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论文

流热耦合作用下组合岩体等效导热系数研究

王宏伟，荣航

辽宁工程技术大学 科学技术处，辽宁 阜新 123000

摘要：

针对存在裂隙和流体的组合岩体，采用理论分析、数值计算和实验研究相结合的方法，基于传热学和热动力学的基本原理，综合考虑不同性质岩石的传热和裂隙流体的对流换热，建立了流热耦合条件下组合岩体等效导热系数的计算模型；采用有限元数值模拟方法，随机模拟岩石的孔隙结构，建立了孔隙分别被空气和水充填时，岩石等效导热系数的统一经验方程；通过对裂隙流体与岩体对流换热系数的实验测试，给出了对流换热系数随与流速和温差的关系；综合分析了裂隙和流体对组合岩体导热性的作用，在低流速和小温差条件下，对流换热阻较小，裂隙宽度和流体导热性对岩体导热系数的影响较大；在高流速和大温差条件下，对流换热阻逐渐超过裂隙流体的热阻，组合岩体导热系数明显增大。

关键词： 流热耦合；组合岩体；等效导热系数；热传导；对流换热

Study on the equivalence heat conduction coefficients of combined rock in fluid thermal coupling

Abstract:

Based on the fundamentals of heat transfer theory and thermal dynamics，the methods combining theoretical analysis，numerical calculation and experimental study were used to analyze the combined rock including crack and fluid.Considered heat transfer and heat convection in combined rock，calculation model of the equivalence heat conduction coefficients was deduced in fluid thermal coupling.Stochastic simulation was used to create pore structure of rock by FEM.Unified empirical equation of equivalence heat conduction coefficients was built when air or water filling in pore.The change of the convective heat transfer coefficient with flow velocity and temperature difference was test.The effect of crack and fluid to heat thermal conductivity was analyzed.The results prove that in low flow and small temperature difference，the convective heat transfer resistance of rock is smaller，and the effect of crack width and fluid thermal conductivity is obvious to thermal conductivity；in high flow and small temperature difference，the convective heat transfer resistance gradually exceeded heat resistance of crack fluid，and thermal conductivity of combined rock significantly increase.

Keywords: fluid thermal coupling；combined rock；equivalence heat conduction coefficients；heat transfer；convective heat transfer

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通讯作者: 王宏伟

作者简介: 王宏伟（1977—），女，辽宁阜新人，副教授

作者Email: lntuwhw@126.com

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