

# 防止精密铸造蜡模变形的几种措施

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**摘要** 介绍了防止熔模铸件变形的几种措施。针对易变形件要从第一道工序射蜡就采用在蜡模中放入阻碍物限制收缩变形、开浇道根后粘浇道, 压蜡后在水中冷却等有效措施, 使蜡模处在一个良好的质量状态之下。大量生产实践证明, 这些预防措施是有效并且十分必要的。

**关键词** 熔模铸造; 蜡模; 措施

中图分类号 TG249.5

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熔模铸造在生产中较多采用糊状模料, 这主要由于糊状模料比液态模料收缩小、凝固快、生产率高<sup>[1]</sup>。在压型→蜡模→铸件的生产过程中, 蜡模的尺寸稳定性和变形程度, 极大地影响了铸件的质量状态, 所以在防止熔模铸件变形中对蜡模的控制是十分重要和必要的。

## 1 在蜡模中放入阻碍物限制收缩变形

精铸件右页结构见图 1, 因需保证门的回转良好, 故两个  $\phi 10.5$  mm 的孔要求同轴, 客户要求用专用销轴检具全检, 并且专用销轴一端要自由落体式无障碍地穿过两个孔。原来的生产工艺为: 压蜡后, 压型放入水中冷却 30 min 后取出蜡模, 修好蜡模后组树。浇注出的铸件用专用销轴穿两个  $\phi 10.5$  mm 的孔, 因两孔不同轴, 销轴穿不进去, 需要 100% 校正, 而且变形没有一点规律, 极大增加了校正工作量, 严重拖后生产进度。

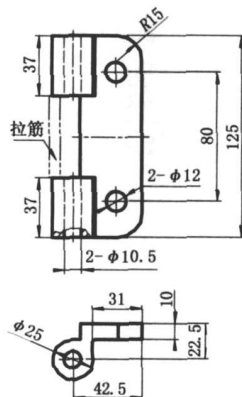


图 1 右页铸件

针对此情况, 改进了工艺, 经过计算, 做了 10 根  $\phi 10.8^{+0.1}_{-0.1}$  mm 的销轴, 在压制右页蜡模后, 就将该销轴在  $\phi 10.5$  mm 孔处穿入蜡模, 之后一并放入水中, 冷却 30 min 后取出, 针对这些蜡模做了两种方法: 一种是修蜡模后直接组树, 另一种是再在上面粘一条拉筋, 见图 1。铸件生产出来用销轴检测, 仅有 1 件两孔略偏斜, 其余则完全符合要求, 此 1 件偏斜的右页, 稍一校正即可

符合要求。经归类, 发现第一种方法未粘拉筋的就已经满足生产要求, 可投入批量生产。

5×5BT 阀套精铸件阀套的 4 个爪有严格要求, 爪的外圆要求加工, 必须保证足够的加工量, 露黑皮不行。为此, 在蜡模和铸件上均有专用样板检测爪尺寸变化 (见图 2)。

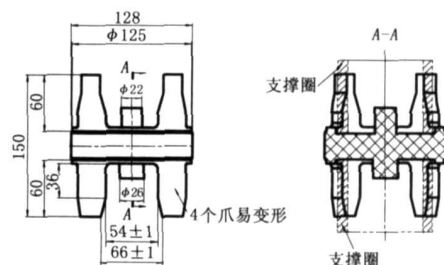


图 2 5×5BT 阀套结构图

原来的工艺为: 压蜡后放入水中冷却 40 min 后取出蜡模。经检测, 4 爪在蜡模上总体为向内变形, 每个爪还左右摆, 变形没有规律。射蜡工 1 小时只能修出 7 件符合样板的蜡模。

为解决变形问题, 经计算, 专门制作了金属支撑圈, 见图 2 双点划线所示, 在阀套蜡模射出后, 将金属支撑圈插入, 一并放入冷水中冷却 40 min 后取出。在采用金属支撑圈并按工艺要求校正蜡模后, 几乎不用修蜡模, 大大提高了修蜡模的工作效率。现批量生产中已按改进后工艺执行, 取得了良好效果。

## 2 采用开浇道根后粘浇道的措施

DN150 法兰盘结构见图 3, 其结构对称、壁厚均匀。如果直接在其上开出浇道, 因浇道较厚大, 与蜡模本体形成壁厚差, 不仅在从模具拿出过程中取蜡模困难, 而且会因取模方式不当造成变形; 也会在蜡模的冷却过程中因壁厚不均, 而造成收缩变形。所以综合考虑, 对 DN150 法兰盘采用先预设浇道根 (高度为 1.0~1.5 mm), 后粘浇道的方法避免在蜡模上因浇道厚大而形成壁厚不均, 导致收缩不同步的变形。

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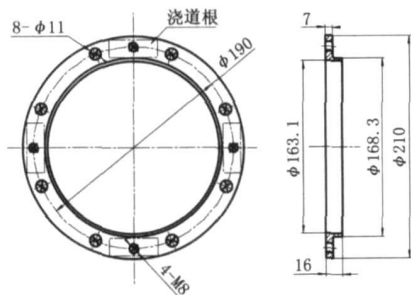


图 3 DN150 法兰盘结构图

### 3 蜡模冷却方式

压蜡后, 还要注意冷却方式的选择, 通常是在空气中冷却或在冷水中冷却。在冷水中冷却可强制蜡模定型, 而有些三端或两端为法兰盘, 如 DN40 法兰闸阀体, 在正常生产条件是放入水箱中冷却的, 导致在蜡模上的两法兰盘间距  $L_1$  和  $L_2$  (见图 4) 相差得很大, 可达到 2.0~2.5 mm。

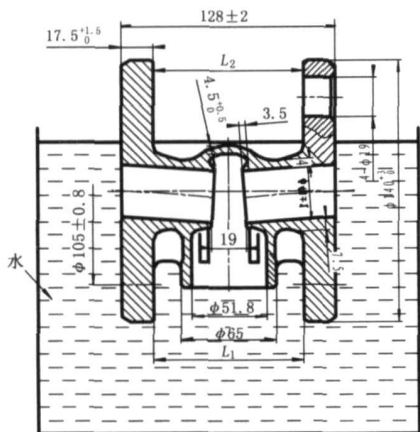


图 4 DN40 法兰闸阀体冷却示意图

经分析, 除结构本身的特点, 蜡模在水箱中为漂浮状态, 出现蜡模的一部分在水中, 一部分在空气中的情况。由于水面上下的法兰盘冷却条件不同, 产生的收缩不同, 使法兰盘产生较大的变形。为防止这种现象, 应设法使蜡模完全浸入水中。使同一蜡模的各个部位冷却条件一致, 待尺寸稳定后再取出, 可大大减少此类问题的发生。

### 4 从工艺设计上来减少变形

#### 4.1 门扣

门扣结构见图 5, 因属于厚大开口件, 易在开口处变形(见图 5 虚线所示), 靠插入阻碍物的方法仅能解决在蜡模上的变形, 无法解决在铸件成形过程中因收缩不均而导致的变形。所以需在开口处加上一条  $\phi 7$  mm 的拉筋(见图 6), 既能解决蜡模上的变形又能解决铸件上的变形, 待铸件热处理后再把拉筋去掉。

#### 4.2 锁紧支架

锁紧支架材质为 SCS13, 结构见图 7, 最初采用横

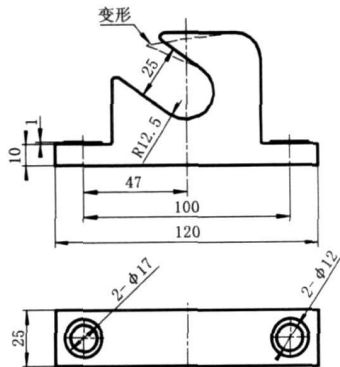


图 5 门扣结构图



图 6 门扣粘拉筋图

模头组树, 2 件/树, 见图 8。铸件做出后, 变形很严重, 达到 3~4 mm, 见图 7 双点划线所示。后改用圆弧模头组树, 仍为 2 件/树, 见图 9。

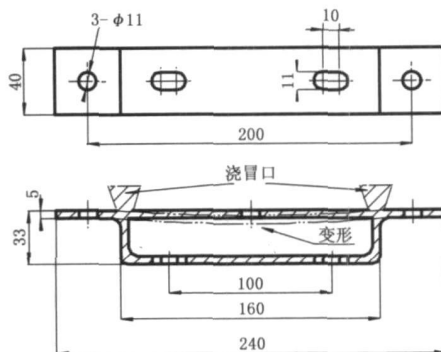


图 7 锁紧支架结构图

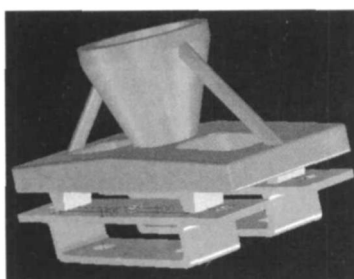


图 8 原工艺锁紧支架组树图  
(用横模头)

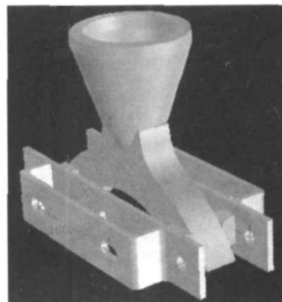


图 9 改进工艺锁紧支架  
组树图(用圆弧模头)

由于用圆弧模头组树, 可充分利用圆形开口件的特点, 虽然在凝固过程中模头有收缩, 但 SCS13 材质的韧性很好, 模头会发生回弹, 这样减少了铸件在凝固过程中由于受模头牵连而造成的收缩变形。变形由原来的 3~4 mm 减少到 1 mm, 极大地减轻了校正的工作量。

### 5 结语

在熔模铸造的整个工艺过程中, 蜡模的变形程度对于铸件变形具有很大影响。在射蜡工序中针对不同产品, 注意应用防止蜡件变形的各项措施, 认真规范工艺操作, 是可以达到防止熔模铸造件变形的目的的。

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900 mm.

**Key Words:** Hypereutectic High Cr Cast Iron, Slope Cooling Plate, Slope Plate Length, Primary Carbide

**Application of Microstructural Analysis to the Microstructure Observation of the Semi-solid Alloy** Zhang Qianqian, Cao Zhanyi, Liu Yongbing, Zhang Youfa, Wu Jihong (Key Laboratory of Automobile Materials of Ministry Education, Department of Materials Science and Engineering, Jilin University, Changchun, China) 2008, 28(2) 128~ 130

**Abstract** The microstructure of semi-solid Mg-10Al-4Zn alloy was observed by OM (optical microscope), SEM (scanning electron microscope), EDS (energy dispersive spectrometer) and LEXT. OM observation reveals that there exists the fine and round semi-solid microstructure with uniform distribution and higher solid fraction. The finer structure can be observed by SEM, and the melting firstly occurred in the boundary with higher solute concentration by combining with EDS analysis. LEXT observation indicates that the solid phase particle is spheroid in three-dimensional structure, which is composed of eutectic phase and remelting  $\alpha$ -Mg phase by two-dimensional planar height diagram verification.

**Key Words:** Microstructural Analysis, Semi-solid, Mg-10Al-4Zn Alloy, Microstructural Observation

**Mechanical Properties of Aluminum Alloy at Elevated Temperature in Squeezing Casting** Jia Zhanzhan<sup>1</sup>, Zhu Wei<sup>1</sup>, Han Zhiqiang<sup>1</sup>, Zhao Haidong<sup>2</sup>, Liu Baicheng<sup>1</sup> (1. Key Laboratory for Advanced Materials Processing Technology, the Ministry of Education, Department of Mechanical Engineering, Tsinghua University, Beijing, China; 2. School of Mechanical Engineering, South China University of Technology, Guangzhou, China) 2008, 28(2) 130~ 133

**Abstract** A series of true stress via true strain curves were mapped under given temperatures, including 250, 300, 350, 400, 450, 500 °C, and strain rate, including 0.1, 0.01, 0.001 s<sup>-1</sup>, based on the measurements of mechanical properties of squeezing casting aluminum alloy with different pressures, such as 20, 50, 75 MPa by means of digital-controlled thermal-mechanical physical analogue machine Gleeble 1500D. The effects of temperature, strain rate and squeezing pressure on the mechanical properties of the aluminum alloy at elevated temperature have been examined. The results indicate that the flow stress of the aluminum alloy is decreased with the increase of the temperature and is increased with the increase of the strain rate. The higher flow stress can be obtained with a higher squeezing pressure, exhibiting the effects of squeezing pressure on the mechanical properties of the aluminum alloy at elevated temperature.

**Key Words:** Squeezing Casting, Aluminum Alloy, Mechanical Properties at Elevated Temperature, Isothermal Compression

**Design and Improvement of Gating and Exhausted System in Die Casting Die for Airless Gun** Chen Tiejun (

Chongqing Changjiang Coating Machine Plant, China Shipbuilding Industrial Corporation, Wanzhou, China) 2008, 28(2) 133~ 134

**Abstract** The improvement of gating system was conducted by analyzing the structure, dimension and processing features of airless gun, in which the one ingate was modified two ones that locates the higher position of components, and the declined core-drawing mechanism was cancelled to simplify the die structure. The qualified products were manufactured successfully with the improved mould by rational die casting process.

**Key Words:** Airless Gun, Die Casting Die, Gating System

**Some Countermeasures of Preventing the Deformation of Investment Castings** Lu Rui<sup>1</sup>, Bao Yuqiu<sup>1</sup>, Xu Yunxiang<sup>2</sup> (1. Penglai Jinchuang Investment Casting Valve Co., Ltd., Penglai, China; 2. Chinese University of Science and Technology, Hefei, China) 2008, 28(2) 135~ 136

**Abstract** Some countermeasures of preventing the deformation of castings in investment casting were expounded. Aiming at easily-deformed castings, the effective measures should be adopted from the first procedure, wax injection, to render the wax pattern in a desirable quality condition. The practical production verified that these countermeasures are effective and necessary for preventing the deformation of investment casting.

**Key Words:** Investment Casting, Wax Pattern, Measures

**Approaches to Deoxidization in Middle Frequency Induction Furnace** Wen Yaixin, Sun Yuaneng (Zhongshan Tiewang Investment Casting Co., Ltd., Zhongshan, China) 2008, 28(2) 137~ 139

**Abstract** The deposition-deoxidization behavior of deoxidizer in middle frequency furnace was expounded. It was found that the deoxidization ability is deteriorated with the increase of oxidization degree of the element when some elements reach to a certain in the furnace. The excessive addition of metal oxide element can improve deoxidization ability and reduce the oxygen content in molten steel to decrease non-metal inclusions, which is helpful for the purification of molten steel.

**Key Words:** Deposition-deoxidization, Oxidization Degree, Deoxidization Energy, Carbon-oxygen Balance

**Effects of Trace Sr on Microstructure and Mechanical Properties of (Al<sub>2</sub>O<sub>3</sub> + Al<sub>3</sub>Zr)<sub>p</sub>/A356 Composites** Xu Ke, Zhao Yutao, Chen Gang, Zhang Songli, Sun Hongqiang, Huo Xiaoyang (School of Materials Science and Engineering, Jiangsu University, Zhenjiang, China) 2008, 28(2) 139~ 141

**Abstract** Effects of trace Sr on microstructure and mechanical properties of (Al<sub>2</sub>O<sub>3</sub> + Al<sub>3</sub>Zr)<sub>p</sub>/A356 composites synthesized by the direct melt reaction in A356-Zr(CO<sub>3</sub>)<sub>2</sub> system were investigated by X-ray diffraction (XRD), scanning electron microscope (SEM) and