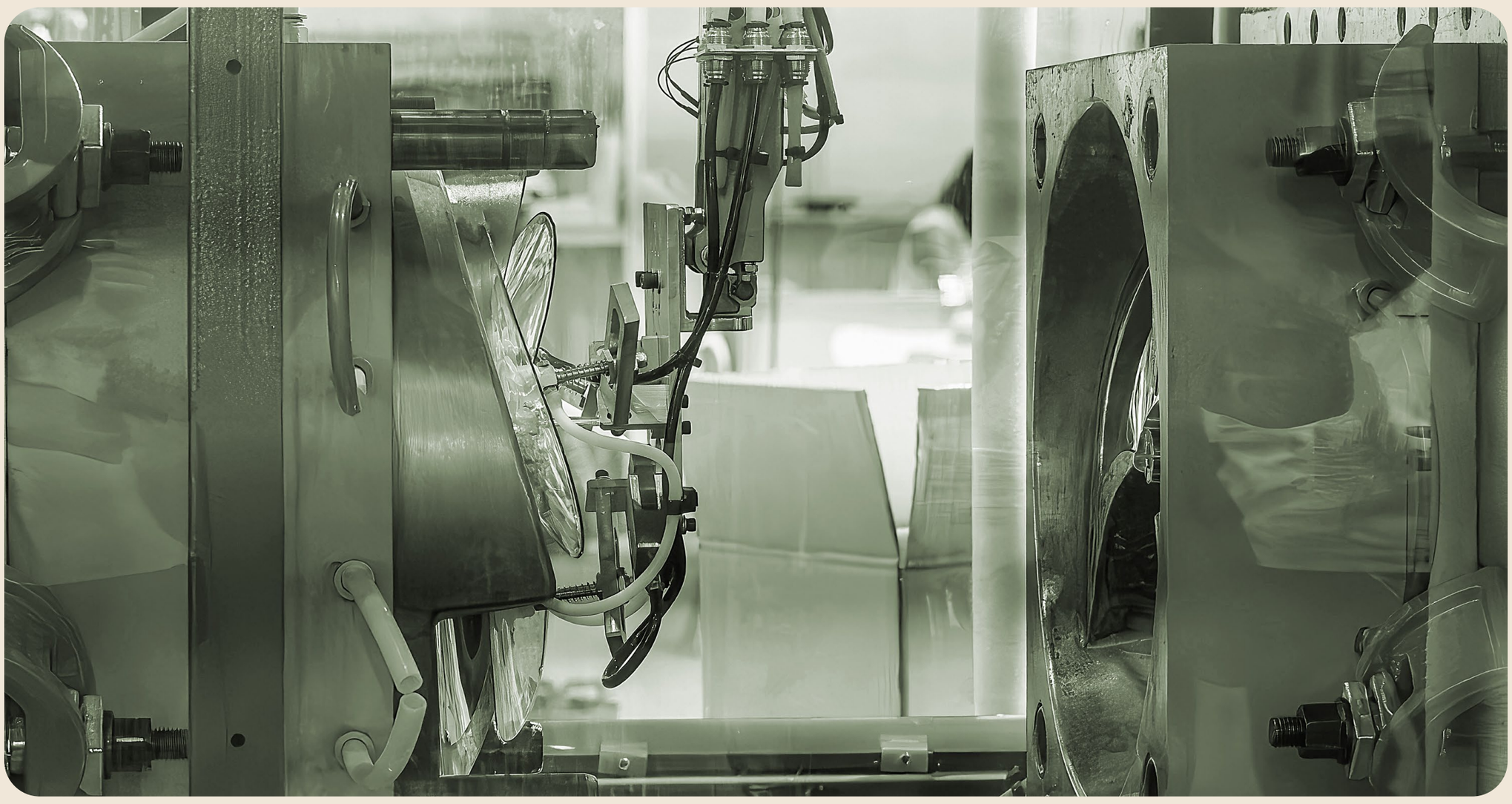


Rubber Injection

Available injection moulding technologies in Tset

Complexity with quality: challenges in injection moulding

The injection moulding process is therefore highly automated. In order to optimise this process as economically as possible, a number of parameters need to be considered. Firstly, the mould costs can have a significant influence on the component costs. It is therefore important to design and construct the mould in such a way that the components fulfil the specific requirements of the respective application.



The mould costs depend on various parameters: Mould dimension and weight, steel grades, gating system, part tolerances and mechanical elements such as sliders, collapsible cores or unscrewing units. The production location of the mould also has a major influence on the mould

price. In addition, the choice of suitable plastic material is of decisive importance. Factors such as shrinkage, warpage and residual stresses must be carefully considered to ensure that the end product meets the desired specifications.

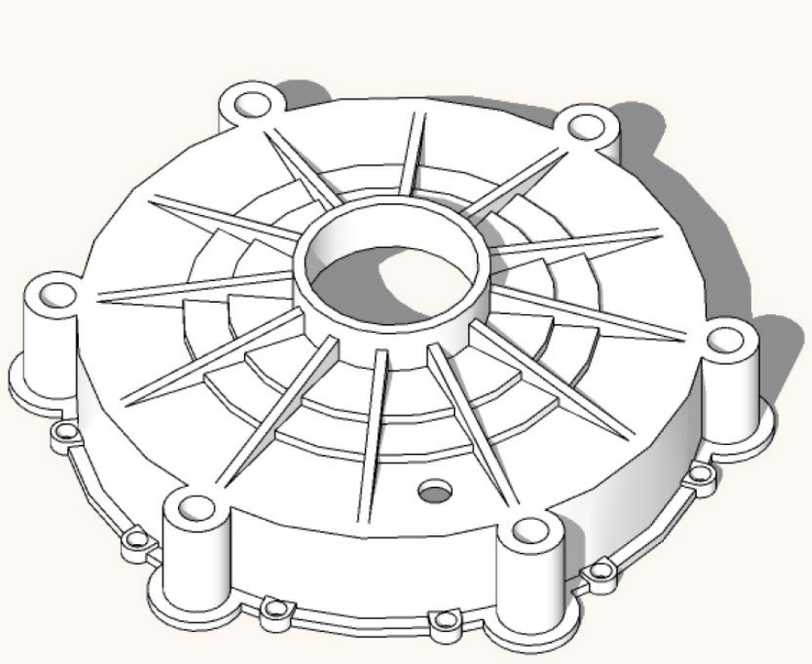
Another important aspect of injection moulding is quality control. Fluctuations in material properties, machine settings or environmental conditions can affect the consistency of the end product. Regular tests and inspections are therefore essential in order to recognise and correct deviations.

Last but not least, the issue of environmental protection is also playing an increasingly important role. To make injection moulding more sustainable, the use of biodegradable materials is currently being researched, as is the optimisation of production processes to reduce energy consumption and the development of recycling processes for the waste produced.

02 Factors influencing the cost structure of injection moulded parts

Chosen plastic type, wall thickness profiles, gating system and part geometry: key factors for cost calculation in injection moulding

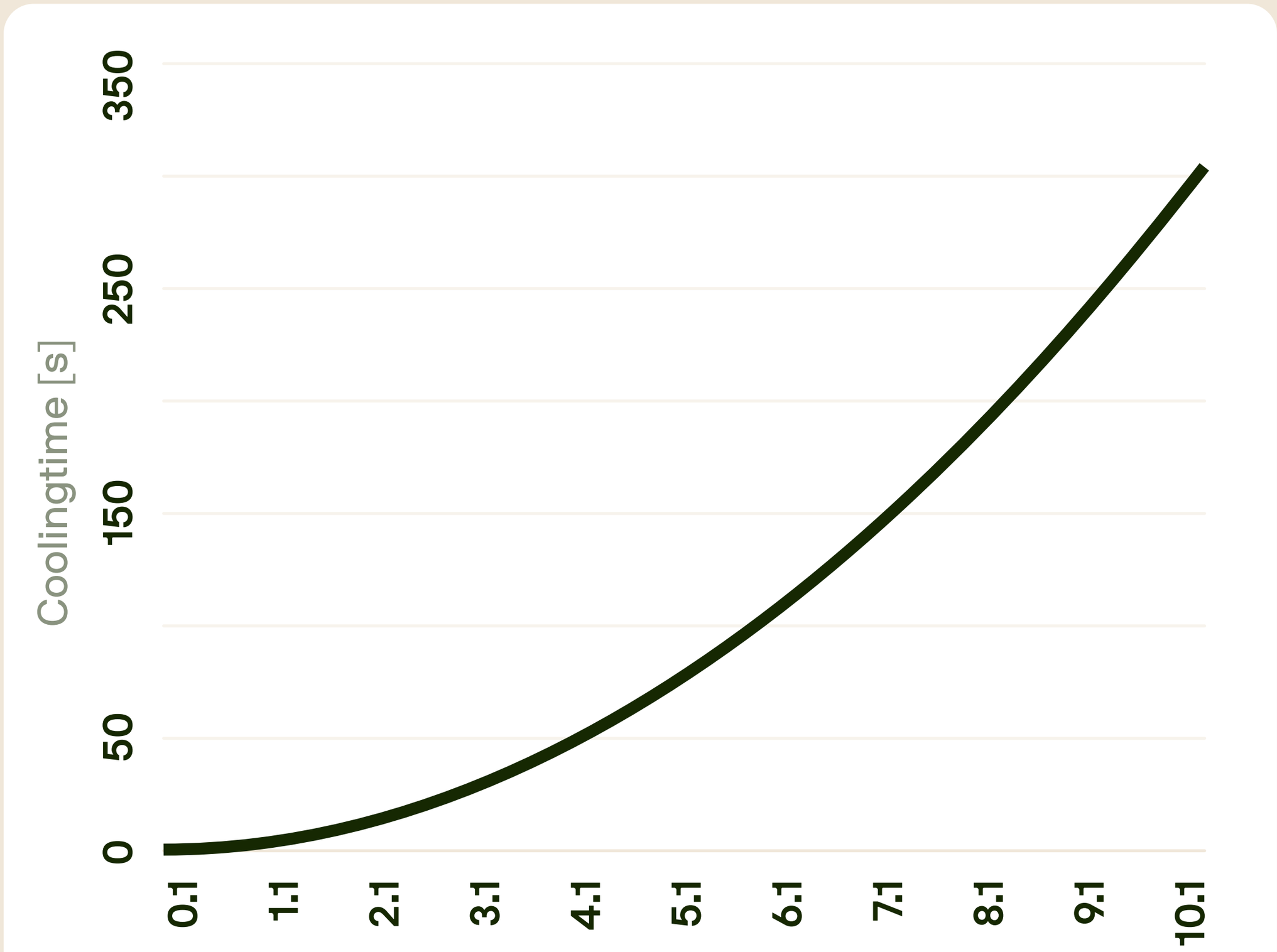
Various parameters play a role in the cost calculation of injection moulded parts. These include: Material used, clamping force of the injection moulding machine, production location, mould concept (mould costs) and ultimately the cycle time. The parameter with the greatest influence on the cycle time of the injection moulding process is the maximum wall thickness of the component. This determines the duration of the cooling time. The greater the maximum wall thickness, the longer it takes for



Injection S_580

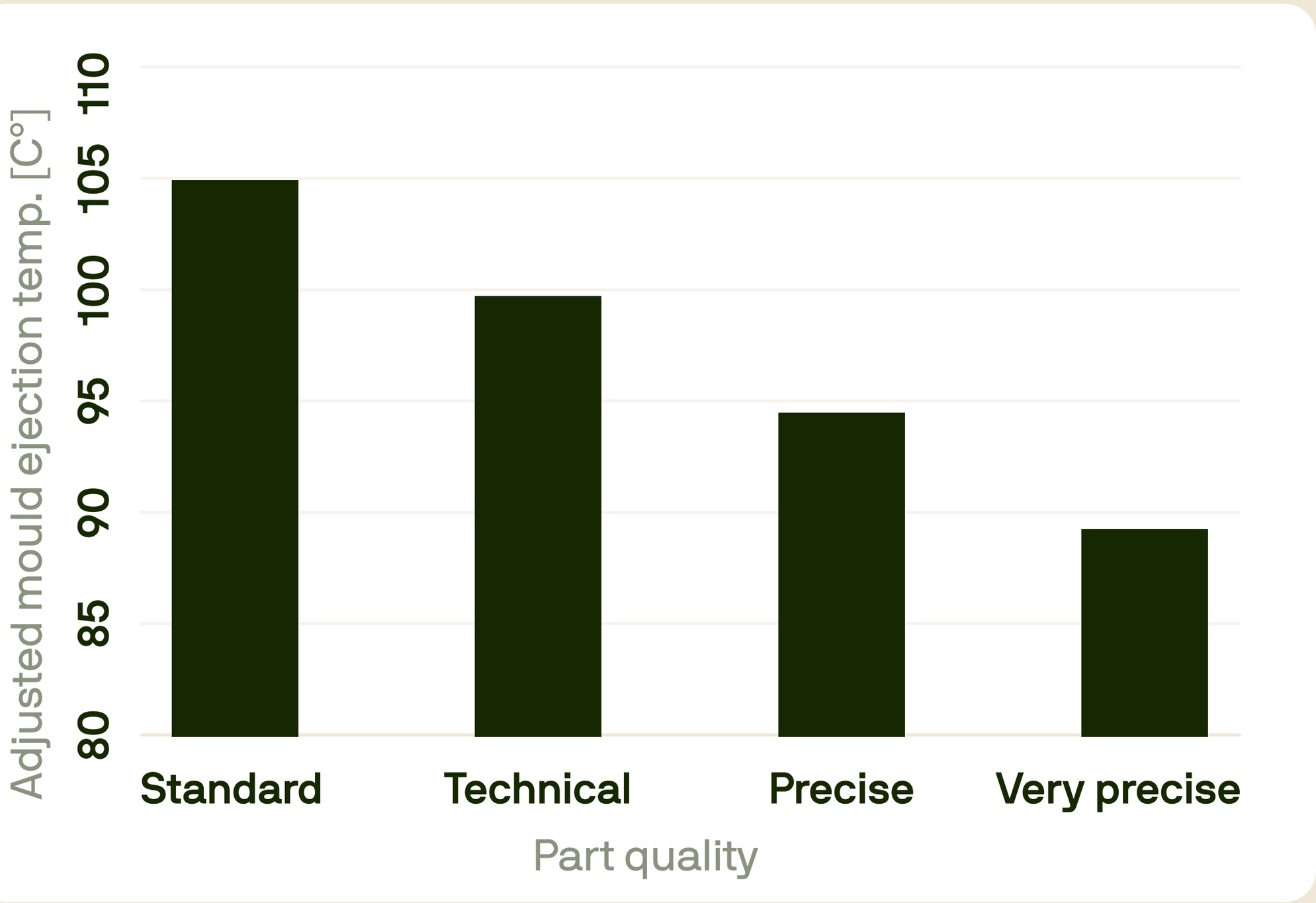
Sliders	No Sliders
Runner Type	Hot runner

the component to cool down to the temperature at which it can be removed from the mould.

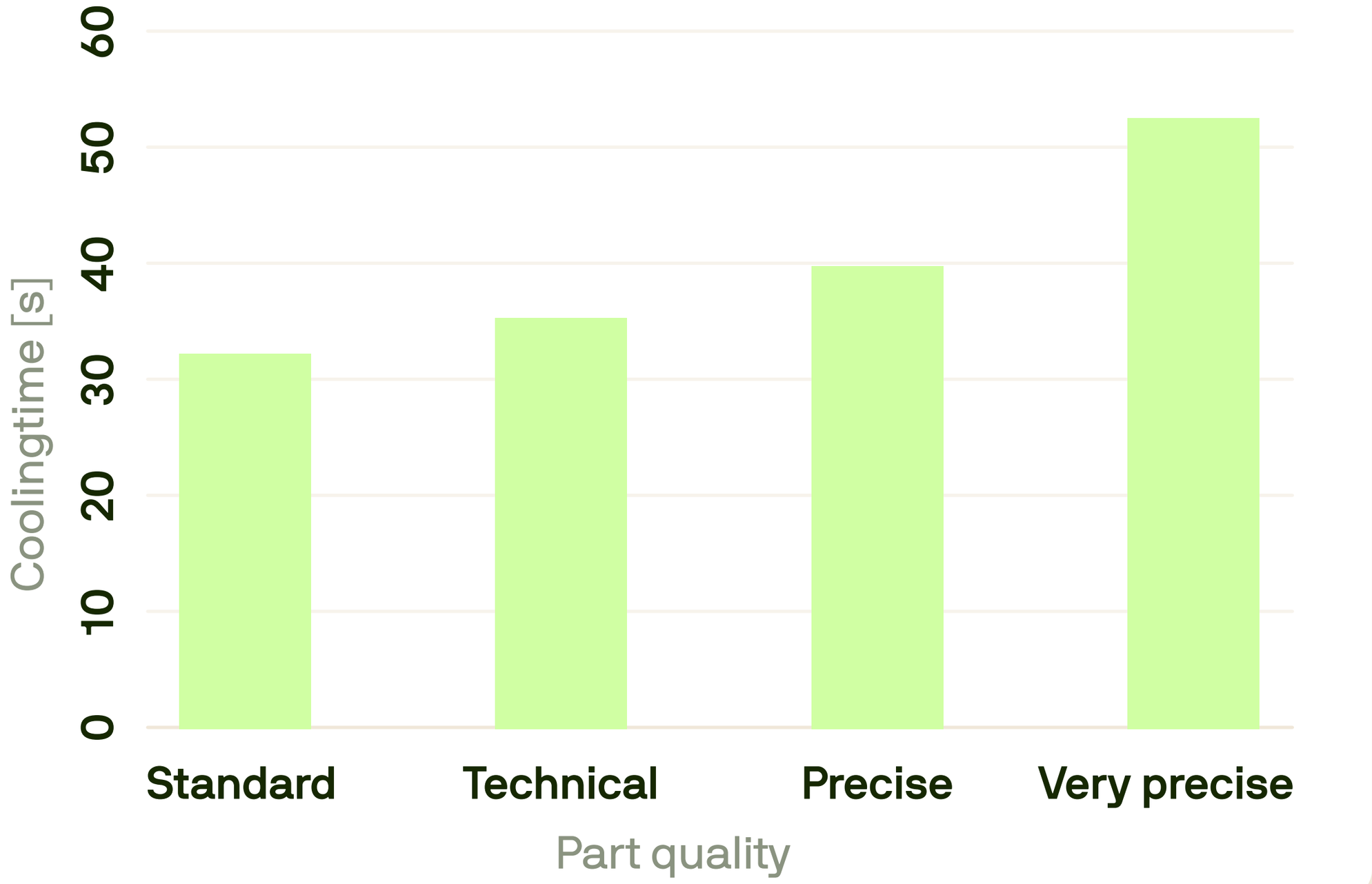


Correlation wall thickness and coolingtime

The cooling time has a fundamental influence on the component quality. This includes dimensional accuracy, but also the surface properties of the component (particularly important for visible parts). The longer the component remains in the mould and the cooler the component is, the lower the tendency to warpage, shrinkage and other influences that can have a negative effect on the component properties.



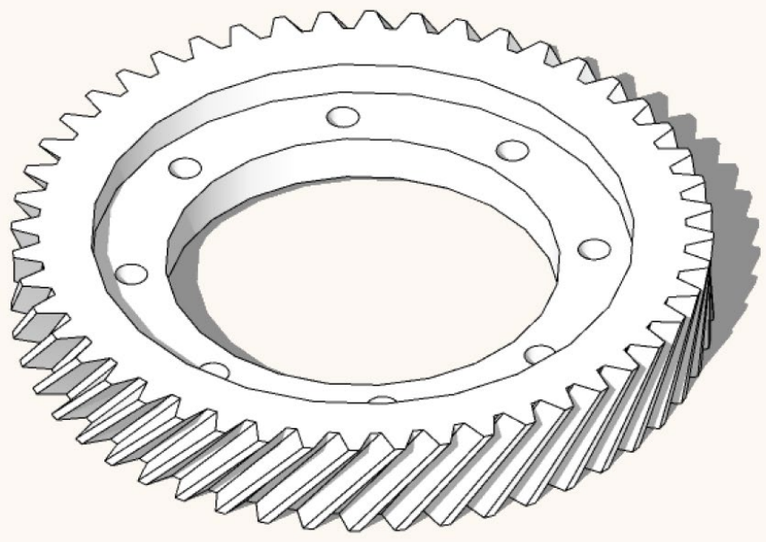
Correlation ejection temperature and part quality



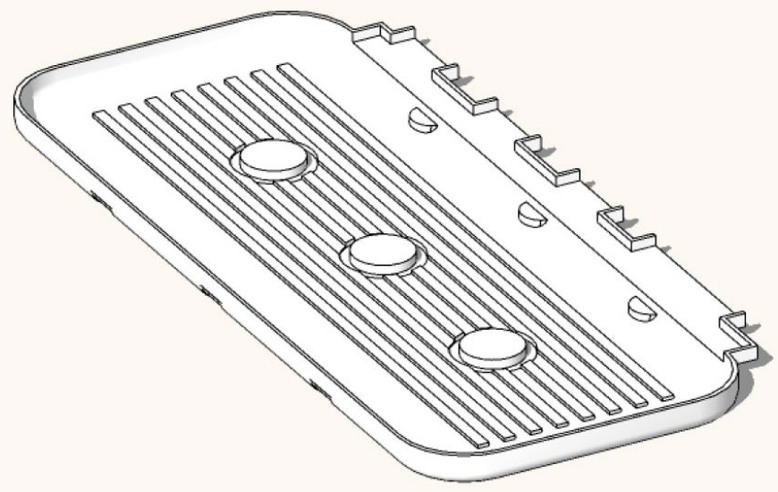
Correlation coolingtime and part quality

The sprue system (cold or hot) determines the type of sprue in a mould, which has a direct impact on the material used and therefore on the material costs. The quantity of the processed plastic material can be influenced by the choice of the gating system. The decision in favour of

a hot runner system can make sense, especially, when high performance materials are processed. Gating and runner scrap can be reduced or even completely eliminated.



Injection S_130



Injection S_333

The component geometry, parting lines or surface qualities influence the tooling concept and represent further cost influencing parameters. A rheological simulation of the component and the mould is generally recommended. This simulation provides information on where filling problems may occur during injection. Shrinkage and warpage, blowholes or material accumulations can also be simulated and predicted. The tool maker takes the simulation results into account accordingly during design phase of the mould.

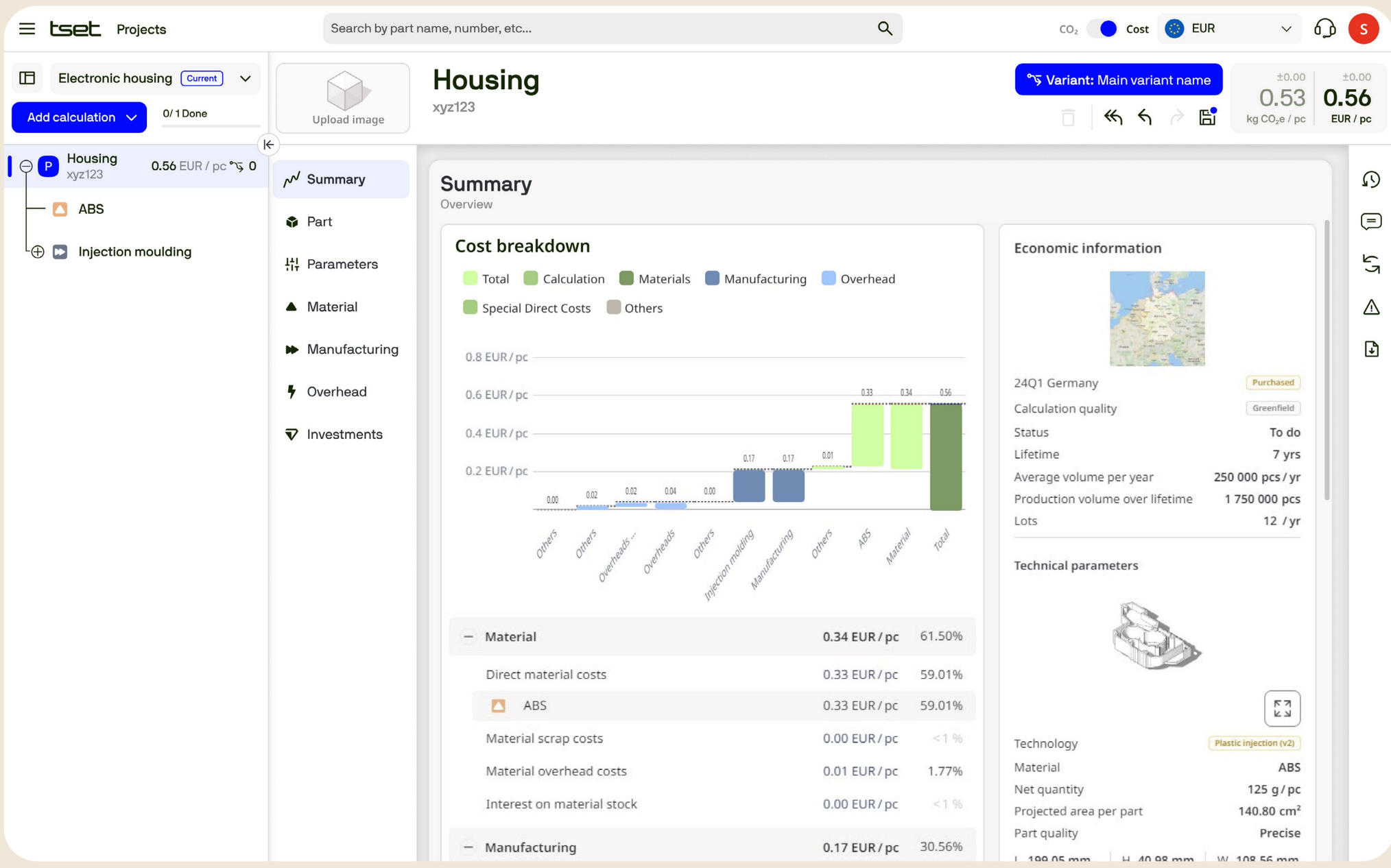
The costs of the injection moulding process can be positively influenced

by a number of measures. This can be achieved, for example, by reducing surface requirements, tolerances, etc., or by eliminating undercuts. The injection moulding process offers a wide range of special processes (e.g. gas injection moulding, injection compression moulding, insert moulding, etc.), from which the most economically and technically viable process must be selected. Cost management software such as the TSET platform help to identify potential savings in the cost and CO_2 emission structure. The resulting “Design to Cost” or “Design to Sustainability” mesaures help to optimise the manufacturing process or to reduce the CO_2 footprint.

03 Case study about injection moulding - How it works in the Tset Software

The solution:
Efficient cost management with Tset

Tset’s cost management software acts as a platform that combines data-driven algorithms with in-depth industry knowledge. It enables the early assessment of entire systems and creates data-based calculations to support cost planning and CO_2 reduction.



Screenshot from Tset software – Summary of calculation

By comparing different scenarios with different parameters, potential savings can be easily identified. The central knowledge database for costs and CO_2 helps to discover and quickly implement optimisation potential across departments - through communication via the tool.

System

Add machine

0.09 EUR/pc

Designation	Manufacturer	Quantity	Number of sys...	Investment per ma... EUR	Total invest... EUR	Rate EUR / h	Overall rate EUR / h	Cost EUR / pc
Engel Victory 1350/200 (2000 kN)	Engel	1.00	1.00	181 400.00	181 400.00	11.61	11.61	0.06
Engel Viper 12 servo Z-2960	Engel	1.00	1.00	37 300.00	37 300.00	1.38	1.38	0.01
Motan Metro HES 50	Motan	1.00	1.00	1 000.00	1 000.00	0.20	0.20	0.00
Engel Victory 1350/200 (2000 kN)	N.N	1.00	1.00	16 400.00	16 400.00	1.59	1.64	0.01
Engel Victory 1350/200 (2000 kN)	ASYS	1.00	1.00	4 700.00	4 700.00	0.24	0.24	0.00
Engel Victory 1350/200 (2000 kN)	Regloplas	2.00	1.00	6 400.00	12 800.00	1.18	2.37	0.01
Motan Luxor 120/250 - Dryer	Motan	1.00	1.00	12 400.00	12 400.00	1.16	1.16	0.01
Total				**259 600.00**	**266 000.00**	**17.35**	**18.53**	**0.09**

Manufacturing cell layout

The Tset software provides pre-assembled injection moulding production cells in a clamping force range from 28t to 5500t for the calculation of injection moulded components. Depending on the component requirements, these manufacturing cells are equipped with appropriate peripherals such as handling systems, tempering units, material dryers, conveyor belts and – of course – the correctly dimensioned injection molding machine. Tset provides a detailed bottom-up calculation based on a few input parameters, whereby the material input, production costs and surcharges

are of course itemised accordingly. In addition to the calculation of standard injection moulded parts, Tset supports insert moulding and the physical and chemical foaming of injection moulded parts. Subsequent processes such as cleaning, painting or metallisation can also be taken into account automatically.

The tool shows in detail how minimal changes to a parameter affect the correlating cost factors. By changing the mould concept, for example from two to four cavities, the calculation is dynamically re-initiated and the entire production cell is re-dimensioned. In this way, the Tset software makes it possible to adjust the various cost-sensitive parameters of the process and thus easily determine the most cost-efficient solution.

04 Conclusion

Injection moulding offers efficiency and precision, but also challenges such as high tool costs and a complex choice of materials. Quality control and sustainability are of crucial importance. Tailored cost management helps to modify the decisive parameters and thus optimise costs and CO_2 emissions.

In conclusion, our analysis highlights several critical insights that can significantly impact your production strategies and overall efficiency. The following key findings summarize the main points of our research:

- **Injection moudling is efficient and precise, suitable for mass production.**
- **Quality control and sustainability are essential.**
- **The Tset software can help you optimize costs and CO_2 emissions.**