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Analysis of Lift Arm Failure and Its Improvement for the Use in Farm Tractor

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Abstract : Currently, research focus in the development of agricultural equipment and tractor parts in India is innovation and use of alternate materials like austempered ductile iron (ADI). Three-point linkage mechanism of the tractor is susceptible to unpredictable load conditions in the field, and one of the critical components vulnerable to failure is lift arm. Conventionally, lift arm is manufactured either by forging or casting (SG Iron) and main objective of the present work is to reduce the failure occurrences in the lift arm, which is achieved by changing the manufacturing material, i.e ADI, without changing existing design. Effect of four pertinent variables of manufacturing ADI, viz. austenitizing temperature, austenitizing time, austempering temperature, austempering time, was investigated using Taguchi method for design of experiments. To analyze the effect of parameters on the mechanical properties, mean average and signal-to-noise (S/N) ratio was calculated based on the design of experiments with L9 orthogonal array and the linear graph. The best combination for achieving the desired mechanical properties of lift arm is austenitization at 860°C for 90 minutes and austempering at 350°C for 60 minutes. Results showed that the developed component is having 925 MPA tensile strength, 7.8 per cent elongation and 120 joules toughness making it more suitable material for lift arm manufacturing. The confirmatory experiment has been performed and found a good agreement between predicted and experimental value. Also, the CAD model of the existing design was developed in computer aided design software, and structural loading calculations were performed by a commercial finite element analysis package. An optimized shape of the lift arm has also been proposed resulting in light weight and cheaper product than the existing design, which can withstand the same loading conditions effectively.

Keywords : austempered ductile iron, design of experiment, finite element analysis, lift arm
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