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The impact of tube corrugation within the multi-disciplinary design optimization of a charge air cooler.

Mr. Atul Singh[1]*, Dr. David J.J. Toal[2], Dr. Edward S. Richardson[3], Dr. Claus Ibsen[4], Mr. Kevin Jose[5], Prof. Atul Bhaskar[6]

[1] University of Southampton, SO17 1BJ Southampton, UK, atul.singh@soton.ac.uk
[2] University of Southampton, SO17 1BJ Southampton, UK, D.J.J.Toal@soton.ac.uk
[3] University of Southampton, SO17 1BJ Southampton, UK, E.S.Richardson@soton.ac.uk
[4] Vestas aircoil A/S, 6940 Lem, Denmark, ci@vestas-aircoil.com
[5] University of Southampton, SO17 1BJ Southampton, UK, Kevin.Jose@soton.ac.uk
[6] University of Southampton, SO17 1BJ Southampton, UK, A.Bhaskar@soton.ac.uk

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The following paper explores the impact of corrugated tubes [1] within a charge air cooler (CAC) on overall cooler performance, cost and size, for the first time. Corrugated tubes have been demonstrated to perform better in terms of heat transfer, when compared to the smooth tube [2], however they have not been optimized in the context of a CAC. In this study, CAC with corrugated tubes is compared against a similar system comprising of smooth tubes as a baseline design. Both the CACs have common design parameters, such as number of tubes per rows, number of rows, number of passes, number of fins, fin material, and tube material, while two additional design parameters exist i.e., groove depth, and pitch for the CAC with corrugated tubes, that characterizes the helical corrugation. These two systems are optimized for minimum manufacturing cost where cost is a function of cooler dimensions and material selection. Feasible designs are then obtained by satisfying the constraints that are based on customer requirements for the overall CAC dimensions, pressure drops, and power dissipation. A vibration constraint is also introduced over the current state of the art [3], making the current approach multi-disciplinary and a first of its kind.

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