



Fig. 1. Methods of gate cutting in silicon moulds



Fig. 2. Patterns for mould cavity creation

The results of experiments with rotational speeds 100, 200, 300, 400, 500 and 600 rpm for clockwise and counterclockwise direction of rotation are shown on Figs. 3 to 8. The castings were cast on centrifugal casting machine. The temperature of moulds cavities during casting was 90 ± 3 °C.



Fig. 3. Cast at 100 rpm a, clockwise rotation b, counterclockwise rotation



Fig. 4. Cast at 200 rpm a, clockwise rotation b, counterclockwise rotation



Fig. 5. Cast at 300 rpm a, clockwise rotation b, counterclockwise rotation



Fig. 6. Cast at 400 rpm a, clockwise rotation b, counterclockwise rotation



Fig. 7. Cast at 500 rpm a, clockwise rotation b, counterclockwise rotation



Fig. 8. Cast at 600 rpm a, clockwise rotation b, counterclockwise rotation

Discussion

Fig.3 shows silicon mould cast at 100 rpm with clockwise and counterclockwise direction. It can be seen that this rotational speed was so low that centrifugal force is not enough to force the molten metal to fill the mould's cavities with all kinds of runners. The rotational speed increased to 200 rpm (Fig. 4) fills the mould's cavities with straight runners, but it is not big enough to fill the mould's cavities with side runners or back runners. The results similar as for 200 rpm were obtained at 300 and 400 rpm (Figs. 5 and 6). Increasing the rotational speed to 500 rpm (Fig. 7) succeded in filling all the mould's cavities with side runners. This increasing also causes big fins in parting line, which increases the costs and time of final processing of castings. The mould's cavities with back runners are also not filled properly as in previous cases due to low centrifugal force. The centrifugal force at 600 rpm (Fig. 8) was so big that it caused splashing of such amount of molten metal through parting line (Fig. 9) that mould's cavities can not be properly filled with remaining amount.



Fig. 9. Close up of mould with fin in parting line



Fig. 10. Mould with all cavities filled

On Fig. 10 can be seen silicon mould after casting with filling obtained after:

- mould's temperature increasing to 120 °C,
- increasing of clamping pressure
- increasing revolutions to 600 rpm
- mould surface treated with french chalk powder

There was also visible fins of molten metal in parting line or its spraying from mould through parting plane into inner space of casting machine

It can be seen on Figs. 3 - 8 that the direction of rotation has not significant effect on the mould filling.

Conclusions

From these test spins was established that the most suitable runners for molten metal filling into mould's cavity are straight runners with the shortest possible length.

The runners from the side of mould's cavity can be used for complex shape castings spin cast at higher rotational speeds. The runners from the side of mould's cavity should be used only as additional to straight runners.

The runners from back side of mould's cavity should be avoided because of number of necessary adjustments.

Using straight runners the revolutions from 200 rpm are sufficient for simple shape castings casted in moulds with diameter 230 mm. The side position of runners requires up to 500 rpm and there is risk of fin in parting line. This risk can be eliminated by holding pressure increasing by minimum 25 %. It is also determined that direction of rotation has not significant effect on mould's cavities filling.