The University of Queensland - IIT Delhi Academy of Research Joint PhD Project

PROJECT TITLE	**MODELLING AND FABRICATION OF OPTIMAL FIBER-BASED FILTER FOR EFFECTIVE AIR-BORNE FINE-PARTICLE CAPTURE**
PROJECT CODE	**UQIDAR 00218**
PROJECT DESCRIPTION	Air pollution is a major medical hazard, and among the world's most populous countries, the largest increase in the number of pollution-related deaths was seen in India. Capturing of ultra-fine particles is the most challenging. High efficiency particulate air and ultra-low penetration air filters are used to collect fine air-borne particle of minimum size 0.3 and 0.1 Î¼m respectively. Particles are trapped by sticking to a fiber through diffusion, interception, or impaction and sometimes by electrostatic attraction. To reach higher filtration efficiencies without increasing the pressure drop due to small pore size, electret filter media with electrostatically charged microfibers are often used which can even operate for large porosity. These filters generate an electrostatic field in their vicinity and act upon the incoming charged (Coulombic force) or uncharged particles (Polarization force). They are thermally stable and are insensitive to moisture and high temperatures, but efficiency gradually weakens with time. As mentioned by recent paper, filters with high efficiencies, low resistances and dimensional stability are highly desired. They suggested a hierarchical micro/nanofibrous filter for this purpose. The current project proposes to develop numerical model of fibrous filters for fine particle capture. Accompanying the simulations there will be experimental validation and finally an optimized air filter will be proposed. Lattice Boltzmann method for porous media will be used for simulation of filter material with appropriate consideration of boundary condition and forces: Coulomb force and Polarization force. Nonwoven fabrics will be prepared using polymer and employing melt blown technology. The diameter of the fibers will be determined by SEM and image analysis technique. The thickness, weight will also be noted. The process of charging will be carried out by a corona-charging apparatus. The numerically optimized fibrous filter media will be tested for their filtration efficiency and pressure drop using a filter test rig.
PROJECT OUTCOMES	1. Develop a numerical model to test the efficiency of fibrous air filter for fine particle capture 2. By means of numerical simulation, the efficiency of the filter will be characterized based on porosity and electrostatic charge in the fiber, filter thickness, air velocity, fiber diameter. 3. Find the deposition efficiency of filters obtained experimentally and numerically. 4. Device an optimized fibrous air filter
ADVISORY TEAM	**Dr Christopher Leonardi** Mechanical and Mining Engineering, UQ https://researchers.uq.edu.au/researcher/2881 **Assistant Professor Bahni Ray** Mechanical Engineering, IITD http://web.iitd.ac.in/~bray/ **Additional advisors** Professor Apurba Das
TYPE OF STUDENT	Applications are open to **i or q students** who meet eligibility criteria.

DISCIPLINE BACKGROUND OF STUDENT	Ideally, this project requires students with a background in: 1.The student must be Btech and Mtech in either Mechanical, Chemical Engineering, Mathematics or Applied physics. 2. He/she should have knowledge of numerical coding (Not just using ANSYS) of fluid flow problems
IDEAL CANDIDATE	Essential capabilities:1. A strong understanding of fluid mechanics2. Should have knowledge of numerical coding (Not just using ANSYS) of fluid flow problems Desirable capabilities: 1.Have knowledge of Lattice Boltzmann method 2. Have knowledge of fluid flow through Porous medium Expected qualifications (courses, degrees, etc): Degree in mechanical engineering, Chemical engineering, mathematics or applied physics.
APPLICATION PROCESS	Apply online by the due date: https://www.uqidar.org/students/how-to-apply/