

## STUDY TO MODIFY THE ROUGHNESS AT THE CONTACT SURFACE FOR THE INJECTION MOLDS FOR BI-COMPONENTS PART USING SAND BLASTING

Sorin ILIE, Mircea MIHĂILĂ

SC PLASTOR, Oradea, Romania, University of Oradea, Romania

**ABSTRACT:** To obtain an exactly defined roughness at the contact surface of a bi-component mold the author has used the sand blasting technology. It was tried different types of granules of aluminum oxidizes. For the grinding grain and grinding powders of the aluminum oxidizes is depending of the controls method. Using different grinding grain and powder and also modify the blasting parameters the author try to obtain a specified roughness at the surface of the cavity of a mold. This specific value of roughness depend of the deepness of the penetration layer and determinate the best adhesion between two plastic components of an injected bi-component part.

**KEYWORDS:** sand blasting, roughness, mold surface, contact surface.

### 1. INTRODUCTION

One of the most important characteristic of an injection bi-components plastic part is the adhesion between the two components. Why is this characteristic the most important? Because, all the injection molding bi-component parts needs to be absolute inseparable all of his life time. This made the difference between an assembly part from two different plastics parts components and an injection molding bi-components plastic part.



**Fig.1. Example of no adhesion between the two components of an injection bi-components plastic part**

1-first component it is soft polyurethane  
2-second component it is hard polyurethane

The adhesion or the bonding between the two components are influence of a few factories like the chemical affinity between the different plastics materials, the injection molding parameters of the bi-component molding injection machine and also the

roughness of the contact surface between the two components. The last one was not enough study. He has a big influence for the adhesion between the two components. This influence has also theoretical fundamental explications but, also was demonstrated with several experimental researches using an experimental mold for bi-components laboratory samples for tensile test.

### 2. PRACTICAL EXPERIMENTS

To obtain a specific roughness of a mold surface, it is better to use grinding grain and grinding powers of aluminum oxidizes ( $Al_2O_3$ ). This aluminum grains can be obtained in electrical oven followed by a much lent solidifications. At the end, it is obtained a grain with different colors and shapes, very hard and abrasive. For this reasons these grains are used for:

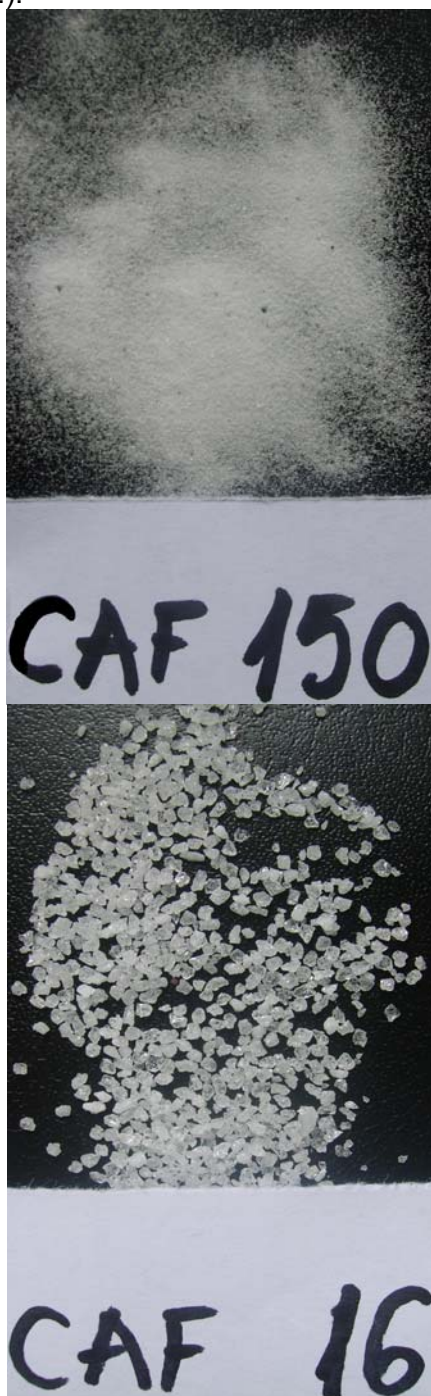
- Cleaning and degreasing the molds surfaces;
- Polishing same very rough surfaces;
- Decorations very hard surfacing like glass surface, ceramics surface;
- Graving of surfaces;
- Sand blasting for obtains different roughness of molds surfaces.

The principal's characteristic of aluminum oxidizes grains are the following:

- Big specific densities;
- A wide fraction of grains between  $3\mu m$  to  $2,4mm$ ; (Fig.2.)
- A big hardness;

- A lot of number of repetitive utilization of the same grains between 8 and 20 depending of the application.

For the grinding grain and grinding powers in depending of the control s method: the sieve method. For dimension of 0,1mm of the size in the side- light of the sieve mesh, where the grains of the general fraction are delayed e.g. П20, П16, П10; the microscopic method- analogous to the designation of a granularity of the grinding grains and grinding powers, e.g. 250/200, 200/160, 125/100. (Fig.2.).



**Fig.2. Examples of two aluminum oxidizes grains**

To obtain different dimensions of roughness it is also important the following characteristics:

- The cavities material;
- The aluminum oxidizes dimension grains;
- Air blast pressure,
- The diameters of sand blast hole;
- The distance between the cavity surface and the sand blasting pistol;
- The mold maker experience.

Function of these parameters the roughness of the cavities surface can be varying from 400µm to 10µm. (Fig.3.).



**Fig.3. Example of roughness after sand blasting**

Using different grinding grain and powder and also modify the blasting parameters it was obtained a specified roughness at the surface of the cavity of the mold. This value of roughness was determinate using the comparative method using etalons samples of standard roughness. To obtain an exactly defined roughness at the contact surface of a bi- component mold, it was used different trials on different surfaces and compared the results. Using different grinding grain and powder and also modify the blasting parameters the author try to obtain a specified roughness at the surface of the cavity of a mold.

To achieve the desired roughness for the contact surface of injected parts originally used to surface sand blasting operation. For this, we used the equipment sand blasting machine MATRASUR (Fig.4.) existing in the molder workshop. The granules are chosen for sanding aluminum oxides which under standard plates leads to the desired roughness.



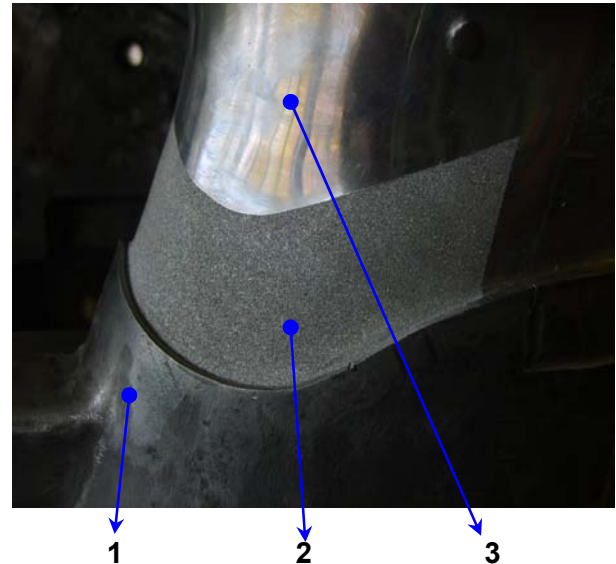
**Fig.4. Example of sandblasting machine from the mold workshop**

The phases necessary for sand blasting operation are:

1. dismantling nests for injection mold insert;
2. nests of cleaning and degreasing surfaces for: plastics scrap, oils, fats, demoulding agents; • impurities, burning material;
3. protect areas which are not intended to be sanded with a special protective Scotch, which is very resistant for bombarding of sand blasting,
4. introducing the correct quantities of the chosen sand in the sandblasting machine;
5. introducing the cavity of the mold in the sandblasting machine;
6. positioning of the mold cavity in the sandblasting machine;
7. setting for the sandblasting machine the special parameters for: air pressure and distance of the sand blasting pistol;
8. realization of the sand blasting operation in the special zone of the cavity surface.

It is very important to obtain a precise roughness of contact surface for a bi-component mold. The roughness of the contact surface must be equal or little smaller than the deepness of the penetration layer to obtain a better adhesion. The deepness of the penetration layer can be calculated very precise using theoretical formula. The values of all parameters from the formula necessary for calculation can be determined using computer simulations of the all injection process. This simulation can give the more exact values of all parameters because of the

complexity of the whole injection process these parameters are difficult to have manual determinations. The sand blasting surface of the mold is very clear visible after the sand blasting process comparative with the over surfaces of the cavity.



**Fig.5. Example of sandblasting surface of the cavity for a mold**

- 1 the parting surface of the mold;
- 2 sand blasting surface with a specific roughness necessary for a better adhesion;
- 3 polished surface of the mold.

It is important to make a good cleaning of the mold cavity and also of sand blasting surface after the operation of sand blasting. This cleaning can be made using air pressure and same liquids solvents. This operation assures a clean surface of the mold cavity. After this last operation the mold can be complete assembly and prepare for injection molding of the thermoplastic material. This mold was introduced in a bi-component injection molding machine.

After injection on the first component in the cavity of the mold all the roughness of the contact surface of the mold was transferred to the first injected component part. After the first step, the bi-component injection molding machine effectuates the transfer of the cavities. In this way the first injected component part it is introduced in the cavity of the second cavity of the mold. The second thermoplastic material is over molded on the first component part. The hot melt flow on the contact surface on the first component which has a specific roughness obtained in the first step. After the injection of the first thermoplastic material, the surface roughness

at the contact surface of the mold it is transferred on the surface of the first injection component. When the second thermoplastic material is over molded on the first component the roughness at the contact surface will be easily melted. That's give a better penetration, a good interdiffusion and also, a co-crystallization between the two thermoplastic components. All these factors have a very big contribution for a better adhesion between two plastic components for the bi- material injection of plastics parts.

### 3. CONCLUSIONS

The best results for adhesion between two thermoplastic components it was obtained when the roughness of the contact surface was equal or little smaller then the deepness of the penetration layer. The deepness of the penetration layer can be calculated using theoretical formula. This formula was determinate using the equations of heat transfer between the melt of the second injection thermoplastic material and the cavities surfaces [3]. The values necessary for calculation which must be introduced in the formula can be determined using computer simulations of the all injection process. These values are very important because in this way can be obtained the more precise value of the deepness of the penetration layer. Function of the accuracy of the deepness of the penetration layer can be obtained also the more precise the value of the roughness of the contact surface. This value it is very important because to much big value of the roughness of the contact surface can determined a very poor adherence between the first and the second component of the thermoplastic material. The cause of this non-adhesion it is because the melt of second component can not melt all the highness of the roughness. In this way between the roughness of the first component and the second component over molded will be an air layer and no penetration, a weak interdiffusion, and no-co-crystallizations. All this factors give a very bad adhesion.

In the over hand, if the roughness of the contact surface is too small the melt of the

second component over molded on the first component has a not enough penetration and interdiffusion of the molecules between the two components.

These are the reasons for a précised roughness of the contact surface. This roughness can be obtained with the best accuracy only using sand blasting and using different grinding grain and powder of sand or different types of granules of aluminum oxidizes.

### REFERENCES

- [1] ILIE SORIN: Influența rugozității suprafețelor de contact asupra adeziunii pieselor injectate bi- material, Contract de cercetare efectuat la firma S.C. PLASTOR S.A., 2009;
- [2] ILIE SORIN: The thickness of interpenetration layer at the injection molding of bi-components parts, *Lucrările sesiunii anuale de comunicări științifice*, Oradea, 2008;
- [3] ILIE SORIN: The thickness of interpenetration layer at the injection function of roughness at contact surface of bi-components parts, *ModTech International Conference - New face of TMCR, Modern Technologies, Quality and Innovation - New face of TMCR*, 2009;
- [4] MENGE GEOR.: How to make injection molds, Hanser/Gardner Publications, Inc., Cincinnati, 1993;
- [5] MIHĂILA IOAN: *Tehnologii Neconvenționale*, Editura Imprimeriei de Vest, Oradea, 1999;
- [6] ROSATO DONALD: *Injection moulding handbook*, Chapman&Hall, New York, 1995;
- [7] ȘEREȘ IOAN: *Matrițe de injectat*, Oradea, Editura Imprimeriei de Vest, 1999;
- [8] ȘEREȘ IOAN: *Materiale termoplastice pentru injectare, tehnologie încercări*, Oradea, Editura Imprimeriei de Vest, 2002;
- [9] TROTIGNON JEAN: *Matieres plastiques structures-proprietes, mise en euvre, normalisation*, Edition Nathan, Paris, 1996;
- [10] UNGUR HORIA: *Elastomeri termoplastici*, pp.52, Anul 4, Nr.20, *Tehnică și tehnologie*, ISSN 1453-8423, Editor Tehnic Media, București, 2005;
- [11] \*\*\*: *Over molding: A Multifaceted Medical Device Technology*, broșură Canon Communication January 2006;
- [12] \*\*\*: *Co-injection molding (sandwich molding, multi-material molding)*, broșură Bayer Material Science, Edition: 2006.