ME Seminar

Spray Dynamics During Painting of Automobiles

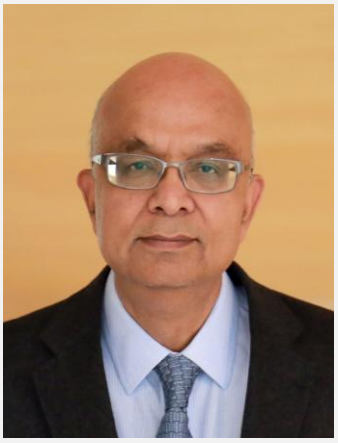
Prof. Sanjeev Chandra, University of Toronto, Canada

ABSTRACT

Paint is applied on automobiles using electrostatic rotating bell atomizers that produce sprays with an average droplet size of 30-40 µm that are entrained in an air jet which accelerates them towards the surface to be coated. However, 40–50% of the paint sprayed fails to reach its target and is wasted. Changes in spray parameters are also found to cause variations in paint colour and the rate of surface coverage. Experiments were conducted, both in the laboratory and in automotive paint shops, to measure paint transfer efficiency and surface coverage rates. The weight of the target was continuously recorded as droplets landed on it and transfer efficiency calculated by dividing the target weight change by the weight of liquid sprayed. High speed videos were taken of droplet impact on target surfaces and area coverage measured from these images as a function of time, radial position, and airstream velocity. A stochastic model of spray transport was developed by calculating the trajectories of individual droplets and the model shown to accurately predict paint transfer efficiencies. Airstream velocity had a significant impact on the motion of droplets, with larger droplets more likely to reach the surface. A critical diameter was identified below which droplets consistently failed to reach the target and were swept away by the airflow. Smaller droplets have a lower probability of landing on the surface as radial distance from the spray axis increases. This creates a segregation of droplet sizes landing on the surface that can alter the amount of pigment deposited and hence paint colour.

ABOUT THE SPEAKER

Sanjeev Chandra is a Professor in the Department of Mechanical and Industrial Engineering at the University of Toronto, which he joined in 1990 after receiving his Ph.D. from Cornell University. Prof. Chandra is known internationally for his research on the dynamics of droplets and sprays and is one of the founders of the Centre for Advanced Coating Technologies at the University of Toronto. His research spans the areas of fluid mechanics, heat transfer and materials science and has also been applied in spray coating, spray cooling, spray painting, ink-jet printing, electronic cooling and waste heat recovery.



Prof. Chandra has published over 300 papers in referred journals and international conference proceedings. He was awarded the The Brockhouse Canada Prize for Interdisciplinary Research in 2010. He received the Jules Stachiewicz Medal for heat transfer in 2015 and the Robert W. Angus Medal for the management and practice of mechanical engineering in 2020, both awarded by the Canadian Society for Mechanical Engineering. He received the Classic Paper Award from the American Society of Mechanical Engineers in 2019. He is a Fellow of the Canadian Academy of Engineering, the American Society of Mechanical Engineers, the Canadian Society for Mechanical Engineering and the American Association for the Advancement of Science. He has served as visiting professor at the University of Limoges (France), Korea University (S. Korea), the University of Bremen (Germany), the University of Darmstadt (Germany), Nanyang Technical University (Singapore) the University of Brighton (UK), the Institute for Advanced Industrial Science and Technology (Japan) and the Indian Institute of Technology-Madras (India).

February 10, 2025, 3:30 PM, AR Auditorium, Mechanical Engineering, IISc