

## Körber European Science Prize 1985

### Back Pressure Casting Technology

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*The technology is as old as the use of metals itself. Is there still room for improvement? There certainly is – after all, the demands made of metal materials are rising constantly, and the same applies to cast glasses, ceramics and plastics. In the field of casting technology, Bulgarian research scientists have been among the best in the world for decades. The 'back pressure casting process' developed in Bulgaria was supported with the awarding of the Körber Prize in 1985.*



Back pressure casting technology facilitates the extremely precise and energy-conscious moulding of metal pressure parts made of aluminium. (Photo: Peter Allert)

When metal is cast, numerous chemical and physical processes occur, in particular an intensive interaction between the gaseous, liquid and solid components of the melt. The processes are influenced by several marginal conditions: the temperature profile during the casting and cooling of the cast, the material properties of the melt, the geometry of the casting mould, and the melt pressure. The casting technician can alter these parameters to improve his product, but this optimization is usually only possible within narrow limits. An important determinant with which the processes can be influenced is the melt pressure, and pressure casting methods have established themselves in several areas. This particular idea from Bulgaria, already developed in the 1960s, now involves applying pressure to the melt from two sides at the same time. It is pressed into a cast in which a gas already generates a somewhat weaker back pressure. This principle provides several advantages, including the following:

- The casting speed can be easily adjusted by means of the difference in pressure.
- The gas in the cast ensures that the setting melt has a smoother surface.
- Casting under high pressure can now also take place in sand moulds as these are held together by the surrounding back pressure gas.
- The melt is less porous than in conventional processes.
- Pressure and back pressure retain gases in the melt, which is desirable in the case of gas-alloyed materials and when the melt contains vaporizing components.

However, the Bulgarians were faced with a seemingly insurmountable obstacle. To be able to implement the fundamental idea in a wide variety of applications they had to develop calculation methods. Casting processes can, however, only be described using equation systems which cannot be solved mathematically with any great accuracy. Empirical data therefore had to be acquired, and consequently test series conducted and recalculated. These, however, required a network of efficient measuring and controlling instruments as well as all manner of high-performance computers and computing programs. The Körber Prize was used to establish such a system, and the experiments even resulted in the creation

of a new mathematical approach to describing casting processes. Shortly before the political upheavals in Bulgaria, the results of the project were crowned by the foundation of a joint subsidiary of the Bulgarian institute and a French metal-casting company for the manufacture of back pressure casts.

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