电磁铁与永磁铁研磨铝合金管件内表面的对比研究

赵杨,陈燕,李文龙,韩冰
(辽宁科技大学机械工程与自动化学院,鞍山 114051)

摘要: 为了改善管件内表面质量,避免内部辅助磁极与管件内表面产生相互摩擦,提出采用电磁场驱动辅助磁极研磨管件内表面的方法。通过直流电磁铁交互作用,形成电磁场,从而使得管件内部辅助磁极与外部磁场形成闭合回路。利用 Ansoft 软件分析电磁场在不同工作状态下产生的磁感应强度。在电磁场作用下,内部辅助磁极转动,带动新的磁性研磨粒子参与研磨,避免出现相互摩擦现象,进一步提高了研磨质量。在永磁场作用下,添加圆柱形辅助磁极研磨 25 min,6061 铝合金管内表面粗糙度由原始的 *Ra* 0.791 μm 降低到 *Ra* 0.197 μm; 在电磁场作用下,添加圆柱形辅助磁极研磨 25 min,6061 铝合金管内表面粗糙度由原始的 *Ra* 0.791 μm 降低到 *Ra* 0.153 μm,提高了研磨质量。圆柱形辅助磁极在电磁场作用下,能够有效去除管件内表面的沟状纹理、凹坑等缺陷,解决了辅助磁极与管件内表面相互摩擦的问题,表面质量得到明显改善。

关键词: 合金管件; 电磁场; 辅助磁极; 磁粒研磨; 表面质量
中图分类号: TG176　**文献标志码**: A　**文章编号**: 1671-3133(2020) 03-0088-05
DOI: 10.16731/j.cnki.1671-3133.2020.03.015

Contrastive study on the inner surface of aluminum alloy pipe grinded by electromagnet and permanent magnet

Zhao Yang, Chen Yan, Li Wenlong, Han Bing
(School of Mechanical Engineering and Automation, University of Science and Technology Liaoning, Anshan 114051, Liaoning, China)

Abstract: In order to improve the internal surface quality of pipe, and avoid the friction between the auxiliary magnetic pole and the internal surface of pipe, the auxiliary magnetic pole driven by electromagnetic field was used to grind the internal surface of pipe. The electromagnetic field was formed by the interaction of DC electromagnets. A closed magnetic loop was formed between the auxiliary magnetic pole inside the pipe and the external magnetic field. Magnetic field strength with electromagnetic field under different working conditions was analyzed by Ansoft software. Under the action of electromagnetic field, the internal auxiliary magnetic pole rotates and drives new magnetic abrasive particles to participate in grinding, which avoids the phenomenon of mutual friction and further improves the grinding quality. When the cylindrical magnet was used as auxiliary magnet and grinding for 25 minutes, the inner surface roughness of 6061 aluminum alloy pipe is reduced from *Ra* 0.791 μm to *Ra* 0.197 μm under the action of permanent magnet field, while the inner surface roughness of 6061 aluminum alloy pipe is reduced from *Ra* 0.791 μm to *Ra* 0.153 μm under the action of electromagnetic field. This method not only removes the groove texture and pits on the inner surface of the pipe effectively, but also solves the problem of mutual friction between the auxiliary magnetic pole and the inner surface of the pipe. The surface quality can be improved manifestly.

Keywords: alloy pipe; electromagnetic field; auxiliary magnetic pole; magnetic abrasive finishing; surface quality

0　引言

管件作为传输介质的重要载体,其工作的稳定性直接影响发动机及设备运行的稳定性[1-2]。航空发动机管路在输送液体和气体的过程中,管件内表面的质量缺陷会直接引发流场、速度场和压力场的梯度变化,进而产生涡流、喘振等现象,影响发动机运行的可靠性[3-5]。管件内表面的凹坑、沟状纹理等缺陷,会加剧液体对管件的腐蚀,降低管件的服役能力[6-7]; 因此,需要解决管件内表面的质量缺陷问题。Yoon 等人[8]提出采用不同的磁极排列来研磨管件内表面的方法,能够有效提高表面质量和研磨效率,但很难去