

传递现象

## 四丁基溴化铵包络化合物浆在铜管内的对流传热特性

肖睿, 何世辉, 黄冲, 冯自平, 樊栓狮

中国科学院广州能源研究所

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摘要

四丁基溴化铵 (TBAB) 包络化合物浆是在常压下由TBAB水溶液被冷却到0~12℃时生成的, 是一种理想的冷量输送和蓄冷媒体, 以固液两相悬浊液的形式存在。作为冷量传输媒体, 由于存在相变过程, 其冷量传输密度远高于相同温差下的冷水。另一方面, TBAB包络化合物浆具有良好的流动性, 可以像液态水一样方便地通过泵和管道系统输送。因此, 在中央空调及区域集中供冷系统中具有很好的节能应用前景。本文研究了TBAB包络化合物浆在水平铜管内的传热特性。在定热流边界条件及不同Reynolds数下测量并分析了对流换热系数。实验中发现固相粒子的扰动和表观黏性的下降都能破坏或拉薄包络化合物浆流动的动量边界层, 结果导致了传热系数的提高。在不同的Reynolds数下固相含量 ( $\Phi$ ) 对Nusselt数的影响很微弱。通过与文献的比较发现, 本文所测取的包络化合物浆Nusselt数均高于冰浆甚至单相水。最后获得了  $Nu$  与  $Re$  之间的实验关联式。

关键词

[四丁基溴化铵](#) [包络化合物浆](#) [蓄能](#) [潜热输送](#) [传热](#)

分类号

## Convictional heat transfer of TBAB clathrate hydrate slurry flow in copper tube

XIAO Rui, HE Shihui, HUANG Chong, FENG Ziping, FAN Shuanshi

### Abstract

Tetra-n-butyl-ammonium bromide (TBAB) solution turns into clathrate hydrate slurry (CHS) when it is chilled in the temperature range of 0—12℃. This is well compatible with the temperature range of common air-conditioning operation. Thus, it is considered as an ideal heat-transport and cold-storage medium. Due to the phase change, TBAB slurry has far higher cold-loading density than water under the same temperature difference. Moreover, TBAB slurry behaves as fluid, so it can be easily transported through pipeline. Therefore, it is very promising to use TBAB slurry in air conditioning or district cooling system for its energy-saving advantages. In this paper, the heat transfer characteristics of TBAB slurry were investigated in a horizontal copper tube. The convictional heat transfer coefficients were measured and analyzed at different Reynolds numbers and constant heat flux. It was found that both the perturbation of solid particles and the decrease of apparent viscosity could destroy or thin the momentum boundary layer of slurry flow, which consequently contributed to a better heat transfer coefficient. The influence of volume fraction of solid phase ( $\Phi$ ) on Nusselt number seemed slight in spite of the change of Reynolds number. The comparison with references showed that the Nusselt numbers measured in CHS were consistently higher than those of the ice slurry and even single phase water. A correlation of Nusselt number with Reynolds number was presented.

### Key words

[TBAB](#) [slurry](#) [thermal energy storage](#) [latent heat transport](#) [heat transfer](#)

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通讯作者 冯自平 [fengzp@ms.giec.ac.cn](mailto:fengzp@ms.giec.ac.cn)