DEVELOPMENT OF PRESSURE DIE CASTING AND PERMANENT-MOULD CASTING TECHNOLOGIES

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Abstract

Contribution deals with main directions of pressure die casting and permanent – mould casting. Research of mentioned technologies are made. Results of research are transferred into industrial practice. They are research of metal properties in interval of crystallization especially viscosity of liquid alloys, research of filtration, simulation of die filling and liquid metals solidifying, research of pressure die casting special methods, die materials, research of cooling system of permanent – moulds, thermography and radioscopy of permanent – moulds.

Key words
pressure die casting, permanent mould casting, pressing control in time, aluminium alloys

1. Introduction

Pressure die casting and permanent-mould casting rank among important technologies. At the end of twenties years of the last century in Czechoslovakia pressure die casting machines with cold chamber rose than spread all over the world. Since 1957 Vihorlat Snina, Slovakia became a producer of pressure die casting machines and since 1961 a producer of permanent-mould casting machines what was an assumption to widening these technologies also in Slovakia.

2. ASSUMPTIONS OF DEVELOPMENT OF PRESSURE DIE CASTING AND PERMANENT-MOULD CASTING

The motor of development in these technologies is especially an automobile industry [1]. It goes mainly about production of automobile motor parts. It widens also
about parts of coachwork and an existing consideration of casting whole body by the technology of pressure die casting of aluminium alloys. These aims are realized always more with the special methods of pressure die casting as thixo-casting, vacural casting and squeeze casting. An uncertain estimate of these methods extent is in literature from 2 up to 5 per cent. At pressure die casting machines and permanent-mould casting machines it is necessary to avoid vibration during working of machines [18].

3. INDIVIDUAL DIRECTIONS OF TECHNOLOGIES

At pressure die casting and permanent-mould casting it is important to know thoroughly properties of liquid metals and alloys at critical conditions of classical technologies and usual conditions of special processes of thixo and rheo pressure die casting. It is especially important to reach viscosity in interval of crystallization for securing good flow property at production of exact casting with the mentioned technologies [2]. It is necessary to solve particularly the problems of flow property at pressure die casting magnesium alloys that demand the design of pressure die casting machine with the velocity of pressing piston over 6 ms⁻¹ [3]. Managing flow property at pressure die casting and permanent-mould casting means lowering wastes and increase castings quality.

The simulation of filling and solidifying, regarding the position of cooling channels and ingate system with overflows was presented in [4]. A great part of research is possible to solve by simulation and to make whole process cheaper.

The filtration is also direction of development of metals at pressure die casting and permanent-mould casting. The result is higher mechanical properties of casting, increased running property and better machinability of castings. The results of research direct to higher quality and increasing complex economy [5]. At permanent-mould casting foam filters are used [6].

Further new direction is regulation of individual processes of pressure die casting and permanent-mould casting with feedback [2]. The peak is pressure die casting machine with regulation of pressing in real time. With connection with pressure sensors are reproduced profiles of pressure during pressing. A casting with mass 6.7 kg is produced on this machine [7]. The pressure die casting machine with warm chamber is also controlled in real time where equal parameters are reached from one casting to other one. At zinc castings increased specific gravity of metal and precision of pressure die casting is reached [8]. Further special sorts of pressure die casting are used. They are thixo casting with low pressing velocity [9], vacox casting with influence of individual technological parameters at aluminium alloys casting. There are casting without pores, what enables to weld and to treat termally them what is otherwise an unfulfilled assumption for repair of pressure die castings and permanent-mould castings [10].

At squeeze casting mechanical properties of produced castings are improved. The pressure increasing over 50 MPa cause a grain grows. Therefore it is not necessary at castings without pores to work with pressure higher than 50 MPa [9].
From measurement of column stress in internal openings it is passed on measuring instruments for measuring column stress with three sensors in two parallel planes perpendicular to axes of columns. Measuring is performed on the basis of plane shift during load [1].

Further research concerns the material of permanent mould. For influence of solidifying state is recommended copper-beryllium [6].

Research of individual lubricant for permanent moulds is performed [12]. It is recommended shungit on the basis of carbon with additive of oxides of silicon and aluminium that has high thermal and chemical stability. In connection with it the research of measuring method of heat outlet of permanent mould lubricants for the heat conductance from 0,3 up to 0,5 WK-1m-1 is performed [13], [19].

The further research concerns cooling system of the permanent mould that consists of robot arm with integrating aggregates for temperature measuring. The surface of the permanent mould is measured with help of two pyrometers. On the basis of comparing the given value and the actual one is stated the programme at cooling for two spraying nozzles that are moved along hot internal walls of the permanent moulds and by need they spray air, water or their combination [14].

The research of aluminium alloy casting in to the permanent mould is performed. It is connection between velocity of solidifying smaller than 0,5 Ks-1, formation of structure in casting and in heat treated state mechanical properties of casting [15], [16].

The further research concerns permanent-mould casting to integrated securing permanent mould at casting light alloys. The aim is reduction of wastes by regulation of parameters of casting process. In detection of process unstability thermography and radioscopy are used. Permanent mould temperature rise is followed with thermal camera and casting density with radioscopy during form filling, solidifying and cooling. We can know defects of casting in time. Possibilities of transmission of laboratory methods into the practice in industry are discussed [17].

The further research is performed at the permanent-mould casting with direct ingate technique through four ingates where in ingate system foam filters were used. Form filling was reached without turbulence and oxides. Substantial advantage is calming turbulent flows at form filling [6].

4. CONCLUSION

From the performed research with the aim of utilizing in practice in industry directions of development of pressure die casting and permanent-mould casting concerning used materials, technologie and casting machines. It is followed process quality improvement by raising parameters, energy and materials saving and by lowering wastes in competition with the other technologies. The research performed continously in the mentioned technologies has the great practical reach.
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