基于螺旋交叉磁场的大曲率不规则弯管内表面磁研磨研究*[1]

李龙邦[1],陈燕[1],陈松[1],赵杨[1],董晓旭[2]
(1 辽宁科技大学机械工程与自动化学院,鞍山 114051;
2 河钢集团矿业公司石人沟铁矿,遵化 064200)

摘要: 通过改变电磁极的励磁方式和布置方式配合吸附有磁性磨料的柔性辅助磁链形成不同研磨运动轨迹,以解决大曲率不规则弯管弯折处内表面精密抛光难题。在工件内部放置由多个径向充磁磁极串联而成的柔性辅助磁链,以加强研磨区域磁感应强度,进而增强研磨压力,并光顺通过弯管弯折处,以提高弯管弯折处内表面质量。根据磨粒运动轨迹模型,提出交叉电磁极耦合研磨磁路轨迹方法,形成螺旋交叉磁场,解决大曲率弯管弯折处磁极干涉无法排布问题。针对大曲率不规则 TB8 钛合金弯管弯折处内表面进行抛光实验,实验结果表明:当磨粒的平均粒径为 250 μm 时,研磨液用量为 8 mL,激励电流为 1 A,转速在 800 r/min 范围内,经过 50 min 的研磨,采用螺旋交叉电磁研磨后的工件表面质量明显优于旋转电磁研磨,表面粗糙度降至 *Ra* 0.32 μm。基于螺旋交叉磁场下的柔性辅助磁链的磁粒研磨,对大曲率不规则弯管弯折处内表面质量的提高有显著作用,为复杂空间弯管内表面的光整加工提供了一种新的方法。

关键词: 大曲率不规则弯管;柔性辅助磁链;磁路轨迹;螺旋交叉磁场
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Study on magnetic abrasive finishing of irregular curved pipes with large curvature based on spiral cross magnetic field

Li Longbang[1],Chen Yan[1],Chen Song[1],Zhao Yang[1],Dong Xiaoxu[2]
(1 School of Mechanical Engineering and Automation,University of Science and Technology Liaoning,Anshan 114051,Liaoning,China;
2 River Steel Group Mineral Company Shirengou Iron Mine,Zunhua 064200,Hebei,China)

Abstract: Changing the excitation mode and arrangement of the electromagnetic pole and the flexible auxiliary magnetic chain with magnetic abrasive was used to form different finishing pathes to solve large irregular curvature bend in the inner surface precision finishing problems. A flexible magnetic chain consisting of several radial magnetized poles was placed inside the workpiece to strengthen the magnetic induction intensity in lapping region,thereby it enhanced the lapping pressure and faird the bend of elbow to improve the inner surface quality. According to the motion-track model of the magnetic abrasive particles,a new method of intersecting electromagnetic pole coupled lapping track of magnetic path was proposed to form a spiral cross magnetic field,which can solve the problem that the magnetic pole interference cannot be arranged at the bend of large curvature curved pipe. Aiming at the internal surface polishing experiment of irregular TB8 titanium alloy bend pipe with large curvature. When the average particle size was 250 μm,the amount of abrasive fluid was 8 mL,the excitation current was 1 A,and the speed was within 800 r/min,after the grinding of 50 min,the surface quality of workpiece after spiral electromagnetic finishing was much better than rotary electromagnetic finishing,and the surface roughness was reduced to *Ra* 0.32 μm. The magnetic abrasive finishing based on the flexible auxiliary magnetic chain under the spiral cross magnetic field has a significant effect on the improvement of the inner surface quality of the large curvature irregular bend,and provides a new method for the finishing of the inner surface of the complex space elbow.

Keywords: irregularly curved pipe with large curvature;flexible auxiliary magnetic chain;magnetic path;spiral cross magnetic field

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