Direct-fired supercritical CO2 (sCO2) cycles are gaining the attention of government, power industries and academia due to its remarkably promising efficiency, compactness and carbon capture. However, the state-of-art combustor operating conditions in this cycle are unconventional. Methane and pure Oxygen will burn in the presence of high CO2 concentration at 300 bar pressure. Therefore, experimentation on these combustors is expensive, time-consuming and even dangerous. Hence, the development of this combustor must rely heavily on accurate computational modeling. It is known that assumptions in the existing computational models were made depending on certain characteristics of that combustion phenomenon, therefore it is very important to understand the characteristics of a combustion phenomenon before using computational models.

In the current work, a few fundamental characteristics of sCO2 combustion phenomenon are studied in detail and, appropriate modeling tools are developed and identified based on accuracy and computational cost. The result shows that Damköhler numbers for sCO2 combustion are close to unity especially at high CO2 concentrations. Hence, turbulence-chemistry interactions are very prominent. Therefore, a comprehensive study also carried out to estimate the influence of various levels of scalar dissipations on important sensitive reactions and species productions rates. Especially, the blowout limits are studied under various possible sCO2 combustor conditions. Further, a new species elimination methodology is proposed to develop a skeletal kinetic mechanism from the detailed mechanism.

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The public is welcome to attend.