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基于旋转磁场的 6061 铝合金弯管内表面光整加工

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摘 要: 为解决液压导管内表面缺陷所引起的振动和噪音，通过 Ansoft Maxwell 软件对不同锥度的聚磁头进行磁场强度分析，得出最佳聚磁头锥度尺寸。利用六自由度机械手臂驱动 N-S-S-N 四磁极圆周排布所形成的旋转磁场，带动填放在弯管内部的吸附磁性磨粒的圆柱形辅助磁极，经 30 min 研磨，快速去除弯管内部的沟状及鱼鳞状纹理；旋转磁场带动磁性磨粒继续研磨 45 min，管件直管处由原始内表面粗糙度 *R*a 为 0.48 μm 降低至 *R*a 为 0.12 μm；管件弯折处由原始内表面粗糙度 *R*a 为 0.67 μm 降低至 *R*a 为 0.13 μm，完成对 6061 铝合金弯管内表面的光整加工。对其进行振动试验检测，当振动频率为 2482 Hz 时，研磨前的弯管加速度为 0.3059 m/s^2，研磨后降至 0.1899 m/s^2，振幅和噪音也显著降低，液压油路的稳定性显著提高，从而验证了对弯管内表面光整加工有利于减振降噪，提高液压导管的使役可靠性。

关键词: 旋转磁场；铝合金弯管；聚磁头；研磨均匀性；表面粗糙度；振动检测
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Finishing Internal Surface of 6061 Aluminum Alloy Bend Pipe Based on Rotating Magnetic Field

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Abstract: The inner surface defects of the hydraulic pipe can cause vibration and noise. To solve the problem and improve the reliability of the hydraulic oil circuit, the magnetic field strength with different tapers were analyzed by Ansoft Maxwell software, and the optimum taper size of the magnetic concentrator was obtained. The rotating magnetic field formed by the circumferential arrangement of N-S-S-N four magnetic poles was driven by a six-degree-of-freedom manipulator, and the cylindrical auxiliary magnetic poles filled with magnetic abrasives inside the bend pipe were grinded for 30 minutes to quickly remove the groove and fish scale texture inside the bend pipe. The rotating magnetic field drived the magnetic abrasive grains to continue grinding for 45 minutes and the internal surface roughness of the straight pipe section was reduced from *R*a 0.48 μm to *R*a 0.12 μm. The internal surface roughness of pipe bending was reduced from *R*a 0.67 μm to *R*a 0.13 μm, finishing the inner surface of the 6061 aluminum alloy elbow. Vibration tests show that the bend acceleration decreased from 0.3059 m/s^2 to 0.1899 m/s^2 after grinding when the vibration frequency is 2482 Hz. The amplitude and noise are also significantly reduced, and the stability of hydraulic oil circuit is significantly improved. It is proved that finishing the bend pipe surface is beneficial to reducing vibration and noise, and improving the performance of operational reliability of hydraulic conduit.

Keywords: rotating magnetic field; aluminum alloy bend pipe; magnetic pole head; uniformity of grinding; surface roughness; vibration detection

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