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STUDY TO DETERMINATE THE INFLUENCE OF THE ROUGHNESS AT THE CONTACT SURFACE FOR THE INJECTION MOLDING BI-COMPONENTS PARTS

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Abstract: The purpose of this paper-work is to present the practical experiments to determinate the influence of the roughness at the contact surface between two thermoplastics polyurethanes. Thirst polyurethanes it is a soft plastic material and the second is very rigid or hard polyurethane. The adhesion between these two materials it is very important for the bi-components injection molding parts. These parts obtained with bi-components molding injection technologies are very complex because they combine multi characteristic of the different plastics material like thermoplastics polyurethanes.

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, alls 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.)

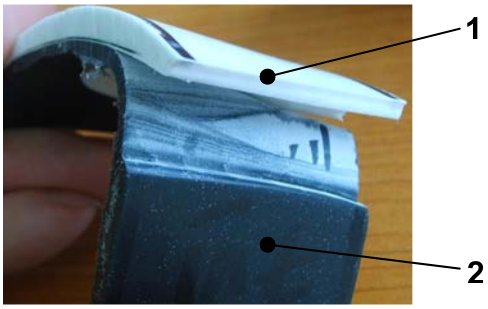

Fig.1. Example of no adhesion between the two components of an injection bi-components plastic part
1-first component it is a soft polyurethane
2-second component it is a hard polyurethane

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 I thing 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. TRIALS TESTS

I have used same metallic inserts which I have positioned in the cavity of the mold with five different roughnesses (Fig.2.) at the contact surface between the two components. These roughnesses have been made using classical cutting methods, like: milling, polishing and sand blasting. The values of the roughness chosen for study are presented in the table. (Tab.1.). these values are very different with big variations to see their influence into the bonding between the two components of an injection bi-components plastic part.

Fig.2. View of specials metallic inserts

Tab.1. Roughness value for different metallic insets

Designation of insert	R_a [µm]	R_z [µm]
Insert A	3,2	12,5
Insert B	0,1	0,5
Insert C	1,6	8
Insert D	25	50
Insert E	50	200

I have injected several laboratory bi-component samples using a soft polyurethane material for the first component and a hard and rigid polyurethane thermoplastic material for the second component. I have used for the first component the soft polyurethane named LRP5260 and for the second component the hard polyurethane LRP 5260.

To determinate the best injection molding parameters to inject the laboratories samples using a bi-component injection molding machines, I have used CAE programs which simulate the bi-component injection process. For this reason I have design with a big accuracy the 3D model of the laboratory samples which are injected at one shot of an bi-component injection molding machine.(Fig.3).

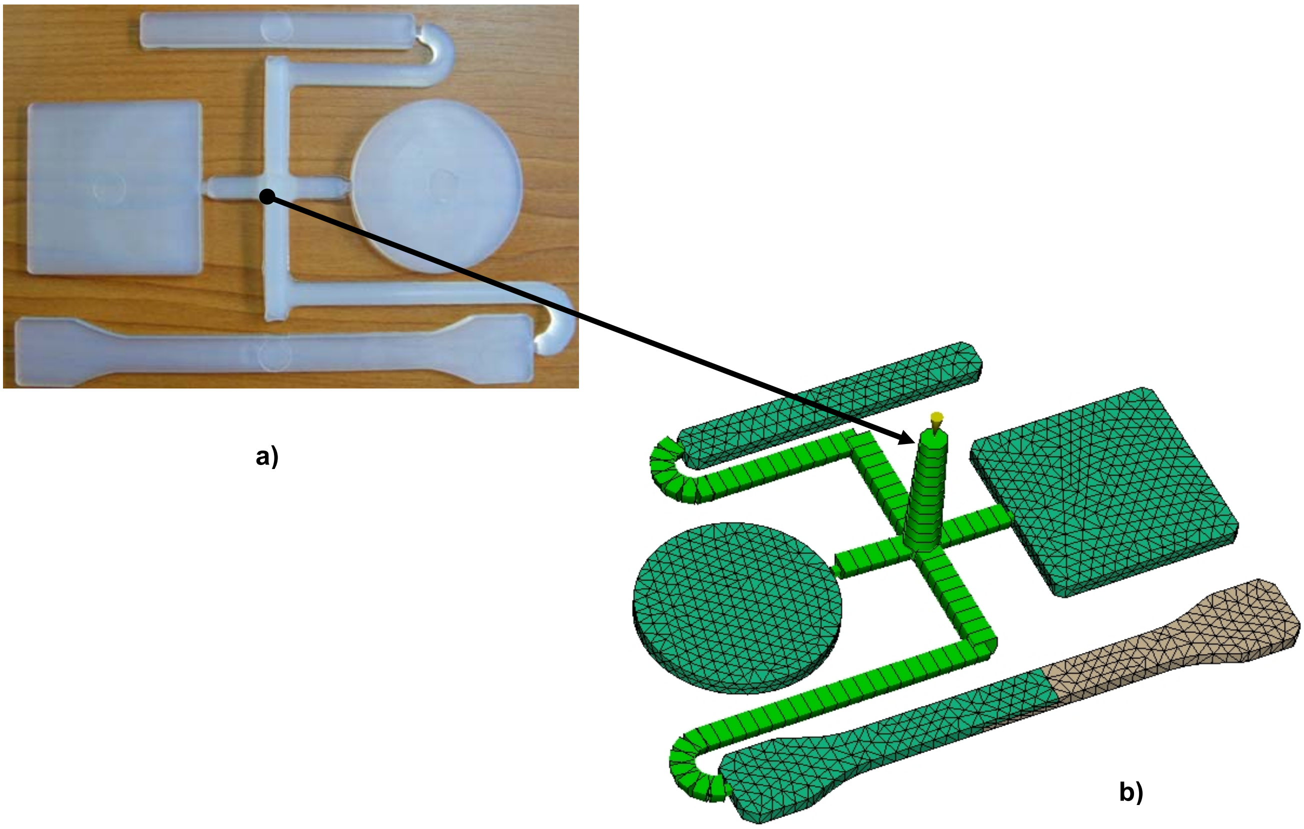

Fig.3. View of 3D model of a laboratory samples
a) Injected laboratory samples in on shot
b) 3D accuracy model of the samples

Using the characteristics of the two polyurethanes from the data base and the 3 D model of the laboratory samples, the CAE programs simulate the injection molding bi-component process. After several iterations the computers simulate program calculate the best injection condition recommended for inject the laboratory samples on an injection molding machine. These best injection conditions are: injection time, mold temperature, melt temperature of the two components and most important the melt temperature at the contact surface between the two components.(Fig.4.).

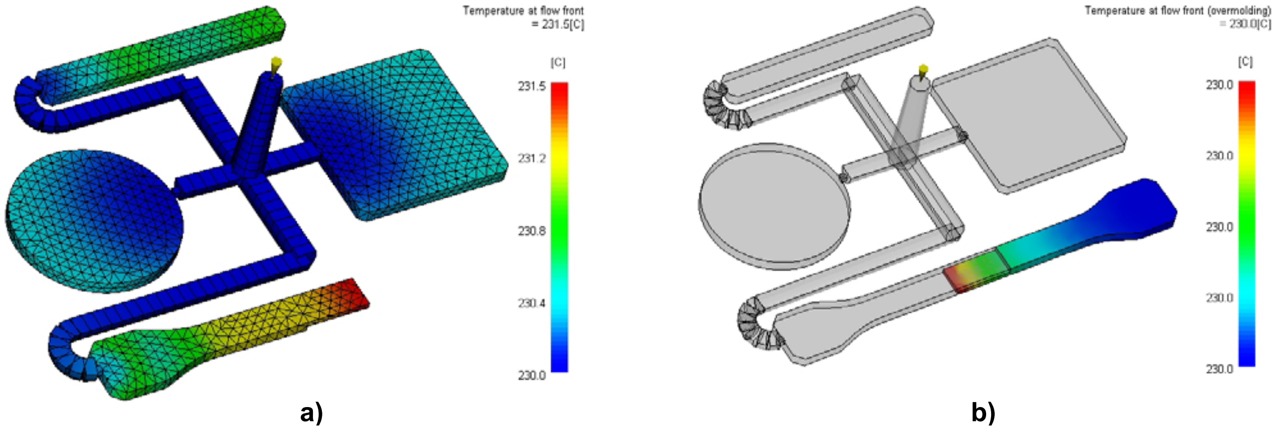

Fig.4. The results of flow front temperatures after CAE simulation
a) the flow front temperature for the first component
b) the flow front temperature for the second component

Using the results of CAE simulation program I have adjust all the parameters of the bi- component injection machine to obtain same values of the computer simulation. The principal injection parameters which I've set for the first thermoplastic material and also for the second are: mold temperature, melt temperature, injection speed, holding pressure, holding time and cooling time. I have injected 15 laboratory samples (fig.5.) with each special metallic inserts (notated A, B, C, D and E) using exactly the same parameters for the bi-component injection machine presented in table. (Tab. 2.).

Tab.2. The values sets for the bi-component injection machine used for the experimental trials

Name of the injection parameters	Values for the first component	Values for the second component
Melt temperature [°C]	220	240
Mold temperature	45	45
Injection time [s]	2,50	0,58
Switch over pressure [bars]	150	100
Holding pressure [bars]	200	200
Holding time [s]	20	16
Cooling time [s]	18	12

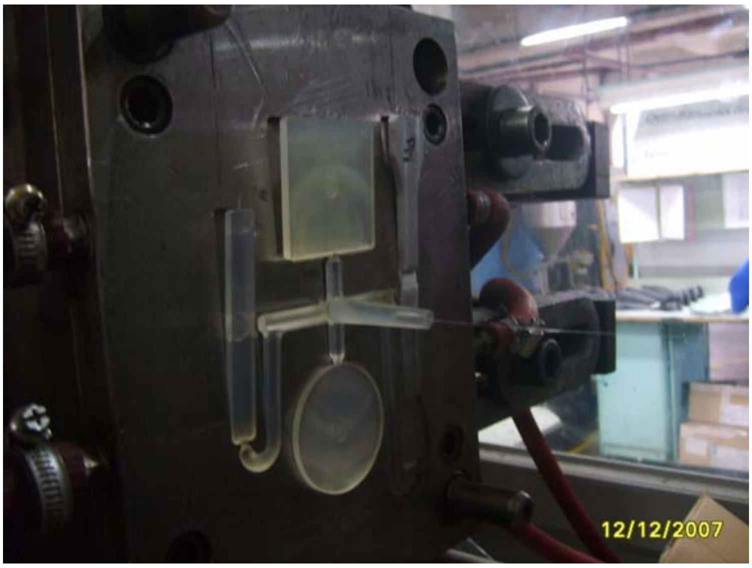

Fig.5. View of the trials on injection molding machine

After minimum 24 hours of thermal stabilization at the ambient temperate alls the laboratory samples was tested at tensile test using standard laboratory equipment. The laboratory test set give us the exactly value of the tensile force in the moment of bonding crack in the contact surface between the two thermoplastic components. That mean started with this moment we have no more adhesion between the two thermoplastics polyurethanes. The different values of the tensile force at bonding break depend of the different metallic inserts used in the cavity of the laboratory samples.

3. CONCLUSIONS

I can say that, these results show the influence of the roughness of the contact surface for the injection molding bi-components parts. Because all the other parameters of the bi-component injection molding machine was constant only one variable can be the cause of different values of the tensile force at bonding break. The results show us that, increase the roughness of the contact surface between two polyurethanes thermoplastic for an injection molding bi-components part the adhesion between the two components also increase. But this value of the bonding between the two components has a limit value and she is depending of the roughness of the contact surface and also the local injection condition. The local molding condition are very important because depending of this values we can influence the thickness of the interfusion layer.

These conclusions are very important for the plastics literature because I like to clarify the very different and opposite opinions about adhesion of multi components injected parts.

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