Time & Location: March 30, 2017 at 3:00 PM in ENGINEERING II 202A
Title: Design and modeling of a heat exchanger for porous combustor powered steam generators in automotive industry

A major challenge faced by automobile manufacturers is to achieve reduction of particulate emission to acceptable standards, as the emission standards become more and more stringent. One of the ecologically friendly options to reduce emissions is to develop external combustion in a steam engine as a replacement of the internal combustion engine. There are multiple factors, other than pollution that need to be considered for developing a substitute for Internal Combustion Engine, like specific power, throttle response, torque speed curve, fuel consumption and refueling infrastructure. External combustion in a steam engine seems to be a bright idea, for a cleaner and more environment friendly alternative to the IC engine that is capable of satisfying the multiple technology requirements mentioned. One way of performing external heterogeneous combustion is to use porous ceramic media, which is a modern and innovative technique, used in many practical applications. The heterogeneous combustion inside ceramic porous media provides numerous advantages, as the ceramic, acts as a regenerator that distributes heat from the flue gases to the upstream reactants, resulting in the extended flammability limits of the reactants.

The heat exchanger design is the major challenge in developing an external combustion engine because of the space, such systems consume in an automobile. The goal of the research is to develop a compact and efficient heat exchanger for the application. The proposed research uses natural gas as a fuel that is mixed with air for combustion and the generated flue gases are fed to a heat exchanger to generate superheated system for performing engine work to the vehicle. The performed research is focused on designing and modeling of the boiler heat exchanger section. The justification for selection of working fluid and power plant technology is presented as part of the research, where the proposed system consists of an Air and Flue Gas Path and a Water and Steam Path. Models are developed for coupled thermal and fluid analysis of a heat exchanger, consisting of three sections. The first section converts water to a saturated liquid. The second portion consists of a section where water is converted to saturated steam. The third section is the superheater, where saturated steam is converted to superheated steam. The Finite Element Model is appropriately meshed and boundary conditions set up to solve the mass, momentum and energy conservation equations. The k-epsilon model is implemented to take care of turbulence. Analytical calculations following the established codes and standards are also executed to develop the design.

Major: Aerospace Engineering

Educational Career:
Bachelor’s of MECHANICAL ENGINEERING, BS, 2010, WEST BENGAL UNIVERSITY OF TECHNOLOGY

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Approved for distribution by Nina Orlovskaya, Committee Chair, on March 6, 2017.

The public is welcome to attend.