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Sunday–Tuesday, November 20–22, 2022; Indiana Convention Center, Indianapolis, Indiana.

Session T13: Industrial Applications: General

4:10 PM–6:33 PM, Monday, November 21, 2022
Room: 140

Chair: Kamran Alba, University of Houston

Abstract: T13.00010 : Homogenization of turbulent flows inside industrial environments: an application to the curing of Carbon Fiber Reinforced Polymers

6:07 PM–6:20 PM

← *Abstract* →

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This work proposes a study of turbulence homogenization inside large industrial environments, with a first application to the curing treatment of Carbon-Fiber-Reinforced Polymers, which are composite materials widely spread in the aerospace industry. The state-of-the-art design of these machineries causes a highly anisotropic turbulent flow, that leads to an heterogeneous heat exchange between the air and the mold containing the material to be treated, which causes the curing procedure to be inhomogeneous.

Aim of this work is to propose innovative methods to homogenize the turbulence inside a 16 m^3 autoclave and analyse their impact on the air/mold heat exchange under different operating conditions. The first designs include the addition of random (both in location and number) velocity perturbations generated at the walls of the chamber. The impact of these sources has been examined by conducting hybrid DNS-LES simulations in an empty chamber where the circulating flow has a Reynolds number Re = $O(10^6)$; the computational analysis has been carried out by using the open-source software PLUTO 4.4.2. Aim of this analysis is the mapping of the kinetic energy and enstrhophy inside the system,together with the distribution of a tracer within the chamber.

Afterwards, the impact of the velocity perturbations is analysed by simulating different stages of a realistic curing scenario, where a rectangular mold made of steel is located inside the chamber. It will be showed that a more homogeneous turbulence leads to an improvement of the heat flux distribution uniformity on the surface of the solid sample.