

Category: Injection Moulding

Subcategory: High temperature plastics

Industry: E+E, Medical technology

## Small machines for precious material

*Dr. Boy's experience values in the manufacture of small parts made from PEEK*

In addition to the high temperature resistance, the Polyetherketones can also impress with many other outstanding properties. Outstanding mechanical properties and biocompatibility are other frequently demanded highlights of this material.

Naturally, the processing temperatures for PEEK and its variants are correspondingly high. Apart from the high temperatures some material- typical peculiarities should also be considered.

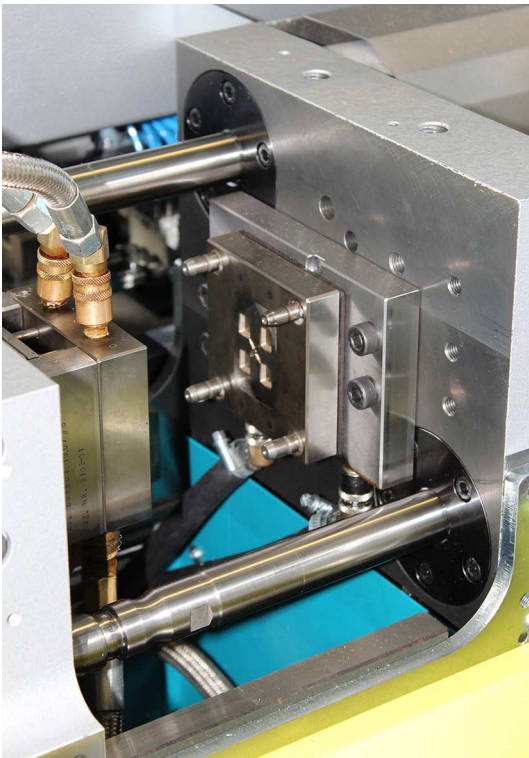
A high solidity is very often a reason for the choice of this plastic material for small components, which often have to withstand high loads

Due to its biocompatibility, the material is also very suitable for the manufacture of highly resilient implants. The fact that the processing of this high-quality material means special demands for both, the processor and the injection moulding machine as well seems only logical.

When processing PEEK the temperature level is at the upper limit of that what is normal in the plastics processing. The plasticizing unit of the injection moulding machine operates in the temperature range of about 400 ° C, the injection mould is heated up to temperatures of about 200 ° C, and the pre-drying usually takes place beyond 150 ° C. Machine modifications and modifications of the peripheral equipment are often necessary to avoid damages from waste heat during the production.

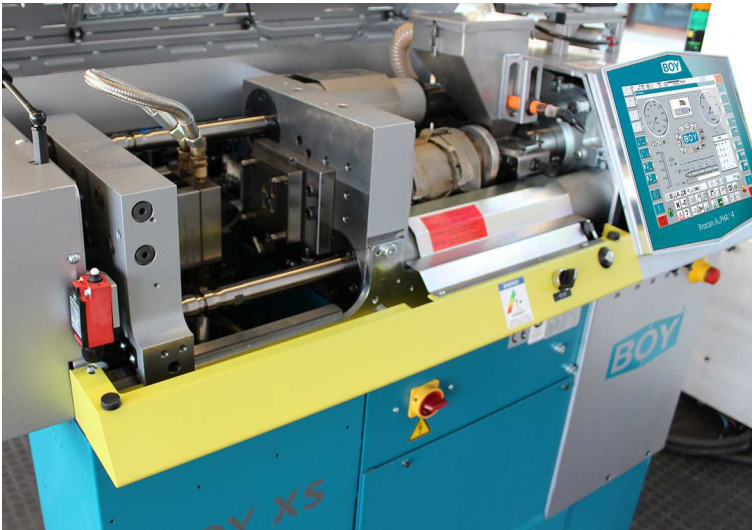
## Prevention of thermal damage

Due to the high material costs of Polyetherketones an almost waste-free production is not only the target in case of medical applications. Hot runner moulds or moulds with compact gating systems are preferable to material-intensive solutions. These are often moulds with small numbers of cavities (**picture 1**) and complex moulding part contours make this necessary, too. Thus the low shot weights require small plasticizing units, i.e. in the PEEK processing small injection moulding machines are often considered as useful.



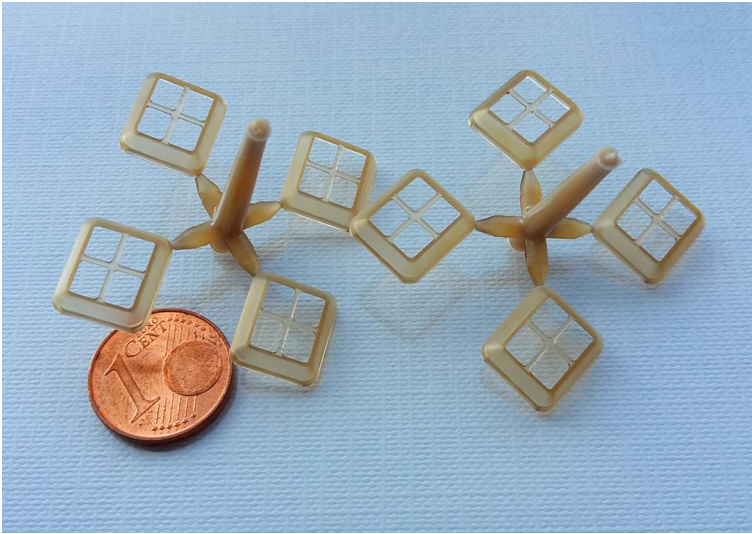
It is generally recommendable to adapt the plasticizing unit to the production conditions, i.e. the size must comply with the flow rate, whereby it should be observed that on the one hand the material is melted and homogenized, but on the other hand the dwell time in the plasticizing cylinder should not be too long. Very good results are achievable with the injection moulding machines Boy XS (**picture 2**) and Boy XXS (manufacturer: Dr. Boy GmbH & Co. KG). Both machines (clamping force: 100 and 63 kN respectively) are particularly suitable for the processing of high-temperature Thermoplastics due to the design of the antechamber of the screw and the nozzle as well. With a minimal screw pitch volume, the dwell time in the small plasticizing cylinders of the Boy injection

moulding machines is minimized. This means that a variety of materials can be processed without thermal damage even at high temperatures.



### **Screw with special coating**

Small housing parts "diode frames" for the electrical industry were manufactured on a BOY XS with a quadruple mould during the Fakuma 2017 (**picture 3**). The very thin-walled parts with wall thicknesses of 0.5 - 0.6 mm also have a very filigree grid with a flow cross-section of 0.25 mm<sup>2</sup>, which produces a high shearing stress for the plastic. The weight of the 10 x 11.7 mm frames made of PEEK (KETASPIRE KT 880 natural, manufactured by SOLVAY SA) is 0.085 g. The gate with a weight of 0.33 g still has savings potential, but also serves for the removal and defined storage of the parts. A removal system grips and sorts the parts into separate containers (good and rejected parts) after a direct comparison of the quality-relevant process parameters with the specifications. The automation device is mounted laterally behind the cantilevered two-platen clamping unit of the injection moulding machine (space-saving) and can optionally be equipped with a small conveyor belt.



In the case of a test of bone implants for VBM Orthopedic Polymers - a French manufacturer of orthopedic parts - the issue was to find a sustainable solution of the problem. The parts with a shot weight of 0.68 g manufactured at VBM showed a variety of black spots and were thus unusable. Although the material with medical approval was found to be resistant to high temperatures (statement of supplier), significant material damage in the form of black spots was the result.

In technical centre of the company Boy, located in Neustadt-Fernthal, the moulded parts were tested on a Boy XS with a standard plasticizing unit. These parts are implanted in an emergency to fix bone fractures. The result was better from the first attempt, but not entirely perfect. Only the change to a screw (12 mm) with a special coating achieved the desired success. At first the screw was cleaned at 400 ° C. Then it was possible to produce perfect parts. Even during the dwell time tests, when the injection moulding machine is stopped for a period of 15 minutes, no signs of deterioration or black spots could be discovered after a restart.

## **Conclusion**

The processing shows that Polyetherketones are thermally robust, but shearing stresses can definitely lead to material damage. Very small cuts and thin-walled bridges might be the cause of discolorations, which indicate damages to the plastic.

Especially in medical technology, dark spots are a direct rejection criterion. The machine should therefore run in the optimum working range. This means for the processor to find the right injection conditions and to keep them reliably constant.

### **The author**

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0/quadruply manufactured diode holder for the electrical industry made from PEEK. The processing temperature in the plasticizing unit of the injection moulding machine is about 400 ° C (© Dr. Boy)

Picture 1. Mould with cooling plate for PEEK-processing. The diagonal arrangement of the two tie bars allows an easy access to the mould area and the ejector (© Dr. Boy)

Picture 2. The Boy XS cantilevered two-platen clamping system with 100 kN clamping force reduces the space requirement to 0.77 m<sup>2</sup> (© Dr. Boy)

Picture 3. diode frames diode frames (© Dr. Boy)