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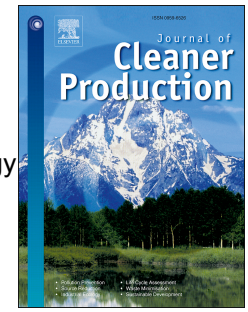

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Multi-objective optimization of arc welding parameters - the trade-offs between energy and thermal efficiency

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Abstract: Arc welding is a common joining method, which is usually characterized by high energy consumption and low energy efficiency. With the recent focus on energy management and carbon emissions, energy saving has become a priority for manufacturing industry. In the past, energy saving technologies for welding had primarily aim for heat source improvement, with less emphasis on parameter optimization. It is obvious that parameter optimization methods for energy reduction can be applied to existing equipment where large investments are not required. Therefore, a multi-objective optimization method based on Fitness Sharing Genetic Algorithm (FSGA) is proposed for energy reduction and thermal efficiency improvement of arc welding process in this paper. Two objectives including energy consumption and thermal efficiency are considered in the optimization model with two independent variables, namely welding current and welding velocity. Additionally, the limits of the variables and welding quality are also considered. A case study of rail track joints using Shielded Metal Arc Welding (SMAW) is conducted for the verification of the proposed optimization method. Finally, the optimization method and results are analyzed with the actual data and Genetic Algorithm (GA) respectively. Comparison with actual data shows that the proposed approach has a more significant effect on energy saving and thermal efficiency improvement. The optimization analysis shows that FSGA has a better population diversity and global search capability compared with GA.

Key words:

Multi-objective optimization

Arc welding

Energy consumption

Thermal efficiency

Fitness sharing genetic algorithm (FSGA)