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## Webinar on

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## Effects of bluff-body cone angle on turbulence-chemistry interaction behaviors in large-scale semicoke and bituminous coal co-combustion

**Liutao Sun**
Harbin Institute of Technology, China

**Statement of the Problem:** Semicoke, a solid byproduct from low-temperature pyrolysis of low-rank coal, is characterized by an ultralow volatile content (less than 10%) and a high calorific value, which always causes high NO emissions, poor flame stability and low char burnout when burned at a relatively high temperature. Hence, co-combustion with high-volatile bituminous coal is a feasible approach. However, the optimal semicoke blending ratio is limited to within 45% ~ 50%, which is usually not sufficient for the large-scale utilization of semicoke in power plants. The implementation of semicoke co-combustion by a larger proportion still faces many challenges, such as poor performances in ignition and pollution emissions. To stabilize semicoke co-combustion, bluff-body burners have been adopted to stabilize flames to promote ignition and reduce the unburned carbon content in fly ash and NOx emissions.

**Methodology & Theoretical Orientation:** A numerical study using computational fluid dynamics (CFD) was utilized during semicoke co-combustion under various bluff body cone angles (α). Damkhöler numbers (Da) for homogeneous and heterogeneous reaction was utilized to elaborate the microscopic characteristic of co-combustion.

**Findings:** With increasing α the main reaction zone moves upstream significantly, and a widened flame and uniform temperature profile are obtained due to enhancing the internal flue gas recirculation. The maximum homogeneous Da values are below 0.50, and the heterogeneous Da values of C-O2, C-CO2, and C-H2O are within 0.670-1.207, 0.004-0.017 and 0.001-0.004, indicating that the char oxidation reaction is dominated by diffusion/kinetics, while the char gasification reactions are controlled by chemical kinetics. However, both reactions tend to be kinetically-controlled with increasing α.

**Conclusion & Significance:** Based on comprehensive analyses of the simulations, we can gain deep insight into turbulence-chemistry interaction behaviors and NOx formation affected by the cone angle cases, further uncovering the underlying control mechanisms on low-NOx emissions in large-scale semicoke co-combustion.

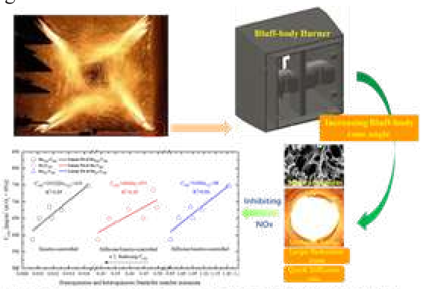


**Figure 1:** Effects of bluff body cone angles on the turbulence-chemistry interaction characteristics, burnout and NOx emissions.

## Biography

Sun has his expertise in improving the semicoke blended combustion and air/oxy-MILD semicoke combustion. His findings can provide deep insight into the turbulence-chemistry interactions and its effect on NOx emission characteristics of semicoke co-combustion in a bluff-body tangential burner and can guide the boiler operation. This approach is responsive to all stakeholders and has a different way of focusing.

1095532412@qq.com