ANNALS OF FACULTY ENGINEERING HUNEDOARA
- INTERNATIONAL JOURNAL OF ENGINEERING
Tome IX (Year 2011). Fascicule 3. (ISSN 1584 - 2673)

[1.] Emil RAGAN, [2] Marta KOLLÁROVÁ

CALCULATION OF TRANSIENT CHARACTERISTICS IN MOULD CAVITY

[1-2]FACULTY OF MANUFACTURING TECHNOLOGIES OF TECHNICAL UNIVERSITY OF KOŠICE WITH A SEAT IN PREŠOV, DEPARTMENT OF MAUFACTURING MANAGEMENT, SLOVAKIA

ABSTRACT: The present study is focused on the possibilities of quantities solutions in mould cavity in dependence on the model of the regulation system. At following of the technological parameters influence it is prevented rising faults of made castings and the output quality of the castings is increased. Theoretical results of the calculated model are introduces for the case of the solution by the analytic method and the graphic-calculated method. Further they contain the solutions of the case model that are determined for applications in various technological advances of the cast.
KEYWORDS: low pressure cast, gravitation cast, pressure die cast

❖ INTRODUCTION

The technological process of the casting production consists of model production, mould production and processing cast. Always larger space [1,2] is devoted to research in region of cast quality and casting without faults especially for the automobile industry. The aim of the contribution is to describe the technological processes determined for the low pressure cast, the gravitation cast and the pressure die cast.

At present the attention is concentrated on the quality of castings that depends on the time of the die cavity filling and the speed of liquid metal connecting with the piston speed [3,4,5]. The too high velocity of streaming liquid metal in the gate results in turbulent stream of liquid metal. For the technological process following influence of various pressure die cast: technological parameters like the time of the die cavity filling, the speed of liquid metal, the working temperature etc. has the importance for elimination of risen faults in the castings. With regards to a quality of the casting it is necessary following of the die cavity filling what a transparency of the die does not enable. It results from it that it is more suitably following quantities that single marches in the die cavity like e.g. the pressure of the gas above the metal level in the crucible at low pressure casting evoke. It is possible to consider this quantity in the model of the regulation system like the unlet quantity and to determine through the methods of regulation at the well-known transmission the course of the die cavity filling like the outlet quantity.

❖ THE SIMULATION MODEL COMPILING

The principle of the simulation model compiling in the technical practice is to perform measurements on the real or modeling system with melting metal or modeling liquid. Then we can determine the transient characteristic with the followed time course of the inlet and outlet quantity.

At whatever other time course of the inlet quantity it is possible [6,7] to get the time course of the outlet quantity on the real system. It goes about the complicated process where the grade of opportunity of the real course will be the highest at the transient characteristic determined on the real system with melting metal and the lowest will be at the transient characteristic determined on the modeling system with the modeling liquid. In the case when the inlet quantity over runs with jumps on the certain constant value and the transient characteristic is well know it goes about the simplest case. As follows we get the outlet quantity by multiplication of the transient characteristic with the mentioned constant value.

Other case sets in when the time course of the inlet and outlet quantity is measured. In principle by the method of gradual integration it is possible graphically to get the process of the system and from here to determine the transient characteristic.

© copyright FACULTY of ENGINEERING - HUNEDOARA, ROMANIA

❖ THEORETICAL ANALYSIS AND MECHANISM OF MODELS

MODEL FOR LOW PRESSURE CASTING

For design and experimental calculation at low pressure casting of melting metal was used the model from the quartz glass time course of melting aluminum column at admission of pressure CO_2 and was scanned with motion picture camera. In an ideal case it is possible to determine the transient characteristic:

$$f(t) = 3\ 390\ [\ 1 - \exp(-0{,}54\ t)] \quad (1)$$

where it is: f(t) - transient characteristic; t - time

For the case of the gas pressure in the linear function then:

$$P = k.\ t \quad (2)$$

where it is: p - gas pressure above the level of melting metal; k – constant; t - time

As follows we get the time course of melting aluminum column that is the course of the die cavity filling:

$$h = 3\ 390\ k\ [1{,}58 - 0{,}85\ t + t\ .\ \exp(-0{,}54\ t)] \quad (3)$$

From the mentioned continuity it follows that at whatever other course of gas pressure p with the indicated method it is possible to get also the competent course of the die cavity filling h.

MODEL FOR GRAVITATIONAL CASTING

The analysis for gravitational casting as performed on the model from glass with gate channel knife gate and cavity of rectangular section. The film photograph of the mould cavity filling was made with help of the colored water like the model liquid. With regard on very near values of kinetic viscosity of melting aluminum and water it was possible to perform also simulation with this model liquid. From the stand point of very fast filling in the gate channel we can consider the height h like the jump one. We went out from these results and advance then it was possible to calculate the transient characteristic:

$$f(t) = 1 - 0{,}512\ .\ \exp(-0{,}762\ t) - 0{,}110\ .\ \exp(-2{,}05\ t) \quad (4)$$

For determination of the time course of the mould cavity filling it flows:

$$h = h_1(t) \quad (5)$$

MODEL FOR PRESSURE DIE CASTING

On solution of the case of pressure die casting the time course of the pressure die casting machine multiplication pressure p_1 and the pressure of melting metal in the die cavity p_2 shown by tensometer. Analogically from these courses with the mentioned method the transient characteristic was determined:

$$f(t) = 1 - \exp(-45{,}4\ t) - 0{,}0264\ .\ \exp(-1{,}07\ t) \quad (6)$$

With help of this transient characteristic it is possible to determine for the same die, pressure die casting machine and metal but at other applying course of multiplication pressure p_1 the competent course of the pressure in the die cavity p_3.

❖ CONCLUSIONS

The most important step of the simulation model design is the choice of testing model. We get as an outlet solution of the mentioned equations the equations presenting the mathematical model. The determination of single quantities courses in the die cavity in casting technological processes is a great contribution. The obtained results are connected with quality of castings. With help of suitable software program it is possible then to rationalize in time the exacting evaluation of graphical-calculation methods. This method so can be put into the important ones from the standpoint of transitions in the die cavity at whatever technological processes of mould and die cavity.

❖ REFERENCES

[1.] Vilčko, J., Nestor, J., Malík, J.: Smer inovácie tlakových lejacích strojov v náväznosti na kvalitu Al-odliatkov. In: Košice : DT ČSVTS, 1989, s.13-17.

[2.] Valecky J. and col.: High die casting. Praha : SNTL, 1963

[3.] Malik, J., Pribulová, A.: Recycling of return material in die casting technology. In: SGEM 2009. Volume 2. - Sofia : Bulgarian academy of sciences, 2009. – ISBN 9549181812. - P. 697-701.

[4.] Malík, J., Pribulová, A., Futáš, P.: Trendy vo výrobe odliatkov liatych pod tlakom zo zliatin ľahkých kovov pre automobilový priemysel. In: Vplyv automobilového priemyslu na rozvoj regiónov v SR : odborná konferencia. Košice : TU, 2005.

[5.] Ragan E.: Metal casting process under the pressure. ISBN 80-7099-268-9, Prešov: TU FVT, 1997

[6.] Ragan, E., Straka, Ľ., Pavel, J.: Volume mass and tensile strength of pressure castings: Objemová hmotnosť a pevnosť v ťahu tlakových odliatkov. 2007. In: TSO - Technology Systems Operation '2007. Prešov : FVT TU, 2007. ISBN 9788080739003. p. 245-246.

[7.] RAGAN, E. - KOLLÁROVÁ, M.: Matematické modelovanie efektívneho tlaku a P-Q^2 modelovanie pri liatí kovov. In: Scientific papers. Brno, 2008, s. 154 – 159.