ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume X (XX), 2011, NR2

THE ADJUSTMENT PARAMETERS FOR A PNEUMATIC HANDLER OF A INJECTED PIECE WITH A COMPLEX GEOMETRY

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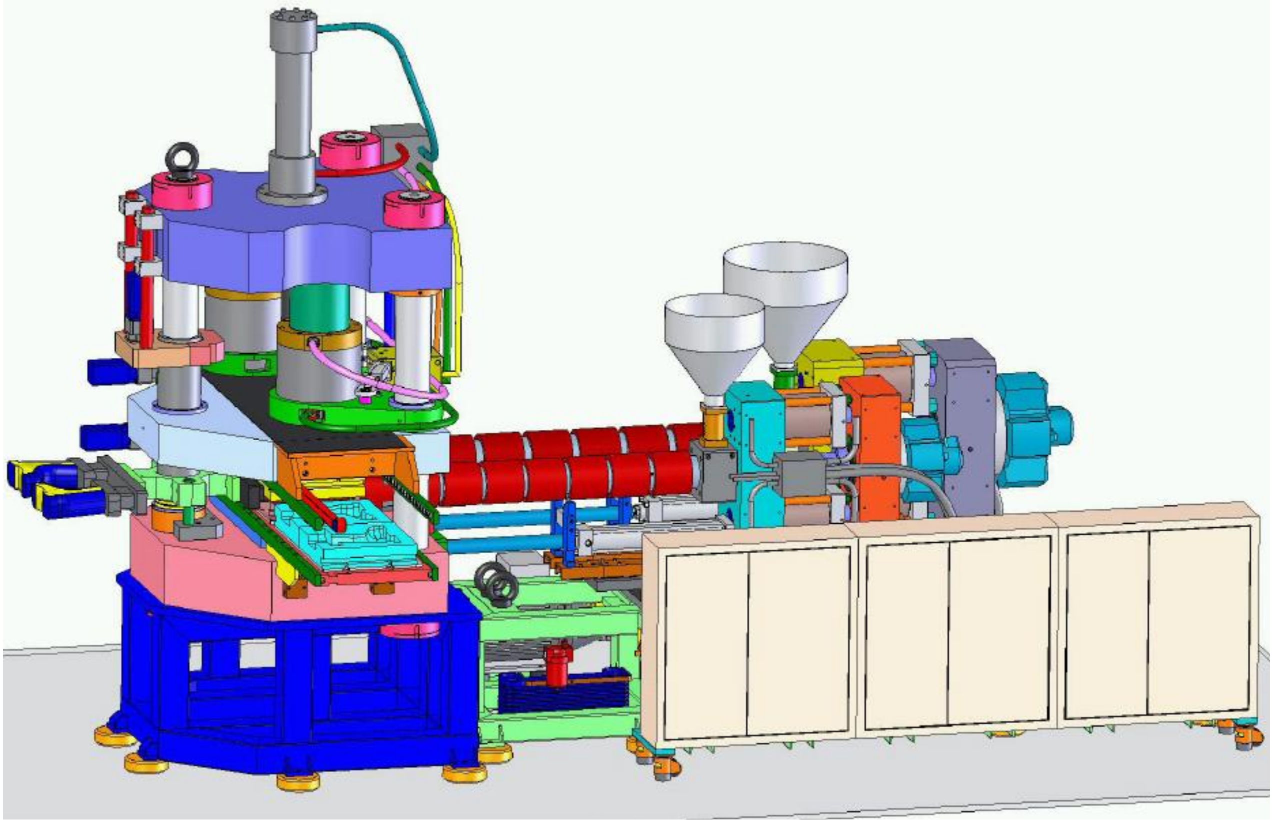
Key words. Injecting technology for plastic materials, alpine ski boots, pneumatic handler used for extraction of injected boots from the mold.

Abstract

The paper is based on a scientific research, made by the authors, with the aim of improving some technical-economic performances, by using a robotic system of extraction from the injecting mold of two injected objects from the category of alpine ski boots. The robotized extraction presents multiple advantages, consisting of time reduction for the extracting operation of the objects, lowering the physical effort made by the worker who servers the integrated injection system, and the reduction of thrown away pieces.

1. INTRODUCTION

The robotization of the injection process represents in the first place a rise of the section for plastic object injection, equipped with modern injection machines and with higher productivity. In picture 1 we presented a 3D design of an injecting machine, used for the series production of the two-material injected object: lower body of the ski boot. Beside this fact we can enumerate multiple advantages due to the automation and robotization process.



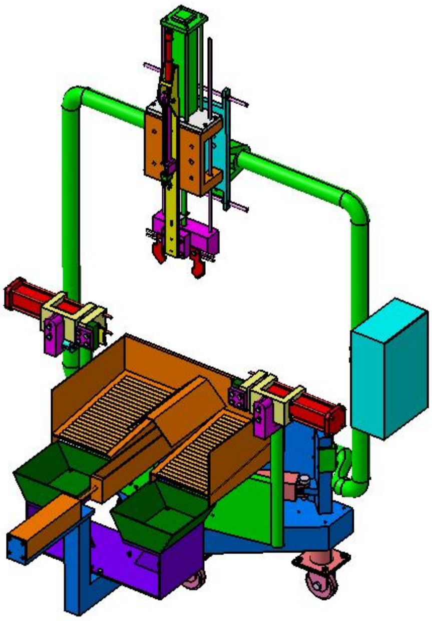
Picture 1. The 3D design of a injecting machine used for the series production of the two-material injected object: lower body of the ski boot

The industrial robots must be seen like machines, which try to make an easy work for humans and not to replace them. The plastic injection is realized at very high temperature which represents unsuitable working conditions for the human operator and rise the necessity of using some special costly equipments.

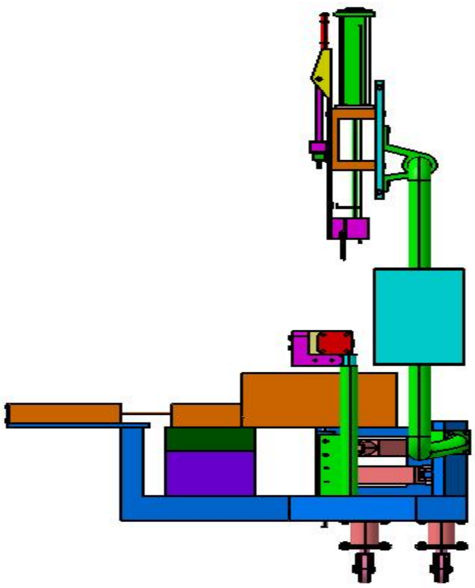
In picture 2 and 3 the paper authors have designed and constructed in 3D a robot with pneumatic auctioning, destined for the extraction operation of two complex injected pieces from the core of a mold for injection of a inferior body of a alpine ski boot.

The robotized system for extracting the boots from the cores of the mold is implemented in the production system of S.C. Plastor S.A. Oradea. The authors, using the CATIA software, have designed in 3D the handler, the result being presented in the pictures below with different isometric views.

The pneumatic handler will be positioned and adjusted in the left side of the injecting system, it’s movement in the desired position is realized manually by being pushed by a team of workers, for this having installed a mobile system of wheels movement.



Picture 2. 3D Model of the handling robotic assemble. Isometric view 1



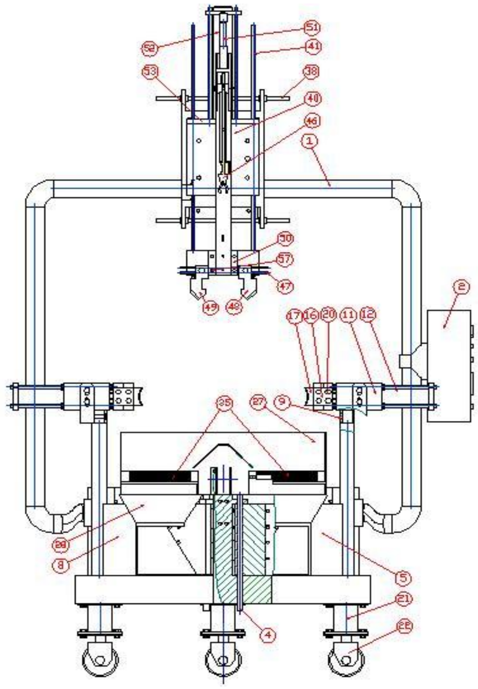
Picture 3. 3D Model of the robotic handler assemble. Isometric view 2

The extraction robotic system of the ski boots from the cores of the mold is implemented in the production system of the company S.C. Plastor S.A. Oradea.

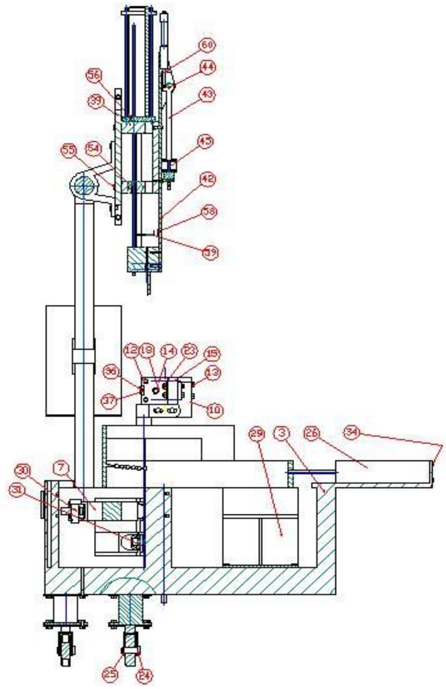
The Authors, using the software CATIA, have designed in 3D the handler, the model being presented in the below pictures in different isometric views.

The pneumatic handler, will be positioned and adjusted on the left side of the injection system, its movement in the desired position being realized manually by being pushed from a team of workers, for this being foreseen with a movement mobile system on wheels.

In picture 4 and 5 I presented two 2D views of the handling robot, from it resulting the positioning of its component elements.



Picture 4. 2D Design of the handling robot assemble. Front view.



Picture 5. 2D Design of the handling robot assemble. Side view.

2. PRESENTING THE WORK PHASE OF THE HANDLING ROBOT

- Moving the handling robot for positioning in front of the core of the injecting mold;
- Blowing compressed air for cooling the area over the injected piece on which it will be grabbed by the handler;
- Lowering the grabbing claw for the injecting network;
- The cut of the injecting network simultaneously with the grabbing by the claw of the handler;
- Rising the grabbing claw at 90° and the evacuation of the injected network;
- Moving the arm of the handler till the contact between the claw and the injected piece has been realized;
- The extraction movement of the piece from the mold core in a extraction composed movement;
- Letting the injected piece to fall in an evacuation gutter;
- Evacuation of the injected piece on the workbench;
- Retraction of the handler arm in the waiting position;
- Retraction of the handler from the front of the injecting mold core to allow their movement in the interior of the mold.

For evacuating the injected piece in the best safety conditions, without affecting its quality, it’s necessary a professional adjustment of the adjusting parameters of the extracting handler. These parameters are very important to assure the quality of the injected piece. Any adjustment error of a parameter can bring to refusal the injected piece, which at its turn is very expensive, and it result a unnecessary growth of the production costs.

3. ADJUSTMENT PARAMETERS OF THE EXTRACTION HANDLER FOR A INFERIOR BODY OF A SKI BOOT ARE:

1) Phase of handler movement:
    a. Initialization moment: positioning the core of the mold;
    b. Movement parameter: adjustment o the position sensor;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
2) Phase of cool air blowing:
    a. Initialization moment: 0,2 [sec] after the end of the previous stage;
    b. Movement parameter: no adjustment;
    c. Time parameter: 20[sec].
    d. Finish control: end of the blowing period.
3) Phase of lowering the grabbing claw:
    a. Initialization moment: 0,5 [sec] after the end of the previous phase;
    b. Movement parameter: adjustment of the position sensor;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
4) Phase of cutting the injection network:
    a. Initialization moment: simultaneous with previous phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
5) Phase of claw rising for grabbing the network
    a. Initialization moment: 0,3 [sec] after the end of the previous phase;
    b. Movement parameter: adjustment of the position sensor;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
6) Phase of handler arm movement:
    a. Initialization moment: 0,5 [sec] after the end of the previous phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
7) Phase of extraction movement:
    a. Initialization moment: immediately after the previous phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: The rotation sensor of the arm is in contact.
8) Phase of the piece falling on the evacuation gutter
    a. Initialization moment: right after the previous phase;
    b. Movement phase: adjustment of the sensor for the presence of the evacuated product;
    c. Time parameter: no adjustment;
    d. Finish control: contact sensor for the presence of the piece in the evacuation gutter.
9) Phase for product evacuation:
    a. Initialization moment: 0,2 [sec] after the previous phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.

10) Phase of arm retrieval:
    a. Initialization moment: simultaneous with the previous phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.
11) Phase of handler retrieval in the waiting position:
    a. Initialization moment: 0,2 [sec] after the end of the final phase;
    b. Movement parameters: adjustment of the sensor position;
    c. Time parameter: no adjustment;
    d. Finish control: position sensor in contact.

4. CONCLUSIONS

The handling robot with pneumatic action runs after an established program and can run for a long time without having to stop, so long it doesn't have any malfunctions or when it doesn't have scheduled any maintenance jobs, interventions or repairing. While the robot handles the injected objects, the human operator can develop, in parallel, other operations which cannot be made by the handler, such as: quality control of the injected products, deburring, labeling, packing, etc. Another great advantage of robotizing the production process is to ensure a very consistent cycle time throughout the production batch manufacturing. This is possible by eliminating the human operator intervention, which, because has a semi-automated workflow can't assure a constant flow in time and movement, and can bring big variation of the cycle time. This variation causes big losses of the production capacity, an inconsistence in the production process and implicitly a variation of the quality of the injecting pieces, which brings to a more rejected pieces and the rise of the production costs.

A big disadvantage of robotization is the high cost rose by the conception, design and execution of the handlers with pneumatic action for extraction of the injected pieces with complex geometry. It must contain a pneumatic part, which has to be solid enough to develop big extraction forces and an electronic part for command and control, to adjust the adjustment parameters (the work schedule, periods, movement,…) and the communication with the injecting machine. The communication between the injecting machine and the handler is very important to make the work schedule of the robot in accordance with the work-schedule of the injecting machine and to prevent interference and impact events of the injecting mold or of the handler's arms. Because those high costs the handlers are used in mass production or in very big series and for long periods of time (2-3 years) which brings to amortization of these costs and improving the production process by important growth of productivity, of production capacities, lowering costs with process rejection and growth of the quality of the pieces with a complex geometry.

Acknowledgement –This paper was supported in the PN II "PARTNERSHIPS IN PRIORITY S&T DOMAINS PROGRAMME", Project "Comparative researches concerning knowledge management in Romanian engineering education", Contract number 92074/1.10.2008

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