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CONTRIBUTIONS TO DIVERSIFY SOLES MOULDS THAT FORMS DIRECTLY ON FACES SHOES

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Abstract: *The classical moulds which are currently used for forming the soles directly on the uppers, allow obtaining one sole model. One mould for each foot is made, and at least one mould for each size number in the size number series. To manufacture one single sole model in the sizes series an average set of 16 moulds are needed. Changing the model implies the entire production of a new set of moulds. Therefore, a large diversification of the soles requires the manufacturing a quantity of moulds sets equal with the quantity of sole models. In this paper are presented solutions to obtain more cavity shapes in the same mould, through the use of modular interchangeable pieces. The moulds with versatile cavities have the same functional characteristics as the moulds with unique cavities, are usable on the same type of machines and can be used independently or together with the classical moulds. A brief analysis on the technological processes for manufacturing moulds with versatile cavities reveals a significant lowering of the manufacturing time for moulds in which will be obtained other sole models. This is due to the fact that some of the mould parts are reused. In conclusion, the producers that chose this type of moulds can launch on the market new models in a shorter time and at lower prices.*

Key words: *shoes soles, designing soles, manufacture soles*

1. INTRODUCTION

More than 80% for footwear soles are obtained as prefabricated parts or directly on the footwear uppers by forming in moulds. The diversification possibilities by materials, shape, volume, antiskid relief mode, side surface model, colour, number of colours, fabrication technologies, etc., are multiple. The technologies currently used to obtain soles can be grouped in: vulcanization technologies of rubber blends; injection forming technologies of fluid thermoplastic polymeric blends and forming technologies of polymeric blends that lead to obtaining polyurethanes by a chemical structuration process [1], [2]. All these technologies are using the spatial forming of the soles in close moulds with cavities that resemble by size and shape the soles which will be obtained. To accomplish this, all over the world, to obtain the soles corresponding to each last model, for each sole model and for each size in the size series a mould is made.

To manufacture one single sole model in the sizes series an average set of 16 moulds are needed. Another sole model requires the design and manufacturing of an entirely new set of moulds. Therefore, a large diversification of the soles requires the manufacturing a quantity of moulds sets equal with the quantity of sole models [3].

These devices, by their complexity and by the high execution level, require high manufacturing costs. In the case of the big sole manufacturers who are using the mould till the physical outwear, the costs for the new moulds design and execution are covered without significantly increasing the soles price. For the smaller sole manufacturer, the moulds outwear morally way before

the physical outwear. This fact is seen in the soles price. If the two manufacturers are launching the same products at the same time on the market, it is obvious that the bigger manufacturers will gain the market by the smaller price of the soles they offer. On the other hand, the big manufacturers are not able to cover the entire footwear soles request and mainly, they can't cover all the fashion trends. It turned out that the smaller producers are more flexible to the new fashion trends and to the present market demands.

In this paper are presented solutions to obtain more cavity shapes in the same mould, in the case of forming the soles directly on the footwear uppers. The designed solutions are aimed to reduce the time and costs of new moulds manufacturing for new soles models.

2. THE SOLUTIONS DEVELOPMENT

The moulds in which the soles are formed directly on the footwear uppers, whatever the nature of th polymeric blends and the forming thermo chemical processes, are formed by a metal last, two lateral jaws and a die. By closing the assembly of the metal last with the upper lasted, the lateral jaws and the die, is formed a cavity in which the sole will be formed directly on the footwear uppers. The cavity formed using this technology is unique and serves for obtaining only one single sole model and size. [4], [5]. The solutions elaborated in this paper are developed in two different directions: one direction consist in obtaining versatile cavities in existing moulds with unique cavities [6].

2.1. Solutions for manufacturing versatile cavities in moulds with unique cavities

We are considering a mould with a specific cavity, which has the shape as in Figure 1. This type of cavity can be modified by successive milling of the lateral jaws, until is reached the situation when the cavity shape becomes cylindrical orthopaedic. For this type of solution, to obtain new cavities, the existing lateral jaws are milled and the die is entirely remanufactured.

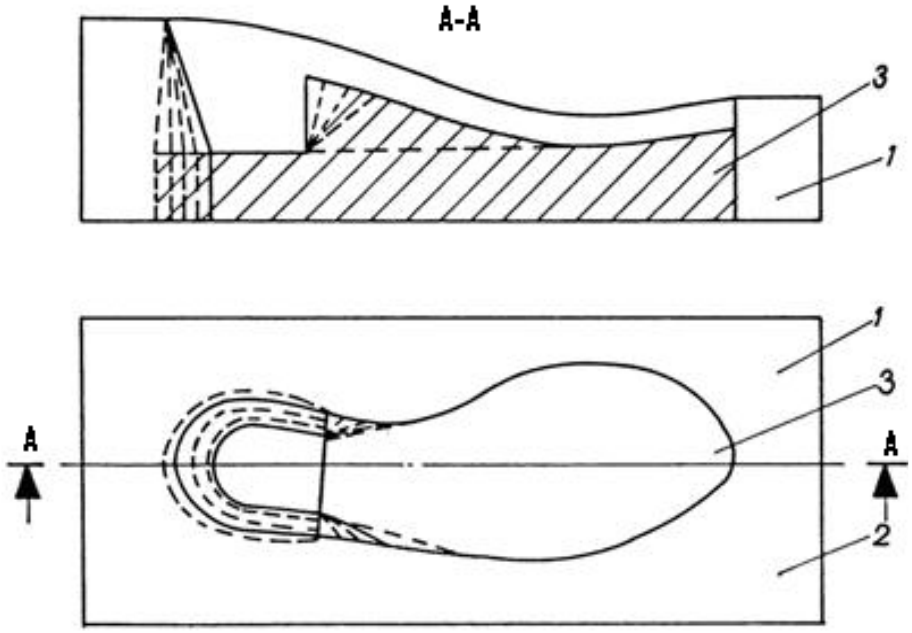

Fig. 1: *Cavity diversification by successive milling of the lateral jaws and remanufacturing the die*
1, 2 – lateral jaws; 3 - die

Returning from the cylindrical orthopaedic cavity shape to another shape is possible by the addition of filling parts on the two lateral jaws and by remanufacturing the die, as represented in the Figure2. Obtaining new cavities by processing all the mould parts, to which is added the necessity of manufacturing new filling parts, can't be a reliable solution for mass sole production [7].

To simplify the problem we chose a solution for obtaining versatility for an existing cavity which is easy to provide, without being necessary to remanufacture the die and without the necessity of major processing of the lateral jaws. This can be achieved by preserving the initial shape of the sole and processing only the antiskid relief model and side surface model. For this purpose, it is removed from the lateral jaws a portion of g_1 thickness all around the cavity, by milling, thickness equivalent with the interchangeable parts thickness which will be mounted on the lateral jaws. The same way is processed the die surface, on a g_2 thickness, on which will be mounted the part that will render the antiskid relief model. These operations [8] are presented in Figure 3.

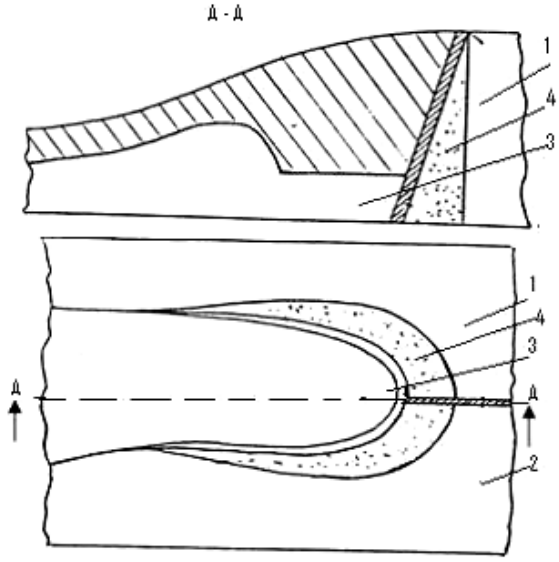

Fig. 2: *Cavity diversification by using filling parts on the lateral jaws and remanufacturing the die*
1, 2 – lateral jaws; 3 - die; 4 – filling parts

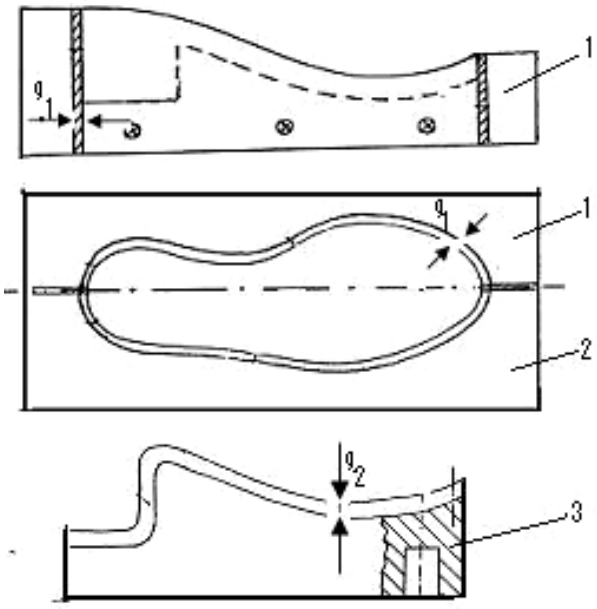

Fig. 3: *Cavity processing in order to mount parts for model diversification*
1, 2 – lateral jaws; 3 – die

The adjustment of mould closing is obtained by fine tuning the parts that will be mounted on the lateral jaws and on the die.

2.2. Solutions for obtaining moulds with versatile cavities

A mould with versatile cavity, in the acceptance of this paper, is a type of mould which is composed by a set of parts which remain unchanged till the mould physical outwear and a set of modules which are remanufactured each time the sole model is changed [6], [7]. This type of mould is presented in Figure 4.

This mould is composed of the lateral jaws 1 and 2 which remain unmodified until the mould outwear. The cavity is formed by mounting the modules 3 and 4 on the lateral jaws and of the module 5 on a mounting board on the machine [8]. The modules 3, 4 and 5 can be entirely modified, remanufactured or partially modified, depending on the sole model changes.

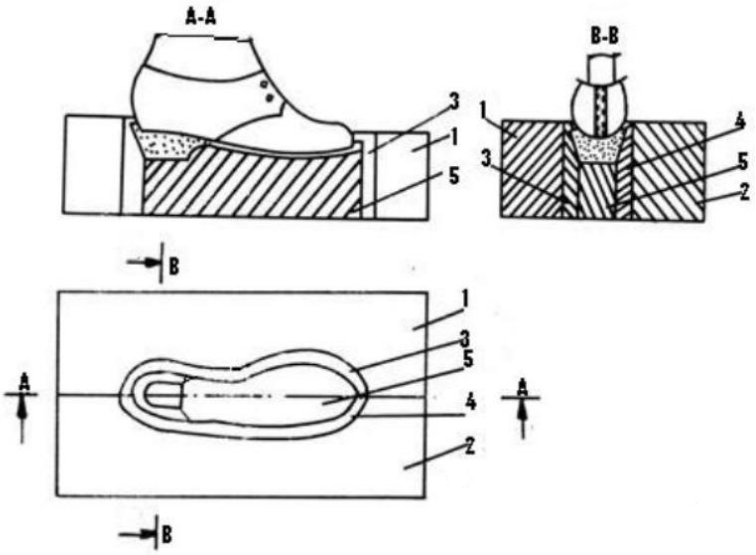

Fig. 4: *Mould with versatile cavity for forming soles directly on the uppers*
1, 2 – lateral jaws; 3, 4, 5 – cavity forming modules

3. EXPERIMENTAL ACHIEVEMENTS

3.1. Obtaining versatile cavities in moulds with unique cavities

The solutions presented on chapter 2.1 have been verified by manufacturing the moulds and the experimental use to obtain soles [7].

A solution for processing the existing mould cavity is represented by the modification of the cavity by successive mechanical milling. This type of moulds and the resulting soles are presented in Figure 5.

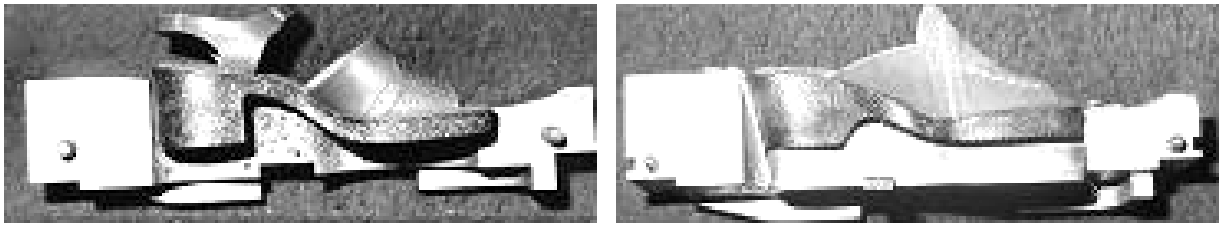

Fig. 5: *Modification of existing mould cavity by successive mechanical milling*

The diversification of the models for the same shape of sole is accomplished by interchanging the parts that render the side surface model and the bottom surface model. These types [7] of parts are presented in Figure 6.

Fig. 6: *Interchangeable parts for model diversification*

The model engraving can be achieved by mechanical milling, chemical and electrochemical processing or by a combination of this methods, on aluminium boards, zinc boards or copper boards.

3.2. Obtaining moulds with versatile cavities

In the case of the moulds that have been designed with versatile cavities, firstly the lateral jaws have were designed, which remain unmodified while using the mould, and the modules that are mounted on the two lateral jaws and the modules which are mounted on the die, corresponding to

multiple shapes and models of the soles [8]. This type of moulds and a set of soles resulting from these moulds are presented in Figure 7.

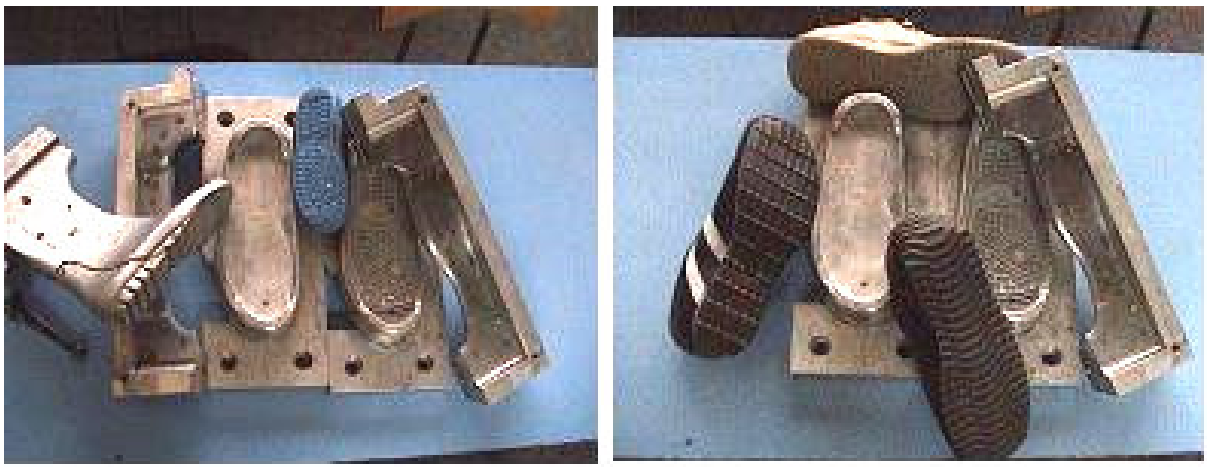

Fig. 7: Mould with modular cavity for sole injection directly on the footwear uppers

4. DISSCUTIONS

Obtaining moulds with versatile cavities by modifying the cavities of existing moulds and experimenting with this moulds revealed a set of aspects like [9]:

- The modifications which can be performed on moulds with classic cavities are limited.
- In the cases that the initial shape and size of the sole is preserved, diversification of the soles can be obtained by changing the side surface model and the antiskid relief model. This is accomplished with minimum costs by operating small modifications on the lateral jaws and manufacturing interchangeable parts which are mounted on the lateral jaws and on the die.
- The solutions for sole model diversification by modifying existing moulds proved to be efficient in the case of small sole production. This is due to the fact that the material of which are manufactured the interchangeable parts is aluminium, zinc or copper, materials that don't have a high hardness.
- The soles obtained in moulds with modified cavities, have similar qualities as the soles obtained in the initial mould.

The experimenting with moulds that have been designed with versatile cavities revealed a set of conclusions as [10]:

- The moulds are composed of base parts, that remain unchanged till the physical outwear, and the modules that are remanufactured entirely or partially on changing the sole model [9], [10].The mounting and dismounting of the modules is easily done, without influencing the lateral jaws quality of the formed soles quality.
- The lateral jaws are fitted with machine mounting systems, closing and opening systems, centring and feeding the cavity, etc. These systems can by typified on last models and machine models.
- The moulds with versatile cavities can be mounted on the same machines as the moulds with unique cavities. These moulds can replace the classical ones or can be used in the same time with the classical ones.
- A brief analysis on the technological processes for manufacturing moulds with versatile cavities reveals a significant lowering of the manufacturing time for moulds in which will be obtained other sole models. The manufacturing time for this type of moulds, depending on their complexity, is lowered up to 25-40% on each mould. This is due to the fact that some of the mould parts are reused. Extending the analysis over the entire moulds set reveals consistent savings.
- A great advantage of using moulds with versatile cavities consists in the fact that the producers that chose this type of moulds can launch on the market new models in a shorter

time and at lower prices.

- The moulds with versatile cavities can be exploited till the physical outwear without risking the moral outwear. In this respect, the activity of fabrication of a large range of sole models can become profitable even for the smaller sole producers.

5. CONCLUSIONS

- Versatile solutions designed moulds authors, enable the producer to launch in fabrication new sole models in a shorter time and with much lower costs.
- These molds can be used independently or in parallel with classical moldings, the same types of equipment.
- The manufacturing solutions for versatile cavities are applicable to the same extent to the moulds in which the soles are formed directly on the uppers, whatever the nature of the polymeric blends and thermo chemical forming processes.

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