

卓越した大学院拠点形成支援補助金
「流動ダイナミクス知の融合教育研究世界拠点」
平成 25 年度 博士課程後期学生（国際）会議派遣 参加報告書

氏名／専攻・学年 Name / Department	許 書涵 機械システムデザイン工学専攻 博士課程後期 1 年
学会名 Conference's name	24th International Symposium on Transport Phenomena
開催地 Venue (Name of the facility, city & country)	山口東京理科大学
日程 Conference period	11/2~11/5
発表タイトル Presentation Title	Experiments on thermoacoustic properties of stacked mesh screens
【発表概要 Brief summary of your presentation】 Traveling wave thermoacoustic devices execute a thermodynamic cycle similar to the Stirling cycle through reversible thermodynamic processes that oscillating gas parcels undergo in a regenerator. For this reason, the regenerator should possess pores tiny enough to achieve a perfect thermal contact between the gas parcels and the pore walls. A random stack of stainless-steel wire mesh screens is always an option of practical regenerators because mesh screens with varieties of mesh numbers and wire diameters are easily available. Unfortunately, there is no widely acceptable theoretical model for the stacked-screen regenerator, due to the complexity of the flow channel geometry. This study experimentally investigates the flow characteristics of the stacked-screen regenerator. From the flow resistence thus obtained, the experimental effective radius of the regenerator was estimated within the framework of the thermoacoustic theory. Namely, we assumed a bundle of cylindrical tubes and explored the tube radius that gives the same flow resistance as the experimental one. It was found that the experimental effective radius decreased when velocity amplitude increased. The results were also compared with the effective radius that was obtained from the empirical equation parametrized by $\omega\tau_v$ and Re; $\omega\tau_v$ is a nondimensional parameter given by the angular frequency ω and viscous relaxation time τ_v, and Re is the Reynolds number based on the oscillating velocity. In spite of the fact that the empirical equation was obtained for air at atmospheric pressure, the deviation between experimental effective radius and that predicted by the proposed equation was found to be 7% at the maximum. In pressurized helium gas, the deviation was found to be 8%. This study indicates that the stacked screen regenerator can be seen as the bundle of cylindrical tubes whose pore sizes is governed by $\omega\tau_v$ and Re.	

【他の講演等から得られた知見、感想等。What you learned from other presentations, general impression you had, etc.】

In this symposium, I heard three presentations about application of porous media: 1. Impinging jet heat transfer of an open-cellular porous heat sink by a circular nozzle with a flange. 2. Numerical analysis of waste heat cascade utilization in sinter cooler. 3. Flow channels with partially filled porous media. Generally speaking, It is difficult to understand the flow and heat transfer in porous media comprehensively due to its complexity of geometry. Therefore, experimental investigation to understand the flow and heat transfer behavior inside of porous media is necessary. Most of researcher in this symposium used extended Darcy's law to construct governing equations. Extended Darcy's law is an empirical equation whose coefficients are up to experimental conditions.

Presentation 1 Used Open-cellular porous plates as a heat sink to enhance impinging jet heat transfer, which focus on behavior of heat transfer which indicate that the mean Nusselt number of open-cellular porous plates can be represented in form of $Nu = a + b Re^n$ and an annular porous heat sink is more effective than a porous plate heat sink without center hole for the impinging jet cooling.

Presentation 2 employed the extended Darcy law to describe flow of cooling air in sinter cooling bed, and introduced the local thermal non-equilibrium model to take temperature difference and heat transfer between cooling air and sinter into consideration. A numerical study using the aid of computational fluid dynamic to model three-dimensional steady state of flow and heat transfer in sinter cooler. The numerical results indicate that quality and quantity of the waste heat in sinter cool cannot be satisfied at the same time under different cooling air flow rate. Calculation results of exergy in each sector of sinter cooler may provide reference for grade recovery and cascade utilization.

Presentation 3 is an investigation in a channel partially filled with a porous medium with a steady viscous lamina flow. The extended Darcy law was also used in this study to construct the governing equations. A two-dimensional steady flow model has been developed to model the flow and transport in a combined flow channel and porous medium. it point out that the interface between clear flow zone and porous media zone exist a jump in shear stress and it is inversely proportional to the permeability of the porous medium. In is should be noticed for design and operation of the porous channels.

As an afterthought for this symposium, the viscous effect of porous media can be described by Darcy law sufficiently (In my research, the Obayashi empirical equation can be expressed as form of Darcy law), irrespective of oscillatory or unidirectional flow. On the other hand, the thermal effect of porous media in the case of oscillatory flow is not investigated totally yet. The local thermal non-equilibrium model mentioned in presentation 2 may be a reference for exploring the heat transfer behavior in porous media. It is need more consideration for investigating this property.