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Research Article

Simulation of Microstructure during Laser Rapid Forming Solidification Based on Cellular Automaton

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The grain microstructure of molten pool during the solidification of TC4 titanium alloy in the single point laser cladding was investigated based on the CAFE model which is the cellular automaton (CA) coupled with the finite element (FE) method. The correct temperature field is the prerequisite for simulating the grain microstructure during the solidification of the molten pool. The model solves the energy equation by the FE method to simulate the temperature distribution in the molten pool of the single point laser cladding. Based on the temperature field, the solidification microstructure of the molten pool is also simulated with the CAFE method. The results show that the maximum temperature in the molten pool increases with the laser power and the scanning rate. The laser power has a larger influence on the temperature distribution of the molten pool than the scanning rate. During the solidification of the molten pool, the heat at the bottom of the molten pool transfers faster than that at the top of the molten pool. The grains rapidly grow into the molten pool, and then the columnar crystals are formed. This study has a very important significance for improving the quality of the structure parts manufactured through the laser cladding forming.

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计算机应用技术

特种铸造及有色合金 2014年第34卷第3期

大型铝合金轮毂低压铸造过程数值模拟及工艺优化

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摘要 针对低压铸造大型铝合金轮毂在热节处产生的缩松、缩孔问题,采用 ProCAST 软件分析低压铸造铝合金轮毂的充型和凝固过程的温度场分布规律,根据模拟结果优化模具的结构和铸造工艺参数。结果表明,通过在模具上加设水冷环以增强冷却速度,有效地减少了轮毂热节处的缩松、缩孔。优化后的工艺不但提高了铸件的性能而且缩短了生产周期,提高了生产效率。

关键词 低压铸造;大型铝合金轮毂;温度场

中图分类号 TG249.2⁺8;TP311:O242 **文献标志码** A **文章编号** 1001-2249(2014)03-0256-04

Numerical Simulation of Low Pressure Casting Large Size Aluminum Alloy Wheel and its Process Optimization

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Abstract: To eliminate shrinkage porosity occurred in the hot spot in low pressure casting large size aluminum alloy wheel, the ProCAST software was adopted to understand the temperature field distribution during filling and solidification process. The mould and casting parameters were optimized according to the simulation. The cooling rate was improved by adding water-cooling ring in the mould, and the

文章编号: 1001-3482(2016)02-0006-05

螺旋复合筛管外护管固液两相流冲蚀磨损分析

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摘要: 外护管作为螺旋复合筛管的重要部件, 冲蚀性能方面研究很少。为了给外护管的设计和使用提供参考, 利用有限元分析软件 CFX 建立外护管缝口处固液两相流冲蚀模型, 模拟含砂石油在外护管缝口处的流动情况, 获得最大冲蚀磨损发生的位置, 并对冲蚀磨损影响因素进行分析。结果表明: 最大冲蚀磨损发生在底面与斜坡面连接处, 并靠近底面的位置; 最大冲蚀率随入口流速的增大呈现指数增长趋势; 石油含砂直径 0.05 mm 左右时, 外护管的冲蚀磨损现象会比较严重; 最大冲蚀率随含砂质量分数的增大呈现反比例降低趋势。

关键词: 筛管; 外护管; 冲蚀磨损; 数值模拟

中图分类号: TE925.302 **文献标识码:** A **doi:** 10.3969/j.issn.1001-3482.2016.02.002

Erosion Wear Analysis of External Protecting Pipe with Spiral Composite Screen Pipe in Solid-Liquid Two-Phase Flow

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Abstract: Though the external protecting pipe is one of the most important components of spiral composite screen pipes, little research has been conducted on the field of its erosion fracture. In order to provide reference for the design of the external protecting pipe, the erosion model of external protecting pipe was established in CFX, and the flow situation of the seam position with the



Numerical Simulation of the Effects of Pressure, Velocity and Types of Quenching gas on the Cooling Performance of Workpieces in Vacuum High-Pressure Gas Quenching Furnace

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Abstract:

Effects of the quenching gas pressure, inlet speed and gas type on the workpiece cooling performance in the vacuum high pressure gas quenching furnace was studied by a large number of computational simulation with the software FLUENT. By comparison of the workpiece cooling rates under different nitrogen quenching pressure of 0.45MPa, 0.6MPa, 1.0 MPa and 1.3MPa, the influence degree of quenching pressure on the workpiece cooling rate was obtained. When the nitrogen quenching pressure was 0.6MPa and the inlet speed increased from 40 to 60m/s, the cooling rate was improved by 27%, but the fan power increased 3.4 times. When the gas volume flow was certain, both the specific heat and density affected the heat transfer coefficient. By computational simulation of the effects of hydrogen, helium, nitrogen and argon four quenching gases on the workpiece cooling rates, we know that under the same pressure and flow, the cooling capacity of four gases is nitrogen>hydrogen>helium>argon, but when the fan power is the same, the cooling capacity of low-density and high-specific heat gas is higher, and the cooling capacity of four gases is hydrogen>helium>nitrogen>argon. The inlet temperature of quenching gas has little influence on the cooling rate. When the nozzle diameter is increased, the cooling rate becomes slower, but the cooling uniformity becomes better.

Keywords: Vacuum High-Pressure Gas Quenching, Temperature Field, Flow Field, Cooling Rate

1. Introduction

Vacuum high-pressure gas quenching is a kind of vacuum heat treatment to heat works under vacuum state, and then cool and harden them by high-pressure and high-velocity gas. It has many outstanding advantages such as no oxidation, no decarburization, degassing, degreasing, good surface quality, small deformation, excellent mechanical properties of heat-treated parts, long longevity, no

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基于混响时间的汽车内饰设计方法研究

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摘要:针对汽车内饰环境,提出利用声学模拟软件 EASE 进行车载扬声器声场混响时间仿真的方法,指导车辆内饰设计,提高工作效率。为验证 EASE 软件仿真的准确性,分别通过 EASE 软件和电声测试系统 CLIO 进行某型国产轿车车载扬声器声场混响时间研究。结果显示:混响时间测量曲线与 EASE 仿真曲线吻合良好,EASE 软件的仿真结果准确可靠。

关键词:声学;内饰设计;声学仿真;混响时间

中图分类号:O422.4;U465.9;TP319;TB52

文献标志码:A

文章编号:1674-5124(2013)01-0117-04

Study on design method for vehicle interior trim based on reverberation time

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Abstract: A method was proposed to guide the design of interior trim and improve the work efficiency in the interior trim environment, in which the reverberation time in vehicular speaker sound field was simulated by acoustic simulation software EASE. Through the software EASE and the electro-acoustic test system CLIO, the research of reverberation time was conducted separately

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水平井封隔器卡瓦的有限元分析及结构改进

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摘要: 在石油钻采中, 封隔器卡瓦承受巨大压力易发生断裂, 直接影响到封隔器的密封性能, 从而影响油井的开采过程及生产安全。运用有限元分析软件 ANSYS Workbench 对卡瓦进行有限元数值模拟分析。施加 140 kN 载荷时, 卡瓦最大应力为 230.11 MPa, 超过其材料的最大抗压强度; 对卡瓦封隔器试验模型进行压裂试验, 试验施加压力为 186.33 kN 时卡瓦发生断裂, 测得抗压强度为 233 MPa; 对卡瓦进行结构设计, 卡瓦牙间距尺寸分别为 15 mm、25 mm 和 30 mm。根据有限元分析结果, 卡瓦牙间距为 30 mm 时卡瓦应力、应变分布趋于均匀, 所承受的最大载荷为 240 kN, 最大应力为 230.66 MPa, 最大变形量为 0.058 mm, 证明此卡瓦结构尺寸较为合理。

关键词: 封隔器卡瓦; 有限元分析; 压裂试验; 卡瓦牙间距; 载荷—应力、变形曲线

中图分类号: TE931 文献标识码: A

Finite element analysis and structure improvements of packer slip in horizontal wells

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· 激光应用技术 ·

铝添加剂对激光熔覆硬质合金涂层质量的影响

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摘要: 采用高功率激光, 在高速钢表面熔覆硬质合金涂层的过程中, 由于工艺参数、设备性能和熔覆粉末等原因, 会引起熔覆层产生各种缺陷或不足。其中, 粉末在熔池中的流动性, 直接影响熔覆层表面形貌; 另外, 在熔覆过程中氧的存在会直接导致熔覆层表面气孔产生。通过试验分析可知: 在熔覆粉末中加入适量的铝添加剂会有效增加粉末在熔池中的流动性, 同时, Al 和 O 结合生成 Al₂O₃ 能有效抑制气孔, 并保护熔覆层表面, 且不降低硬度。实验显示, 当在 YG12 中加入质量分数为 1% 的 Al 粉时, 熔覆层硬度较高, 且比能量合适。

关键词: 激光技术; 铝添加剂; 硬质合金涂层; 显微组织; 显微硬度

中图分类号: TN249 文献标识码: A DOI: 10.3969/j.issn.1001-5078.2012.11.009

Effects of aluminium additives on the quality of hard alloy laser cladding

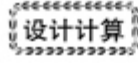
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基于 CFD 的离心泵内部三维流动 数值模拟和性能预测

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摘要: 基于 N-S 时均方程, 利用标准 k-ε 湍流模型, 采用 FLUENT 软件中的多重参考坐标系 (MRF) 和 SIMPLE 算法, 对 40BZ6 型离心水泵叶轮和蜗壳流动区域进行了全三维粘性流动数值模拟, 模拟分析了离心泵内流动速度和压力的分布规律, 将模拟得到的离心泵扬程、轴功率及效率与流量关系与实验数据进行对比, 预测性能与实验性能吻合, 为泵优化设计提供理论基础。

关键词: 离心泵; 数值模拟; 多重参考坐标系; 性能预测

中图分类号: TH3 文献标识码: A doi: 10.3969/j.issn.1005-0329.2012.06.004

Numerical Simulation of Three-dimensional Flow in Centrifugal Pump and Performance Prediction Based on CFD

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Abstract: It was simulated the full three-dimensional viscous flow of the impeller and volute flow fields of the 40BZ6 centrifugal water pump based on average N-S equations and standard k-ε turbulent model, using the multi-reference frame (MRF) of FLUENT software and SIMPLE algorithm. The simulation results shows the distribution laws of flow velocity and pressure in centrifugal pump.

Keywords: Centrifugal pump; Numerical simulation; Multiple reference frame; Performance prediction

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空炉冷态和满装炉量下真空高压气淬过程流场与温度 场数值模拟和实验研究

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摘要: 本文采用标准的 k-ε 三维紊流模型, 利用 FLUENT 软件对喷嘴型真空高压气淬炉中空炉冷态流场和工件满装炉量下气固耦合流动传热过程进行了数值模拟计算。建立了符合实际的控制方程和简化物理模型, 对空炉冷态下炉内的气体流动特征点进行流速测量, 通过实测值与计算机模拟结果进行对比, 验证了流场模拟计算的准确性和适用性; 预测了满炉状态下炉区内的气体流动和工件温度分布, 实测了指定工件的冷却曲线, 比模拟冷却时间慢, 误差在 10% 以内。

关键词: 真空高压气淬; 有限体积分法; 温度场; 流场; 冷却曲线

中图分类号: TG155.1 文献标识码: A 文章编号: 1002-0322(2012)01-0083-04

Numerical simulation and experimental study on flow and temperature fields of vacuum high-pressure gas quenching furnace under empty and full loaded states

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Abstract: Based on the standard k-ε 3D turbulence model, the gas flow of empty and gas-solid coupling flow heat transfer of full loaded nozzle-type vacuum high-pressure gas quenching furnaces were simulated by the FLUENT software, respectively. Reasonable control equation and simplified physical model were established. The flow rate of feature points was measured under empty state. By comparison of the simulated and measured results, the accuracy and applicability of the flow simulation was verified. The gas flow and temperature distribution of full loaded furnace were predicted by simulation and the cooling curve of assigned workpiece was measured. The measured result is a little slower than the simulated one with the error less than 10%.

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硬质合金与 M42 高速钢的激光钎焊组织及性能

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摘要:硬质合金与高速钢的物化性能差异较大, 利用高能激光束可有效实现硬质合金与高速钢的焊接。采用负离焦量 $\Delta f = -3$ mm, 激光扫描速度过小 ($v < 7$ mm/s)、功率过大 ($P > 1500$ W) 时母材中 Co 的大量散失而产生气孔和微裂纹等组织缺陷; 速度过大 ($v > 7$ mm/s)、功率过小 ($P < 1100$ W) 时钎料 Cu 与母材不能互溶, 接头组织融合不良。选取 $v = 7$ mm/s, $P = 1100$ W, 钎焊接头形成等轴组织, 性能良好, 并测定其元素分布及显微维氏硬度, 结果显示: 母材中, 除含 Cu 元素外, 还有 Co、Mo、Cr、Fe 等元素分布, 表明母材与钎料互溶性良好; 接头组织及热影响区显微硬度变化最小, 且平均显微硬度最大, 分别为 941.7 HV, 778 HV。

关键词:激光钎焊; 激光工艺参数; 微观组织; EDS 分析; 显微硬度

中图分类号: TN249 文献标识码: A DOI: 10.3969/j.issn.1001-5078.2013.12.04

Laser brazing organization and properties of hard alloy and W2Mo9Cr4VCo8 high speed steel

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螺旋复合筛管下井过程结构强度数值模拟

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摘要:螺旋复合筛管是一种新型的防砂筛管, 外护管是其中的重要部件。利用有限元分析软件 ANSYS 建立螺旋复合筛管整体有限元模型, 并模拟其在下井过程中堵塞时的结构强度。取扭转载荷为 12 kN·m, 拉力失效载荷为 140 MPa, 压力失效载荷为 120 MPa; 对外护管的材料进行对比, 选用 316L 材料作为外护管材料; 在外护管应力较大区域设置路径, 获得沿路径长度方向的等效应力分布情况, 给出侧流孔的布孔安全距离, 外护管 2 个侧流孔之间轴向安全距离为 3.49 mm, 周向安全距离为 4.56 mm。

关键词:筛管; 强度; 数值模拟

中图分类号: TE925.302

文献标识码: A

doi: 10.3969/j.issn.1001-3482.2015.02.009

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桥塞中金属密封套筒的有限元分析与实验研究

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摘要:针对目前深层开采石油导致的井下工况越来越恶劣的难题,为了替代原有的橡胶密封组件,设计了一种新颖的金属密封套筒结构。简要介绍了该密封工具的主要结构及密封原理。通过有限元方法,分析了密封组件在外层套管的约束下的变形和受力情况,得出了套筒径向变形、接触应力和外加载荷之间的关系。根据所设计的套筒结构进行了密封试验。实验结果表明外加载荷与下压位移的关系与仿真结果大致吻合,验证了模拟参数的准确性,初步验证了该结构的可行性。

关键词:金属对金属密封;桥塞;有限元分析;接触应力;下压位移;实验研究

中图分类号:TH16;TE931 文献标识码:A 文章编号:1001-3997(2016)07-0209-04

Finite Element Analysis and Experimental Study of the Metal Seal Sleeve in Bridge Plug

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Abstract: A new metal seal sleeve structure is designed in order to replace the original rubber seal structure because of the problem that the downhole condition becomes tough with the substantial increase of oil exploitation depth. The main structure of the sleeve and the sealing principle are introduced briefly. The deformation and stress of the seal assembly constrained by the outer casing are calculated by using finite element method. By using this method, the deformed shape of the sealing sleeve, the relationship between required applied load and surface contact stresses are determined. Setting test of the metal seal assembly in the casing is performed based on the sleeve structure of design. Test results show that a consistency between the relationship of applied load and pushing displacement and the simulation results is obtained, verifying the exactness of the parameters used in simulation. That verifies the feasibility of this structure elementarily.

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真空淬过程数值模拟湍流模型适用性研究

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摘要:分别采用标准k-ε模型、重整化群(RNG)k-ε模型和可实现的(Realizable)k-ε模型对某喷嘴型真空高压气淬淬火过程进行了数值模拟。结果表明:通过合理选择湍流模型,可以通过数值模拟的方式实现对淬火过程的预测和分析。由于三种湍流模型对湍流耗散率处理方式的不同,使其适用领域有所不同,对于真空气淬过程,可实现的(Realizable)k-ε模型适用性最好,重整化群(RNG)k-ε模型次之,标准k-ε模型与实验吻合度最差。

关键词:真空高压气淬;湍流模型;流场;温度场;数值模拟

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Applicability of the turbulence model in numerical simulation of vacuum gas quenching process

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Abstract: Numerical simulation of the nozzle type vacuum high pressure gas quenching was carried out using turbulence models of standard k-ε, RNG k-ε, realizable k-ε. The results indicate that numerical simulation can realize the prediction and analysis of quenching process through reasonably selecting turbulence model. Because of the different treatment of turbulent dissipation rate, the three models have different applications. For vacuum high pressure gas quenching, realizable k-ε model's applicability is best followed by the RNG k-ε model, while the standard k-ε model is poor in fitting with the experiment.

Key words: vacuum high pressure gas quenching; turbulence model; flow field; temperature field; numerical