THE STUDY OF AN EXTRACTING HANDLER FOR INJECTED PRODUCTS WITH A HIGH COMPLEX GEOMETRY

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Abstract

The paper is based on a scientific research, made by the authors, in hope of improving the techno-economic performances, by using a robotic system for extraction from the core of the injecting mold of two injected molds from the ski boots category. The robotic extractions presents several advantages, consisting of time reduction for the extracting operation of the molds, reduction of the physical effort made by the worker which works with an integrated injecting system, reduction of the scraps, the production growth for the entire system an the growth of the production capacities.

1. INTRODUCTION

The technology of plastic material injection knows today a dynamic development from all the technologies used in thermoplastic and has the highest rate of efficiency. That's why in the worldwide market is a fierce competition between the classic production methods and the injecting technology for final products.

An optimistic preview over the result of this fierce competition gives the first place to the thermoplastic materials, which slowly will replace the classic materials, as it can be seen in the automobile construction, where a huge percent of the component pieces are obtained with the injecting technologies from thermoplastic materials. Another advantage of this technology is represented by the possibility of obtaining with a single injecting operation of products with a complex geometry.

Such examples of products are the injected pieces used for sport's equipments such as:

- Ski boots;
- Roller-skates ;
- Snow shoes;
- Ski bounds;
- Etc.

The component pieces which compose these products have a high geometrical complexity and a great variety of characteristics. This is a request because of the usage request to which the ski boots are subject. In picture 1 is presented a ski boot model produced al S.C. Plastor S.A. from Oradea..

So in the construction of a ski boot we can observe the following functional areas:

- **zone A** which represent the boot sole, is a rigid zone, resistant for heavy usage and assures the stability when assembling with the ski bound and as result, it has to be injected from a highly rigid polyurethane;
- **zone B** is the superior part of the shoe which protects the foot, and that's why is a very soft and elastic area, which has to assure the opening of the boot and an easy introduction of the foot in the boot, and of course has to be able to make a hermetic closing of the boot with the help of a bent crank and a rank, and as a result it has to be injected from a soft and elastic polyurethane;

- **zone C** is a soft and elastic area, which has to assure the opening of the boot for a easy introduction of the foot inside the boot and to assure a very good flexibility of the leg, for a easy control of the ski position. As a result it has to be injected from a elastic material;

Picture.1. Example of a ski boot used in alpine skiing

- **zone D** is a rigid area, resistant to shocks and has to assure a correct position of the leg and a good stability of the skier on the ski binding and as a result has to be injected from a rigid thermoplastic material.

All these characteristics could have not been realized if we would not use different types of thermoplastic materials, which combined by the technology of injecting two materials at one time, will have to satisfy all the requirements of a product of superior quality.

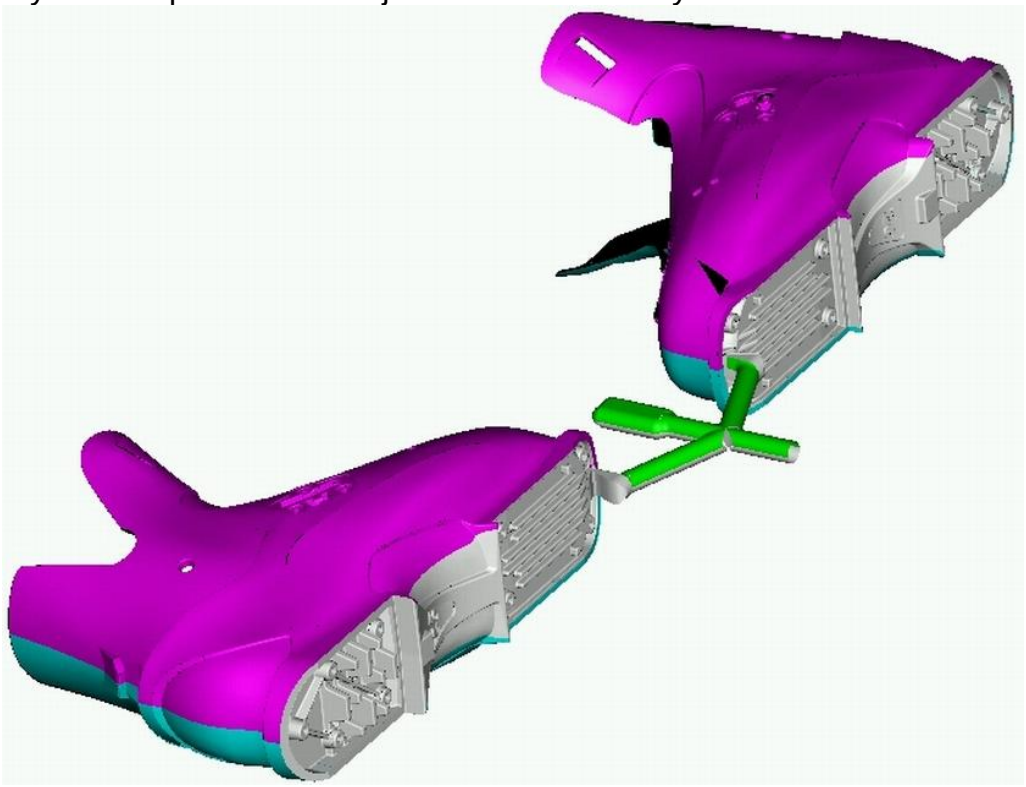
As a result the interior body of the ski boot has become a complex piece both from the geometrical point of view and from the combination of characteristics. To obtain the boot according to picture 2, it has been chose a technology of dual material injection, from two thermoplastic materials with different characteristics.

One of the biggest problems which appeared in front of the designers of such injected pieces with a very complex geometry was and is the extraction of the injected piece from the injected mold. This phase is extremely important because it has to assure the evacuation of the injected piece in fully safe conditions:

- without deformations ;
- without marks, stains, or other traces on the surfaces of the boot;
- without any waste of time;
- without interrupting the function cycle of the injecting machine;

Picture.2 Example of a complex piece: inferior body of an alpine ski boot

In picture 3 are presented the 3D models of two complex pieces described as the inferior body of the alpine ski boot injected simultaneously.



Picture 3. 3D model of two alpine ski boot inferior body injected simultaneously

The extraction of the complex injected pieces from the injecting mold was made in the first steps by hand with the help of a rod. This solution was at the hand, being the simplest and without great initial costs. The human operator was easily to train to position the rod in the exact and precise position and to execute the complex movement of pulling,

rotating and pushing. So we succeeded in removing in the best conditions the injected pieces with a high degree of complexity.

But the designer didn't foresee that:

- the human operator could not assure the operation of extraction for 24 hours continuously and identical for each manufacture cycle;
- the huge human effort which brought the fatigue of the human operator, and the necessity of changing the human operator every 2 hours;
- the destruction in time of the rods, which have been bent, and it was necessary a periodical replacement,
- the lost of time because the human operator didn't entirely respect the steps involved in the process,
- occurrences of stops in the injecting cycles and inconsistency in the functioning of the injecting machines.

Picture 4. Manual extraction of the inferior body of a alpine ski boot

CONCLUSIONS

All these extraction and evacuation problems of pieces with complex geometry could only be eliminated by designing a extraction handler to extract the pieces from the mold. The equipment had to assure the necessary force of extraction and to develop some pretty complex movements, which will assure the curve of movements of the injected piece for evacuating in the best conditions, at an optimum temperature from the injecting mold. The conception, designing and execution of such of a handler is absolutely necessary, for eliminating the physical effort of the human operator, which will have the job of retrieving the injected piece already extracted from the handler and the checking of the quality control of the piece according to the quality specifications.

By integrating the handler in the production process, it will be created a much simpler an easier working place for the human operator, which will be able to operate many different injecting machines reducing the costs with the handling in the production process and the growth of the work productivity.

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