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Flow through the porous material

Tomáš VINŠ[1], Petr NOVOTNÝ [2]

[1] ing.Tomáš Vinš, Katedra Energetických Zařízení, Fakulta Strojní, Technická Universita v Liberci, Studentská 2, 461 17 Liberec 1, e-mail tomas.vins@tul.cz

[2] Ing. Petr Novotný, CSc., Katedra Energetických Zařízení, Fakulta Strojní, Technická Universita v Liberci, Studentská 2, 461 17 Liberec 1, e-mail petr.novotny@tul.cz

Abstract: This article describes deviations of the temperature fields of regenerator. Model created in numerical simulation, which corresponding with real model of regenerator. By the numerical simulation were used the same value of operating and boundary conditions like in the real model. Solution were created by comparing of single models on the base of these assumptions. The temperature field in whole volume of regenerator was obtained on the real model been used thermocouples in the different cross sections and in the different depths.

1. Introduction

Regenerator is element used to capture and in the next step supplying the energy into the working fluid. In reality most working mediums are using the working gases with the high heat capacity. Usually is used the air in experiments to the compressed helium for the heat engines. Regenerator is the porous layer formed of thin layers sieves of the steel. . Among the most important parameters of sieves, the size of the mesh grid and the wire diameter that forming the sieve. The wire diameter that affects the total volume porosity of the regenerator. Creating an efficient regenerator is a compromise between of the voluminal porosity and low pressure loss caused by flowing the working fluid. Porosity causes increases the dead volume and the pressure loss.

The numerical simulations were created because of clarify the current adhesion the flow to the wall in the simulations [2].This deviation was only in simulations, and not once on measurement of the real model of the regenerator.

2. Numerical simulations

Numerical simulations were created using the software Gambit and Fluent . Numeric model that was Discretisation, the match the dimensions and working conditions of the real model of the experiment. The total discretized model contains 800,000 cells.

The volume represents the actual regenerator was accompanied by a constant. Constants describe its porosity and thus the pressure loss caused by air flow C2, α. These values are only a function of the mesh size the sieve DP and porosity of the material ε. Therefore, the only way to calculate the bulk porosity of known weight of the sieve. The number of sieves in the volume of the regenerator. The density of steel sieves and total volume of the regenerator in the space of the cylinder from poly amid. Values C2 loss coefficient α permeability of porous media calculated in the software manual . For control and comparison was used also calculate from the Darcy permeability of the formula.. ad = 4.24e-6 m^{-2} α = 8.13e-9 m^{-2}.

3. Results of numerical simulations

Temperature differences between the experiment and the simulation was influenced by the adhesion of the input flow on the wall of the cone surface. This effect is most influenced by the flow in the conical part input for the heating and cooling. Causing the turbulence and air circulation, and changing the velocity ratios before entering the porous material. Which is reflected in the field of the thermal part regenerator. Adhesion to the wall is in the use of any turbulence model (k-ε, k-ω) but with laminar model. Temperature fields should be copy of the velocity fields. This result was reflected in the experiment, where the apparent temperature difference in the axial but also radial direction. Removal of current adhesions to the wall of the cone has been reached when the input velocity to adjust or reduce the porosity. But even if one of the treatment we received at the default value of the actual experiment. Adhesion to the wall was found for all turbulence models and numerical simulations no viscous.

4. Conclusion

Differences in temperature fields between experiment and numerical simulations are influenced by the entering stream to the wall of the cone before entering the porous material. Lower intensity of energy transfer from the carrier medium directly into the mass. Another deviation, which was measured at experiment is the difference of static pressure at the regenerator. Permeability that was obtained from calculation according to the software manual, then the difference of static pressures differed by several orders of magnitude from the values measured during the experiment. The static pressure difference coming close in the case using Darcy's formula in the numerical simulation to the value of the experiment.

A positive finding in the implementation of the experiment, the measurement of temperature difference between the input and output stream during heating,with the long time heating did not change. The difference was due to heat from the surrounding air.

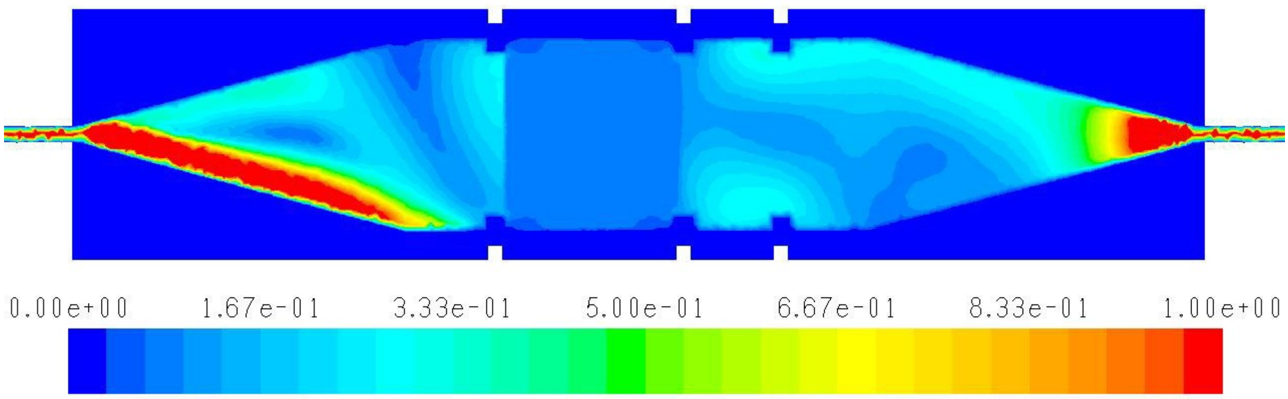

Figure:1. Velocity field

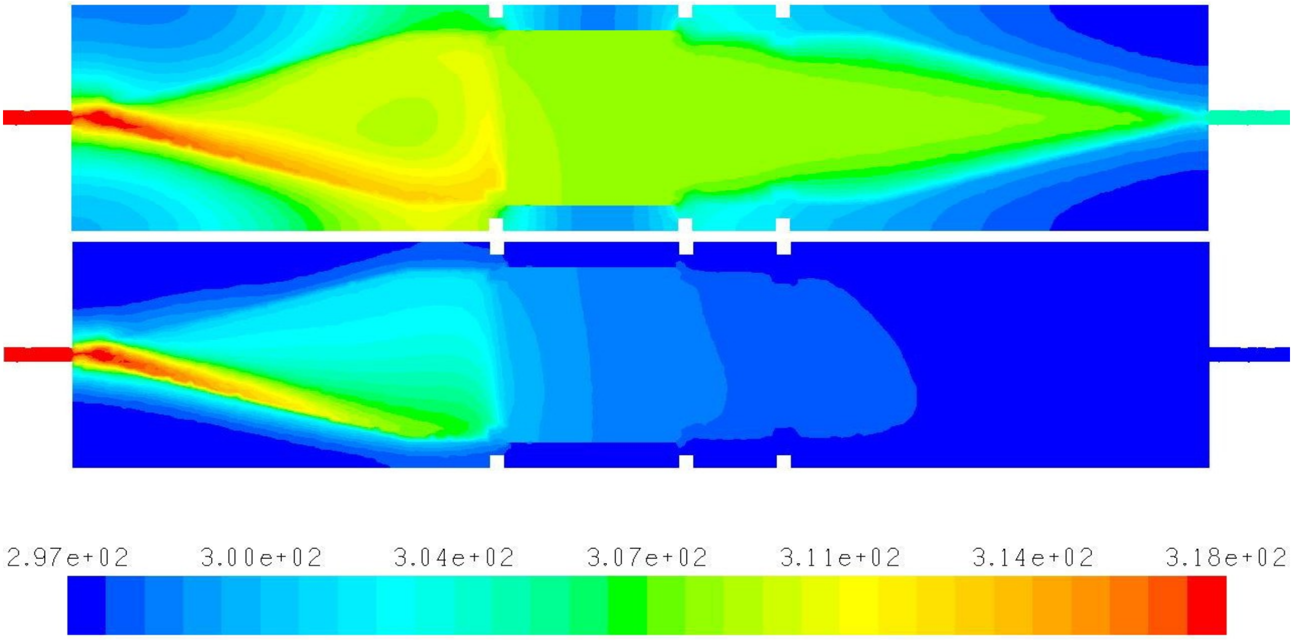

Figure:2. Temperature field

5. Literatura

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