MODELS FOR PREDICTING SOOT PARTICULATE EMISSIONS FROM COMBUSTORS: EVOLUTION, STATUS AND NEEDS

MED COLKET
United Technologies Research Center
411 Silver Lane
East Hartford, CT 06108
(860) 610-7481
colketmb@utrc.utc.com

The detailed physical and chemical processes controlling soot formation and oxidation leading to particulate emissions from an engine have been under investigation for over 45 years. Early studies were driven by diagnostics in which the emissions were altered by the sampling process and models that were hampered by the lack of chemical processes controlling soot inception and growth. Without empirical methods, attempts to model soot production in simple fundamental experiments resulted in agreements of soot mass that were many factors (>1000) in error, although some trends were captured. With increased understanding and better CFD modeling abilities, such tools were applied to more complex systems, e.g. combustors; yet still agreements to within levels of 100 were acceptable.

In the past five years, advanced CFD abilities, chemical kinetics, diagnostics, etc., have resulted in an explosion of work exploring modeling methods for soot formation, its oxidation and particulate emissions. In selected cases, abilities to compute or approximate particulate size distributions from combustors have been developed. Highlights of this work will be reviewed, with discussion of strengths and weaknesses of such tools. In addition, prospects for better simulation tools will be discussed, including needs for estimating the impact of non-petroleum fuels on soot particulate emissions from gas turbine engines.