THE SILICONE RUBBER IN THE MOLD TOOLING

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ABSTRACT

It is well known how vital the issue of a new product on the market can be. And that at the minimum possible price. So everybody tries to use technologies that alludes this.

This becomes possible by using the so-called flexible tools, flexibility which means that they can be changed rapidly and at low costs.

This technique is very largely used also by the manufacturing of the molds for plastic materials. In some cases, the active items of the mold are changeable. To manufacture rapidly these items, they are executed of silicon rubber. In other cases, the entire mold is executed in silicone rubber.

But these types of molds can be used only for small manufacturing series.

1. GENERALITIES

In the case of tools, and implicitly in the case of molds, the notion of flexibility refers to their capacity of adaptation and changing in a relatively short time, with reasonable costs, when the type of product requested on the market is changed. But we have to mention that the definition of these tools, respectively flexible molds, also have other meanings, beyond their flexibility regarding the made product.

Thus, according to some experts in this field, the molds have the following characteristics:

- They are tools, respectively molds used in small series production. But this depends on the type of product and its characteristics;
- They have low costs, or at least reasonable costs, which means that the changing, respectively their adaptation to the new products can be done at the above mentioned costs;
- The flexibility of the tools also refers to the type of material used for their making. Thus, the tools and the molds made of hardened steel are considered rigid till those made of materials with a lower roughness, such as silicone rubber, the various epoxidic resins or low melting point alloys (such as aluminum and zinc alloys), are considered flexible;
- The definition of these tools and molds flexibility can be also given according to the manufacturing method. In this sense, those made of rough materials through classical methods are considered rigid. The flexible ones are those manufactured through new procedures, such as Rapid Prototyping Technologies: the selective laser sintering of the metallic powders, the vacuum casting of the silicone rubber molds, the spraying of melted metal in combination with the forming of the ceramic molds or those made of polymeric resins.

As we can notice from the above presented facts, the silicone rubber is a component part of the flexible tools and molds.

2. THE MAIN CHARACTERISTICS OF THE SILICONE RUBBERS USED IN THE MAKING OF FLEXIBLE MOLDS

The most important characteristic of the silicone rubbers used in the making of flexible tools and molds is the fact that they are not toxic and they are ecological.

On the other hand they have flexibility – in the real sense of the word – also raised to higher temperatures, so they resist at high temperatures as well. And they keep this flexibility for a longer time, more precisely in the sense of tens of manufacturing cycles.

In liquid state, they are fluid enough to fit in various little details.

They have a relatively short hardening time, which can be helped with high temperatures. Thus, they ensure excellent time for molds making.

At the same time, they also have favorable prices, which vary according to the silicone rubber type. There are two types of silicone rubber that are used, a transparent one – more expensive, and an opaque one – cheaper.

3. THE USE OF THE SILICONE RUBBER IN THE CREATION OF MOLDS

As mentioned in this work, the silicone rubber is used for the making of flexible molds.

Thus, flexible molds can be made from silicone rubber, such as those shown in

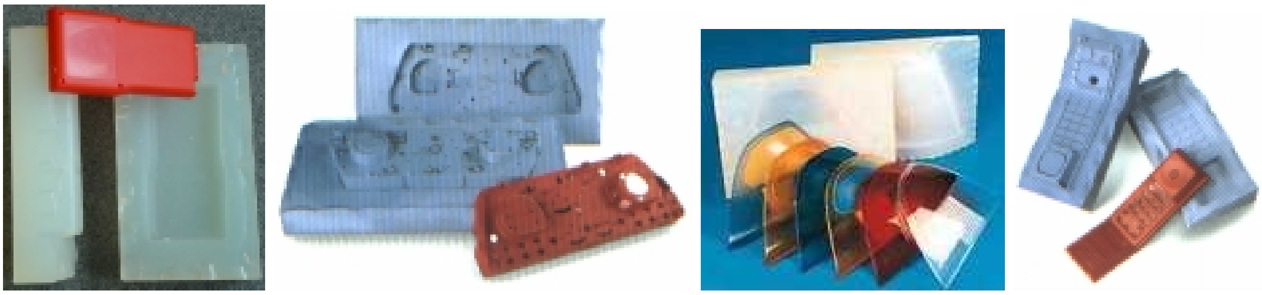

Fig. 3.0.1.

figure 3.0.1, presented together with the manufactured products, or they can be manufactured by making use of this rubber. But the silicone rubber can be also used for the making of the necessary tool for the execution of the mold, such as the electrode for EDM. However, this is already the case of rigid molds.

3.1. THE REALIZATION OF THE MOLDS FROM SILICONE RUBBER

The making of flexible tools directly from silicone rubber is the fastest way of making this type of tools. But they have the disadvantage that the durability of the mold is more limited.

In this case, the body of the mold is materialized by the silicone rubber poured around a master model. This master model can be an existent pattern or a specifically made model. This specifically made model can also be a RP model.

The main steps in the making of this type of mold are:

- *The preparation of the master model,* meaning the choosing of the separation plan and its materialization with adhesive tape and the marking of its border with a black

Fig. 3.1.1.

marker, in order to ease the subsequent separation through the cutting of the semi-molds, the making of the charger, which can be a syringe, respectively of the gas-vents, which can be welding electrodes of ∅2.5 mm, and their connection with one or two bars, in order to ensure the suspending of the model in the forming box. Such a prepared model is presented in figure 3.1.1;

➢ *The suspending of the prepared model in a box,* prepared beforehand according to figure 3.1.2;

➢ *The preparation of the silicone rubber*, consisting in the determination and weighing of the silicone rubber quantity and of the necessary catalyst (hardener) and their mixing with an electro-mechanic mixer for 10 minutes; afterwards, this mixture is introduced in the inferior room of the vacuum casting machine and it is de-gassed for 20 minutes;

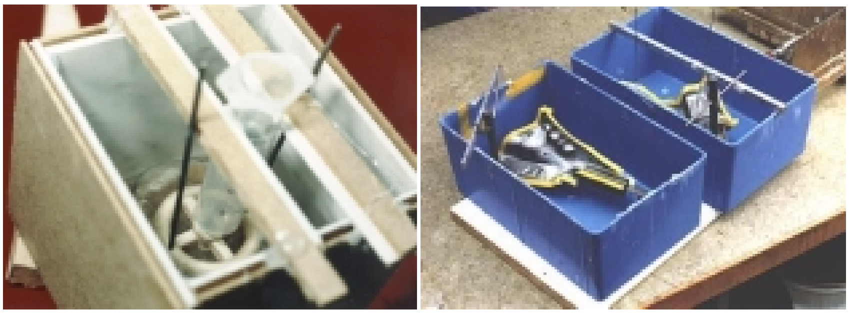

Fig. 3.1.2.

➢ *The casting of the silicone rubber,* manually executed in such a way that the spaces under the model will be filled first;

➢ *The secondary de-gassing of the silicone rubber block* poured in the box for 30 minutes in the inferior room of the vacuum casting machine;

Fig. 3.1.3.

➢ *The curing of the silicone rubber block* for 7 hours at 40°C through thermal polymerization in the oven of the vacuum casting system, presented in figure 3.1.3;

➢ *The semi-molds separation,* made after the dismantling of the box and of the elements which materialized the charging and airing system, through the cutting of the silicone rubber block obtained in this way and presented in figure 3.1.4., according to broken directions, which ensure their subsequent centering, up to the separation plan materialized by the adhesive tape marked with black;

➢ *The checking of the semi-molds* obtained in this way, which is executed visually.

In such molds, there can be made around 30-50 pieces.

Fig. 3.1.4.

In this case, the transparent silicone rubber must be used in order to be able to accomplish the cutting according to the mark on the adhesive tape, which materializes the separation plan. The opaque silicone rubber can also be used, but in this case the mold must be made in 2 steps, in each step being made one semi-mold.

3.2. THE REALIZATION OF MOLDS BY MAKING USE OF THE SILICONE RUBBER

This happens in the use of the opaque silicone rubber. Usually, it is used for the electrolytic making of the flexible molds. But it can also be used for the making through *metal spraying,* but at higher jigs.

In this case, the model from the silicone rubber materializes the negative of the mold which will be executed. Thus, the silicone rubber shape will be made starting from a pattern identical with the mold to be made, which is in fact the negative of the product to be made (figure 3.2.1). Thus, the making of this model through a RP technology is very advantageous.

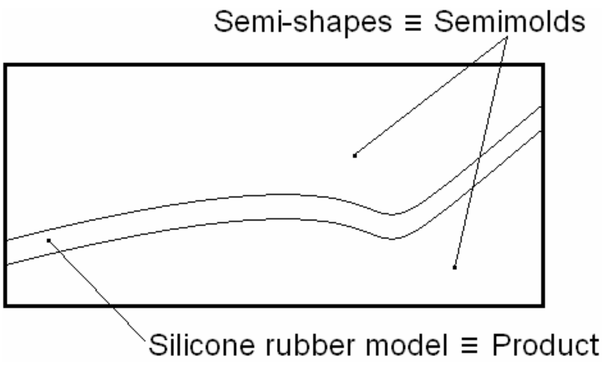

Fig. 3.2.1.

Initially, on the surface of the silicone rubber model, a metallic layer is deposited, having a thickness of a few mm, as we can se in figure 3.2.2. If we work through an electrolytic method, the surface of the silicone rubber pattern must be electrically passivated, as it is non-metallic. For this, more methods are known, such as the depositing through manual painting of a very thin metallic layer (figure 3.2.3).

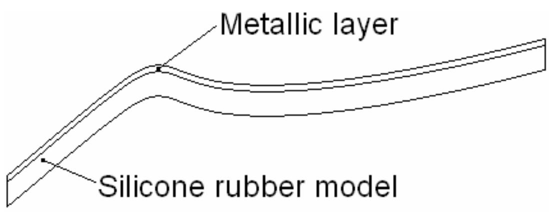

Fig. 3.2.2.

Next, the ensemble thus obtained is set in a forming box in view of casting around the model of a metallic alloy or an epoxidic resin, which will form the body of the mold, as shown in figure 3.2.4, thus allowing its mounting in a modularized tool. If the epoxidic resin is applied, this must contain metallic dust in order to improve the heat conductibility.

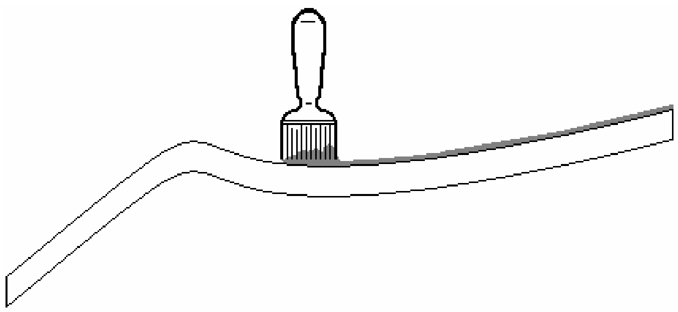

Fig. 3.2.3.

Finally, the silicone rubber model is removed and these operations are also repeated on

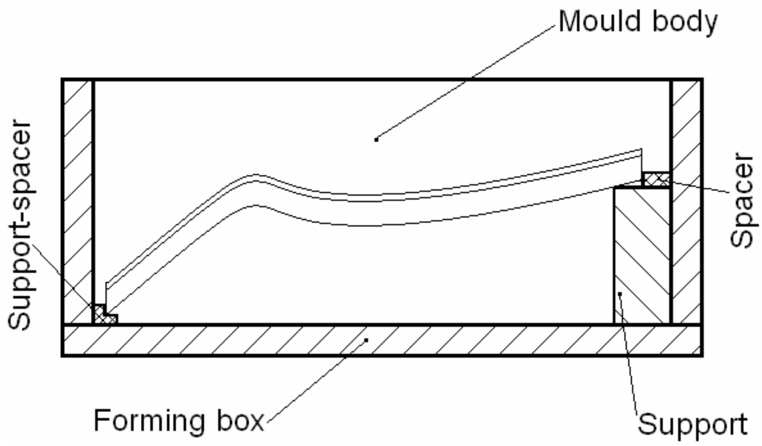

Fig. 3.2.4.

the other semi-model of the silicone rubber, in order to obtain the second semi-mold, in which a gate must be also made/introduced (figure 3.2.5).

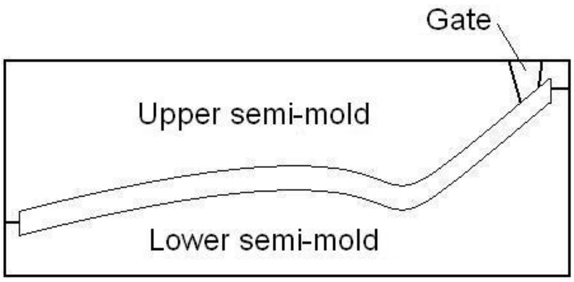

Fig. 3.2.5.

4. CONCLUSIONS

As we can notice from the facts presented in this work, the silicone rubber, in all its alternatives, has a large applicability in the production of the flexible molds. This is due to the advantages it presents, such as favorable costs, respectively the good "processing" regarding the making of some very complex shapes in a short time. At the same time, we have to mention that these advantages allow the enlargement of the silicone rubber applicability in the making of flexible tools.

Also, we have to mention the disadvantage of the making of flexible molds from silicone rubber, which is a lower durability.

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