球形磁铁在弯管内表面磁力研磨中的应用

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摘 要: 空间弯管内表面微裂纹用传统的研磨方法难以去除. 利用六自由度机械手结合磁力研磨加工装置实现空间弯管内表面研磨加工. 为了提高磁力研磨弯管内表面的加工效率,根据研磨工艺数学模型分析得到提高研磨压力是提高研磨效率的有效手段. 因此,提出在研磨介质中添加球形磁铁作为辅助抛光工具提高研磨介质对弯管内表面的压力. 通过 Ansoft Maxwell 软件分析得到添加球形磁铁后加工区域的磁感应强度增大,即研磨压力变大. 并对 TB8 合金弯管进行研磨试验,试验结果表明添加球形磁铁后研磨加工效率提高约 40%; 表面粗糙度降至 0.09 μm 左右,并通过电子显微镜观察到内表面上的微裂纹已去除. 实验验证了球形磁铁辅助研磨弯管内表面的可行性,为提高磁力研磨加工效率提供了一种新方法.

关键词: 磁力研磨; 球形磁铁; 辅助抛光; 弯管; 研磨效率
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The Spherical Magnet Processing of Inner Surface of Bending Pipe by Magnetic Abrasive Finishing

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Abstract: It is difficult to use traditional grinding methods to remove internal surface microcracks of the space bending pipe. Device based on six degrees of freedom manipulator for magnetic abrasive finishing can grind internal surface of the space bending pipe. In order to improve the efficiency of magnetic abrasive finishing, grinding and polishing mathematical model was established and increasing grinding pressure was effective. Therefore, proposed using the spherical magnet as assisted polishing tool in the grinding medium to improve the grinding pressure for the bending pipe inner surface. The Ansoft Maxwell software analysis indicates the magnetic flux density increased by applying the spherical magnet in the processing area. This means an increase of grinding pressure. By performing grinding of TB8 alloys bending pipe, it can be seen that grinding efficiency was increased by 40% after adding spherical magnet, surface roughness was as low as 0.09 μm. In addition, the microcracks on inner surface of the TB8 alloys bending pipe were removed. It is feasible to use spherical magnet auxiliary grinding for surface finish of inner surface of bending pipe.

Key words: magnetic abrasive finishing, spherical magnetic, assisted polishing, bending pipe, finishing efficiency

弯管在弯曲成形时,内表面会产生微裂纹等表面微缺陷. 在交变载荷的作用下微小裂纹极易扩展; 同时容易积存杂质造成腐蚀. 所以去除表面缺陷和降低弯管内表面的表面粗糙度有至关重要的现实意义和实用价值[1]. 传统的研磨方法很难将弯管内表面缺陷完全去除. 磁力研磨加工方法[2-9]可以克服

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