Research Topics in Renewable Energy for 2021

CENTRE FOR RENEWABLE & SUSTAINABLE ENERGY STUDIES

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Division:
Design & Mechatronics / Mechanics / Thermofluids / Renewable Energy

Research field:
Thermal Engineering (Fluid Mechanics, Heat Transfer and Thermodynamics)

General description of research field:
Solar thermal energy is a source of clean energy for electricity generation, process heat and thermal comfort that is unfortunately only available while the sun is shining. Thermal energy storage in rock beds using air as heat transfer fluid provides a low cost solution to store energy harvested during the day for night-time use. The large size of rock bed thermal energy storage, and irregular nature of crushed rock particles means that much of previous research done on prismatic beds of spherical particles is inadequate to describe pressure drop and heat transfer through packed beds.
A combination of two or more of the projects marked suitable for a MEng might be combined for a PhD.

Individual topics listed:	***MEng (Structured)***	***MEng (Research)***	**PhD**	**Funding**
1.**Transition to turbulence and its modelling in packed beds** Modelling flow at pore level in packed beds are computationally expensive, and beyond the capacity of most available computer hardware. A porous model formulation of the bed is preferred. Transition to turbulence in packed beds occur at superficial particle Reynolds numbers as low as 350. Furthermore, turbulent source terms depends on the order of time and space averaging. Previous research focused on structured beds and a representative unit cell approach. The objective of this project is to extend the work to random beds, using a combination of computational fluid dynamics (LES or DNS) and experimental techniques (mainly for validation purposes). A strong background in CFD and fluid dynamics will be advantageous.		X	X	
2.Crushed rock particle shape characterization for pressure drop and heat transfer prediction Crushed rock particles are irregular in shape, whilst pressure drop and heat transfer correlations are usually expressed in terms of simple shapes (spheres or ellipsoids). Furthermore, a specific shape might capture pressure drop satisfactorily, but fails to capture heat transfer, and vice versa. Compare various shape descriptors (e.g. volume or surface equivalent diameter, sphericity, aspect ratio, angularity, roundness, etc.) for crushed rock particles. A measuring method that is independent of operator error is preferred. It might be necessary to develop an entirely new shape descriptor if none of the available descriptors performs satisfactorily in predicting heat transfer and pressure drop in a packed bed.		X		

3. **Effect of polydisperse particle size on pressure drop and heat transfer in packed beds** Polydisperse (similar particles that differ in size and/or shape) particles pack differently from monodisperse particles in a packed bed, and as a result, the pressure drop and heat transfer in poly- and monodispersed beds will differ. Derive a correlation for the pressure drop and/or heat transfer in a	X	X		