Combustion with a high surface area continuous solid immersed within the flame, referred to as combustion in porous media, is an innovative approach to combustion as the solid within the flame acts as an internal regenerator distributing heat from the combustion byproducts to the upstream reactants. By including the solid structure, radiative energy extraction becomes viable, while the solid enables a vast extension of flammability limits compared to conventional flames, while offering dramatically reduced emissions of NOx and CO, and dramatically increased burning velocities. Efforts documented within are used for the development of a streamlined set of design principles, and characterization of the flame's behavior when operating under such conditions, to aid in the development of future combustors for lean burn applications in open flow systems. Principles described herein were developed from a combination of experimental work and reactor network modeling using CHEMKIN-PRO. Experimental work consisted of a parametric analysis of operating conditions pertaining to reactant flow, combustion chamber geometric considerations and the viability of liquid fuel applications. Experimental behavior observed, when utilizing gaseous fuels, was then used to validate model outputs through comparing thermal outputs of both systems. Specific details pertaining to a streamlined chemical mechanism to be used in simulations, included within the appendix, and characterization of surface area of the porous solid are also discussed. Beyond modeling the experimental system, considerations are also undertaken to examine the applicability of exhaust gas recirculation and staged combustion as a means of controlling the thermal and environmental output of porous combustion systems. This work was supported by ACS PRF #51768-ND10 and NSF IIP 1343454.

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The public is welcome to attend.