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·种根据热源温度品位自动调节效能的溴化锂吸收式制冷循环[刊,中]

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摘 要 针对一种提出的根据热源温度品位自动调节效能的新型溴化锂-水吸收式制冷循环进行了理论分析, 该循环可以平滑调节系统 COP 和工作范围。循环在单效循环基础上加入一对中压蒸发/吸收器,中压蒸发器的 冷量用于冷却进入系统的冷却水。这样降低了吸收器出口稀溶液的浓度,升高了被结晶特性限制的发生温度 上限,也降低了循环截止发生温度。通过建立模型直观说明了循环的效率变化以及对循环工作范围的扩大。 计算结果表明在 32℃和 40℃的冷却水温下, 0.n 效循环可以分别将单效循环发生温度范围扩大 2 倍和 6 倍, 同时保持 0.3[~]0.75 的 COP。

关键词 吸收式制冷; 溴化锂/水; 单效; 多效; 发生温度

Analysis of a 0.n-effect LiBr/water Absorption Refrigeration Cycle

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Abstract A novel type of LiBr/water absorption refrigeration cycle with the self-adjustable effect between 0.5 and 1.0 (0.n) have been proposed and analyzed. A pair of medium pressure evaporator/absorber is added into the single effect cycle to form this novel cycle. Cooling water into the cycle is precooled by this evaporator. Precooling makes the solution concentration out of the absorber weaker, thus lifting the highest generation temperature limited by crystallization and dropping the generation starting temperature.

Calculation is given based on several assumptions. Results show that 0.n-effect cycle has generation

Calculation is given based on several assumptions. Results show that 0.n-effect cycle has generation temperature ranges twice and six times larger than single effect cycle under cooling water temperature of 32°C and 40°C respectively. Meanwhile a COP of 0.3~0.75 is obtained.

Keywords absorption refrigeration; LiBr/water; single effect; multi effect; generation temperature

常用固体除湿剂吸附机理与电渗再生效果研究 [刊,中]

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摘 要 电渗再生固体除湿剂具有节能、系统简单等优点,得到了越来越多的关注。本文利用比表面及孔隙度分析仪测试了沸石、大孔硅胶两种常用固体除湿剂的吸附性能;分析了其吸附机理和利用电渗再生的可能性。沸石吸附时属于单层吸附或多孔填充,水分以分子态存在于沸石微孔内,无法形成电渗效应;大孔硅胶吸附时,发生毛细凝结,吸附饱和时存在液态水,存在通过电渗效应再生的可能性。通过实验得到了沸石 30V时存在电渗效应的临界含水率在 40%~55%之间,高于其饱和含水率,初步验证了沸石在非饱和时不存在电渗效应。大孔硅胶 95%含水率、60V 电压时不存在电渗效应,105%含水率 40V、50V、60V 电压时存在电渗效应,同时在非饱和时可以通过电渗效应降低其本身的含水率。

关键词 固体除湿剂;电渗;再生;吸附

Investigation on the Adsorption Mechanism and Electro-osmosis Regeneration of Common Solid Desiccants

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Abstract Regeneration of solid desiccants by electro-osmostic effect caught more and more attentions due to its energy saving and simpleness. The surface area and pore size analyzer was used to test the adsorption performance of the zeolite and the macroporous silica gel firstly. The possibility of electro-osmosis regeneration for the zeolite and the macroporous silica gel has been analyzed combined with different desiccants adsorption and electro-osmosis effect. The adsorption mechanism of the zeolite is monolayer adsorption or porous filler. The water exists in the micro pore of the zeolite in molecular state, thus it can't form electro-osmosis effect. Capillary condensation happens for macroporous silica gel. The liquid water exists when it is saturated, so it is possible for macroporous silica gel to be regenerated by the electro-osmosis effect. The experiment results show the critical moisture content existing electro-osmosis effect of zeolite is between 40%~55% when the voltage is 30V which is higher than its saturated moisture content. This result verifies that there is no electro-osmosis effect for the zeolite when it is unsaturated. As for the macroporous silica, there is no electro-osmosis effect when the moisture content is 95% and the voltage is 60V. And electro-osmosis effect exists for 105% moisture content and 40V, 50V and 60V voltage. Electro-osmosis effect can reduce the moisture content of the macroporous silica gel when it is unsaturated.

Keywords solid desiccant; electro-osmostic; regeneration; adsorption

垂直矩形窄通道换热特性实验研究[刊,中]

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摘 要 本文以去离子水为工质进行实验,研究垂直矩形窄通道换热特性。采用单侧壁面加热,改变工质流动参数,分析沿流动方向的壁面温度分布特性和测温点处的局部换热系数。实验表明:以对流沸腾为主的阶段,换热系数随着质量流速的增加而增加,入口温度对于换热系数基本没有影响;当干度 × < **0.1** 时,换热系

数随着干度的增加而降低,当干度 x > 0.1 时,换热系数随着干度的增加而基本保持不变。以核态沸腾为主的 阶段,换热系数随干度的增加而略微上升,随入口温度的升高而增加。

关键词 换热特性;局部换热系数;矩形窄通道;实验研究;

Experimental Study for Heat Transfer Characteristics of Vertical Rectangular Narrow Channels

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Abstract Ionized water was used to investigate the heat transfer characteristics of vertical rectangular narrow channels for experiment. The distribution characteristics of wall-temperature and the local heat transfer coefficient were analyzed by using single-side heating and various working conditions parameters of the working fluid. Derived from experiments: with convection boiling in a flow, heat transfer coefficient increased with the increase of the mass flow rate but the inlet temperature substantially had no effect on the heat transfer coefficient; with the dryness χ <0.1, heat transfer coefficient increased with decreases of the dryness, with the dryness χ <0.1, heat transfer coefficient keep constant with increases of dryness. With nucleate boiling in a flow, heat transfer coefficient had a slight increases with the increases of dryness and it increased with the increases of inlet temperature.

Keywords heat transfer characteristics; local heat transfer coefficient; rectangular narrow channels; experimental study

铜基 Ni-P-PTFE 化学复合镀层的阻垢和导热综合性能的研究 [刊,中]

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摘 要 本文采用硬水加热法测试了不同 Ni-P-PTFE 化学复合镀层的阻垢性能,通过实验发现随着镀层中 PTFE 含量的增大,表面结垢诱导期增长而结垢量减小,同时阻垢性能增强;另外采用热阻法测试其导热性能 发现 Ni-P-PTFE 复合镀层的导热性能随 PTFE 含量的增大而下降。而镀层中 PTFE 含量又是和施镀乳液中 PTFE 的浓度有关系。因此定义阻垢率和导热系数下降率来综合评价镀层的性能,得出当 PTFE 乳液浓度为 11mL/L1 时的镀层表现出最佳的阻垢导热综合性能的结论。

关键词 Ni-P-PTFE 化学复合镀层;阻垢性能;导热性能; PTFE 乳液浓度

Investigation on Anti-fouling Capacity and Thermal Conductivity of Ni-P-PTFE Composite Coating

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Abstract Effect of anti-fouling capacity of Ni-P-PTFE composite coating was tested in the hard water. It found that anti-fouling capacity of the Ni-P-PTFE coatings was determined by the PTFE concentration in the coating. The induction period was lengthened and fouling deposition dropped with an increase PTFE content in the coating. In addition, the thermal conductivities of the Ni-P-PTFE coatings were measured by thermal resistance method in the paper. In general, the thermal conductivities declined with the PTFE increasing. While the PTFE content of the Ni-P-PTFE coatings is influenced by the PTFE concentration of the solution. So, the anti-fouling efficiency and thermal conductivity reduction rate are defined ,and found the sample formed at the PTFE concentration 11ml•L-1 in the solution behaved the best integrated performance of anti-fouling capacity and thermal conductivity under the conditions in the paper.

Keywords Ni-P-PTFE composite coating; anti-fouling capacity; thermal conductivity; PTFE concentration

复叠式空气源热泵翅片管换热器的结霜因子研究 [刊,中]

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摘 要 空气源热泵在冬季结霜会对机组的运行产生较大影响。本文实验机组为一台复叠式空气源热泵,室外侧换热器采用带亲水膜的翅片管.在焓差实验室中进行室外温度在-18~6℃区间、相对湿度在 70%~90%区间内的实验,研究空气源热泵的翅片管换热器的结霜量。实验结果显示:结霜量随时间增加而增加,并且接近线性关系;室外温度在-3~3℃时的结霜量最高,随着室外温度的下降,结霜量下降;室外湿度对结霜量的影响较大,在 70%的相对湿度下,结霜量远小于 80%~90%的结霜量;本文根据结霜时间、换热面积和盘管表面温度与空气露点温度与结霜量之间的关系,提出了结霜因子的概念,并得到结霜因子的范围为

6.51~10.31kg/(m²•℃•min),其平均值为 8.58kg/(m²•℃•min)。

关键词 空气源热泵;翅片管换热器;空气温度;空气湿度;结霜量

Study of the Frosting Factor Based on Finned-tube Heat Exchanger of Air-source Heat Pump

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Abstract The frost on the heat exchanger of the air-source heat pump has a great influence of the operating performance. The frosting experiment based on a cascade type air-source heat pump water heater is carried out in the enthalpy-difference in this paper, and the outdoor evaporator of the unit is a finned-tube heat exchanger. In addition, the outdoor environmental conditions include that the outdoor temperature is from -18° C to 6° C and outdoor relative humidity is from 70% to 90% in this experiment. Experimental results are described below. First of all, the amount of frosting almost changes linearly with the frosting time which is of maximum in this outdoor temperature range of $-3 \sim 3^{\circ}$ C, and the lower outdoor temperature, the more frosting amount; Secondly, the outdoor relative humidity has a great influence of the quantity, and the more humidity, the more frosting quantity; Finally, the frosting factor is from 6.51 to $10.31 \text{kg/(m}^2 \cdot \text{C} \cdot \text{min})$ and the average value is $8.58 \times 10-4 \text{ kg/(m}^2 \cdot \text{C} \cdot \text{min})$, based on the relationships of the area and form of evaporator coil, the time of frosting, the difference of the dew point temperature and the temperature on the evaporator coil and the frosting quantity.

Keywords air-source heat pump; finned-tube heat exchanger; outdoor temperature; outdoor humidity; the frosting amount

AI2O3 纳米流体相变特性的 DSC 研究「刊,中]

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摘 要 纳米流体相变时所体现出的特性是其作为蓄冷相变材料使用的重要基础。利用差示扫描量热法分别测量了纳米颗粒粒径为 10 nm、20 nm、50 nm、100 nm、500 nm,质量分数为 5%、10%、12%、15%、20%,以及降温速率为 2℃/min、3℃/min、5℃/min、7℃/min、9℃/min 的 Al2O3 纳米流体的凝固点、冰点、融化点、比热及相变潜热的影响。测量结果表明:纳米流体的凝固点、冰点值都高于去离子水;随着颗粒粒径、质量分数和降温速率的增加,纳米流体的凝固点、冰点逐渐升高,而比热值逐渐减小。融化温度随着颗粒粒径、质量分数的增加而增加,且随着降温速率的增加而小幅度的降低。去离子水的相变潜热值高于纳米流体的潜热值;随着纳米颗粒粒径的增加,潜热值越大;随着质量分数和降温速率的增加,相变潜热值越小。

关键词 DSC;纳米流体;相变特性;质量分数;颗粒粒径;降温速率

Phase Change Characteritics of Al2O3-H2O Nano-fluids Measured By DSC

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Abstract As a new phase-change cold storage materials, the thermal properties of nano-fluids are important basis. The effect of the diameter, mass fraction and cooling rate to solidification point, freezing point, melting temperature, specific heat capacity and latent heat of Al2O3 was measured by Differential Scanning Calorimetry. The diameter of nanoparticle is 10nm, 20nm, 50nm, 100nm, 500nm. The mass fraction is 5%, 10%, 12%, 15%, 20%. The cooling rate is 2°C/min, 3°C/min, 5°C/min, 7°C/min, 9°C/min. The results show that the nanoparticle plays a critical role on cool storage. The solidification point and freezing point of nanofluids are higher than the deionized water. With the increase of nanoparticle sizes, mass fraction and cooling rate, the solidification point and freezing point of nanofluids will increase, and the specific heat capacity of nanofluids will decrease. The melting temperature will increase with the increase of nanoparticle sizes, mass fraction, and also decrease with the increase of cooling rate. The latent heat of deionized water is higher than the nanofluids'. The latent heat of nanofluids will increase with the increase of diameter of nanoparticle and decrease with the increase of mass fraction and cooling rate.

Keywords DSC; nano-fluids; phase change characteritics; mass fraction; diameter; cooling rate

复叠式空气源热泵系统的控制稳定性研究[刊,中]

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摘 要 针对可在不同环境温度下制取高温热水的复叠式空气源热泵系统,运用二级压缩比大致相等的原则确定最优中间温度从而控制中间冷凝压力的方法。采用适用性较好的比例-积分-微分(Proportion Integration Differentiation, PID)算法,利用可编程逻辑控制器(Programmable Logic Controller, PLC)进行核心控制,通过实验验证了在不同的室外环境温度条件下,面对负荷的变化,该系统控制快速、平稳且精确,实现了对复叠式空气源热泵系统的优化控制。

关键词 空气源热泵;复叠式; PID; PLC;控制;稳定性

Research on Control Stability of Cascade Air-source Heat Pump

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Abstract For the cascade air-source heat pump under different environment temperature, this paper used the principle that two stage compression ratio is approximately equal, and determined the method which controlled the intermediate pressure at the optimal middle temperature. The proposed method adopted highly applicable Proportion Integration

Differentiation (PID) algorithm, and used the kernel control strategy of Programmable Logic Controller(PLC). A test was conducted which shown that the control method was sensitive, stable and accurate with various outside conditions and indoor loads. The cascade air-source heat pump system realized the optimum control.

Keywords air-source heat pump; cascade; PID; PLC; control; stability

叉流除湿器热质传递性能实验研究 [刊,中]

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摘 要 在太阳能溶液除湿蒸发冷却空调系统实验台上,以 LiCl 溶液为除湿剂,用空气进出口含湿量差和除湿效率作为除湿过程的性能评价指标,来研究叉流除湿器的除湿性能。通过实验数据分析了溶液、空气进口参数对除湿性能的影响,并利用实验数据建立适用于 LiCl 溶液的叉流除湿器的除湿效率和传质系数的实验关联式,发现与实验结果的吻合程度很好,误差在 15%以内,能够利用这些关联式来准确的计算叉流除湿器的除湿性能,可供叉流除湿器设计参考使用。最后将实验结果与相关文献进行比较,结果表明:不同的除湿剂对叉流除湿器的除湿性能的影响基本相同。

关键词 叉流除湿器; 传热传质; 氯化锂溶液; 实验研究

Experimental Investigation on the Performance of the Heat and Mass Transfer of Cross-flow Dehumidifier

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Abstract To describe the heat and mass transfer performance of the cross-flow dehumidifier, this paper measures the dehumidifier's moisture removal rate and dehumidifier effectiveness on the test bed, liquid desiccant evapor cooling air-conditioning system, which is driven by solar energy and using LiCl solution as liquid desiccant. The effect of air and solution inlet parameters on the dehumidifier is analyzed by the experiment. Results of the new empirical correlation are correlated well with the experimental data, and it is proved that the error of the calculation is within 15% compared with the test value. It can be used to calculate the performance of the cross-flow dehumidifier and design the cross-flow dehumidifier. Compared with other results available in the literature, the impacts of air and solution inlet parameters show similar tendency among different desiccant.

Keywords cross-flow dehumidifier; heat and mass transfer; LiCL solution; experimental investigation

有机朗肯循环模拟及涡旋式膨胀机的性能研究 [刊,中]

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摘 要 近些年来,太阳能作为一种可再生能源受到了广泛的关注。其中利用太阳能集热器实现 100℃以下高效的热量回收,是一种普遍且有效的太阳能利用方式。采用有机朗肯循环与 100℃的低温热源相结合进行发电,目前也逐渐受到了研究人员的关注。考虑到膨胀机是有机朗肯循环的核心部件,本文首选择了 R600制冷剂作为 ORC 系统的工质,对其进行了计算以及热力学性能分析。同时搭建了利用压缩空气来驱动的涡旋式膨胀机性能研究的实验台。从 ORC 的理论分析得,当热源温度为 78~97℃,环境温度为 30℃,可以获得 0.7~1kW 的电量,火用效率为 0.84~0.89。利用压缩空气模拟 R600,当温度从 75℃变化到 95℃,对应的压力从 0.8MPa 变化到 1.2MPa,膨胀机出口压力控制在 0.28MPa,等熵效率维持在 0.7 左右。膨胀机的功电转化效率随着膨胀机理想输出功的增加而降低。

关键词 有机朗肯循环;涡旋式膨胀机;等熵效率;火用效率;太阳能

The Simulation of ORC and Experimental Study on Scoll Expander

Gao Peng Jiang Long Wang Liwei Song Fenping Wang Ruzhu

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Abstract As a type of renewable energy, solar energy has attracted more and more attention in recent years. The solar energy can be collected by the solar collectors with the temperature lower than 100°C efficiently. The Organic Rankine Cycle that transforms the low temperature heat source with the temperature lower than 100°C into electricity has been recognized and developed by the academics. Considering that the expander is a key componet of an ORC, firstly, this paper selected R600 as working fluid for ORC system, then the thermodynamic performance is analyzed, and simultaneously the performance of scroll expander is simulated by the experiments with the compressed air. Through the theoretical analysis of ORC, when the heat source temperature and ambient temperature are 78-97°C and 30°C, respectively, 0.7-1kW electricity can be obtained. Correspondingly, exergy efficiency is from 0.84 to 0.89. Compressed air is used to simulate R600. Inlet temperature of the expander changes from 75°C to 95°C while corresponding pressure changes from 0.8MPa to 1.2MPa, and outlet pressure is controlled at 0.28MPa. Isentropic efficiency is maintained at about 0.7. The work-power

efficiency decreases when the ideal output power increases.

Keywords Organic Rankine Cycle; scoll expander; isentropic efficiency; exergy efficiency; solar energy

气泡泵在制冷技术中的应用研究进展[刊,中]

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摘 要 本文回顾了气泡泵研究的相关文献,简要的介绍了气泡泵工作原理,并对应用于扩散-吸收式制冷技术、Einstein 循环制冷技术、吸收式制冷技术和太阳能制冷技术的气泡泵研究进展进行总结。提出气泡泵的重要影响参数有结构形式、运行参数和工质三种,并指出气泡泵的基本理论、运行特性和性能提升方法需要更完善和深入的研究。

关键词 制冷技术;气泡泵;综述;吸收式制冷

Research Progress of Bubble Pump in Refrigeration Application

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Abstract A literature review on bubble pump using in refrigeration technology and a brief introduction the principle of bubble pump are provided. A numbers of bubble pumps that apply to diffusion-absorption refrigeration, Einstein refrigeration cycle, absorption refrigeration and solar refrigeration are provided and discussed. Configuration, operating parameter and working fluid are presented as the important parameters influencing the performance of the bubble pump. Finally, the fundamental theory of bubble pump, working characteristics and the performance of bubble pump improvement are proposed to be researched preferentially.

Keywords refrigeration technology; bubble pump; reviews; absorption refrigeration

外绕微通道冷凝器空气源热泵热水器仿真与优化[刊,中]

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摘 要 空气源热泵热水器比燃气或电热水器更为节能。本文提出了一种外绕微通道冷凝器,可以减少制冷剂充灌量、提高换热效率、降低成本、提高安全性。建立了热泵热水器的准稳态系统模型,制冷剂侧采用稳态模型,水箱和水侧采用动态模型。通过实验证明了该系统模型可以准确地预测时变的系统功耗、水温,以及系统时均 COP。通过仿真分析,发现

水箱隔热层可以缩短水的加热时间、并提高系统 COP 约 9.2%。增大冷凝器也可提升系统 COP,但几乎不改变水的加热时间。最后提出了微通道冷凝器的三流程优化设计方法。

关键词 热泵热水器;微通道换热器;模型;仿真;实验

Modeling and Optimization of Air Source Heat Pump Water Heaters Using Wrap-around Micro-channel Condenser

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Abstract Heat pump water heaters are more energy efficient than the conventional ones using electricity or gas. A wrap-around micro-channel condenser was proposed to reduce the system charge of refrigerant, improve the heat transfer efficiency, reduce cost of heat pump water heaters, and improve safety. A quasi-steady-state system modeling approach to performance simulation of the air source heat pump water heater using wrap-around micro-channel condenser was developed. The refrigerant components were described by steady-state models, while the water tank was described by a dynamic lumped-parameter model. The model was well validated with the laboratory test data of the dynamically cumulative power consumption, time-variant water temperature rise, and the overall time-average COP of heat pump water heaters. Parametric analysis revealed that the insulation layer of water tank can reduce the heating time and improve the system COP around 9.2%, while a bigger condenser can impove the system COP but has negligible impact on the heating time. At last, pass number of the micro-channel condenser was optimized and three-pass design were recommended for higher performance and less chance of refrigerant maldistribution.

Keywords heat pump water heater; micro-channel heat exchanger; model; simulation; experiment

采用三换热器和四通阀的两种车用热泵系统的对比和研究[刊,中]

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摘 要 电动汽车没有足够的余热可供冬季取暖,因此将热泵引进电动车具有重要意义。文章对两种汽车热泵系统:三换 热器与四通阀的热泵系统进行了分析研究。测试结果表明:在大部分工况下,两个系统的能力相近,只相差 10~50W, 但四通阀系统的 COP 要比三换热器系统高 7%~15%,压缩机功率则比三换热器系统低 50~150W。

关键词 车用空调热泵系统;制热量;制冷量;COP

Comparative Study of Three Heat Exchanger and Four-way Valve Automotive Air Conditioning System

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Abstract Electric vehicles don't have enough waste heat for heating in winter, so the introduction of the heat pump system to the electric vehicles is of great significance. Two kinds of heat pump system are researched in the article, and the result shows that: in most conditions, the two systems' ability are similar, the difference between them is only 10W to 50W, but the COP of four-way valve system is 15% ~ 18% higher than three heat exchanger system, and the compressor power is 50 to 150W lower than three heat exchanger system.

Keywords electric vehicle air condition system; heating capacity; cooling capacity; COP

水平管外 R404A 降膜蒸发传热的实验研究 [刊,中]

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摘 要 搭建了降膜蒸发实验台,研究了水平单管外的降膜蒸发传热特性。测试管为外径 19mm、有效实验长度为 2500mm 的光滑管和强化管。实验采用 R404A 作为管外降膜蒸发工质,与管内热水进行换热。布液采用喷嘴喷淋的方式,通过 21 个喷口当量直径为 2mm 的喷嘴完成。分别在变饱和温度(0、5、10、15℃)、变热流密度(从 8 到 30kW/m²) 和变喷淋量(从 0.07 到 0.11kg/ms)时进行实验,研究了降膜蒸发换热性能相应的变化情况,得到 R404A 的管外降膜蒸发换热的一些规律,这对降膜蒸发器的设计及应用具有一定的参考作用。

关键词 降膜蒸发;换热强化;水平管

Experimental Investigation on the Falling Film Evaporation of R404A Outside a Horizontal Tube

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Abstract An experimental study was carried out in order to investigate the heat transfer performance of falling film outside a single horizontal tube with a new test facility. Two types of commercial evaporation tubes were tested: a plain tube and an enhanced tube, which have the same outer diameter of 19 mm and the same effective test length of 2500 mm. Refrigerant 404A was used as working fluid to transfer heat with heating water inside the tube. Spraying feeding method was adopted by using 21 spray nozzles with the equivalent diameter of 2 millimeters. Experiments were performed at saturation temperatures of 0, 5, 10 and 15 oC, heat fluxes from 8 to 30 kW/m² and mass flow rate per unit length of tube from 0.07 to 0.11 kg/ms. The regularity of falling film heat transfer performance of R404A outside a horizontal tube was obtained which is meaningful for the design and application of falling film evaporator.

Keywords falling film evaporation; heat transfer enhancement; horizontal tube

采用铜铝复合管的翅片管换热器换热性能数值模拟与实验研究[刊,中]

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摘 要 提出采用一种铜铝复合管,用来替代传统的空调室外机换热器用铜管,可降低成本 27.8%。首先通过数值模拟研究了Φ7 管径的铜铝复合管与铜管翅片管换热器空气侧的传热与流动性能,计算结果表明,在入口风速为 2.5m/s 的情况下,与采用铜管的换热器相比,采用铜铝复合管的换热器空气侧的压力分布几乎不变,换热量降低 3.12%,对性能影响较小。另一方面,对采用该模型的铜铝复合管换热器进行了性能测试,实验结果表明:铜铝复合管换热器换热量为8775W,与铜管换热器 9101W 相比降低 3.58%,满足换热器标准要求。实验结果与数值模拟结果基本吻合,均证明这种新型铜铝复合管对换热器性能的影响不大,可用于空调的制造中。

关键词 空调;换热器;数值模拟;铜铝复合管

in Finned Tube Heat Exchanger

Numerical Simulation and Experimental Research on Substitute of Aluminum Clad Copper Tube

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Abstract Aimed to instead traditional copper tube used in heat exchanger of air-conditioner, a new type of aluminum clad copper tube is proposed, the cost of exchanger with the aluminum clad copper tube can be reduced by 29.5%. Firstly the airside heat transfer and flow characteristics of heat exchanger with copper tube and aluminum clad copper tube (ACC) are studied by numerical simulation. Computation results show that the performance of fin with ACC tube drops 3.12% compared with that of fin with copper tube while the pressure distribution is almost the same at inlet velocity of 2.5m/s. At the other hand, the performance of heat exchanger with copper and aluminum clad copper tube is experimental investigated. According to the experimental results, heat transfer amount of the heat exchanger with ACC tube decreases by 3.58% compared with that of heat exchanger with copper tube, being in line with the heat exchanger standards. The numerical and experimental results are basically consistent, both of them indicate that this new type of aluminum clad copper pipe has little negative effect on the performance of heat exchanger. As a result, the aluminum clad copper pipe can be applied in air conditioner.

Keywords air conditioner; heat exchanger; numerical simulation; aluminum clad copper tube (ACC)

扁管和百叶窗式微通道换热器空气侧阻力的实验研究[刊,中]

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摘 要 在迎面风速 1~4m/s、雷诺数 100~500,迎风面尺寸 600mm×550mm 以及环境温度 20℃工况条件下,测试了微通道换热器空气侧阻力,对比分析了测试结果与不同关联式计算结果,表明现有不同关联式间预测结果相差较大,其中 Davenport 的关联式与实验值较为接近,但实验值也仅有其预测值的 55%~66%。实验也表明微通道换热器空气阻力与换热量和迎风面积相同的平翅片圆管换热器空气阻力相当,认为独特的扁管结构和较小的换热器厚度是其减小空气阻力的有效手段。

关键词 微通道换热器;换热器空气阻力;百叶窗翅片

Experimental Study of the Air Resistance of Microchannel Heat Exchanger with Flat Tube and Louver Fin

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Abstract An experimental study on the air-side resistance characteristics for micro channel heat exchanger has been performed. A series of tests were conducted for the air velocity of 1-4m/s, Reynolds

numbers of 100 - 500, surface dimension of $600 \text{mm} \times 550 \text{mm}$, at a constant surround temperature of 20°C . The data were compared with different general correlations. The result show that it is a big distance between different correlations. Davenport's predication is the best one, but the experimental data was only it's 55%-66%. The data were compared with the plain fin and round tube heat exchanger with same surface dimension and capacity. The result show that they are near. The special flat tube and lesser depth are two effective way to reduce the air resistance.

Keywords micro channel heat exchanger; exchanger air resistance; louver fin

R404A 在水平强化管外的冷凝实验及数据处理方法 [刊,中]

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摘 要 针对一种双侧强化换热管,实验测试和分析了制冷工质 R404A 在管外凝结与水在管内对流的传热规律,采用 "Wilson 图解法"和 "Gnielinski 法"两种不同的方法对实验数据进行了处理。经理论分析和实验研究表明,Wilson 图解法对于双侧强化换热管管内、管外表面传热系数实验容易产生较大误差,"Gnielinski 法"是更合适的方法。实验得出了管内对流传热和管外凝结传热的计算关联式及传热的强化倍率。对于制冷剂 R404A,在强化管外凝结的表面传热系数随着壁面过冷度的增加而增大,呈现出与纯工质光滑管外冷凝时不同的变化趋势。

|**关键词** 强化传热;冷凝传热;R404A;数据处理

Condensing Test of R404A Outside Horizontal Enhanced Tubes and Method of Data Processing

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Abstract Condensation of refrigerant R404A on doubly-enhanced tubes and water inside tube convection heat transfer rule were experimental measured and analyzed. The experimental data were processed by Wilson graphical method and Gnielinski method. Theoretical analysis and experimental studied show that the Gnielinski method is more appropriate to process the data of doubly-enhanced tubes inside and outside surface heat transfer coefficients experiment as the Wilson graphical method will engender fairly great error. The calculated correlations of convective heat transfer inside tube and condensation heat transfer outside tube were obtained. The heat transfer enhancement ratios of inside and outside tube are 2.17 and 7.91, respectively. The condensation surface heat transfer coefficients of non-azeotropic refrigerant R404A on enhanced tubes increase with increasing wall subcooling degree

which present a different variation trend from pure refrigerants condensation on smooth tubes. That mainly due to the exist of vapour diffusion layer formed between the liquid film and the vapour bulk.

Keywords heat transfer enhancement; condensation heat transfer; R404A; data processing

冰浆贮存的均匀性研究[刊,中]

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摘 要 在自行搭建的冰浆蓄冷实验台基础上,以从冰浆开始输入蓄冰槽到输冰结束为止的冰浆堆积贮存过程为研究对象,观察形成的"富冰层"发展变化特性,研究冰浆贮存的均匀性。通过改变冰浆入口含冰率、冰浆入口流量和蓄冰槽初始液面高度控制参数,采用正交实验方差分析法分析上述参数对冰浆贮存均匀性的影响显著性和影响规律。

关键词 冰浆贮存;均匀性;正交实验; 方差分析

Research on Ice Slurry Storage Homogeneity

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Abstract The characteristics of ice-rich layer formed during ice slurry storage and the ice slurry storage homogeneity were investigated experimentally based on the self-built experiment table, which focused on the period of ice slurry accumulation from the start that ice slurry starting entering the ice storage tank to the end of ice-delivering. The control factors that ice slurry inlet IPF, ice slurry inlet flow and initial water level of ice storage tank were varied in order to get the significance of influence and influence law of above factors on the ice slurry storage homogeneity using the orthogonal experiment and variance analysis.

Keywords ice slurry storage; homogeneity; orthogonal experiment; variance analysis

蒸汽压缩/喷射制冷系统喷射器设计及节能分析[刊,中]

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摘 要 蒸汽压缩/喷射制冷系统是一种有效的节能系统,可以减少节流膨胀损失,降低压缩机压力比,提高制冷系统效率。选择5种计算工况对蒸汽压缩/喷射制冷系统进行计算,研究喷射器结构与蒸发温度和冷凝温度的变化规律,并与普通蒸汽压缩系统对比,从制冷量、压缩机耗功、性能系数三个角度分析新系统的节能效果。计算结果表明蒸汽压缩/喷射制冷系统在低温工况条件下节能效果最优,制冷量最大可提高29%,压缩机耗功最大可降低65%,COP值最大可提高63%。

关键词 蒸汽压缩喷射制冷;喷射器;结构设计;节能分析

Ejector Design and Energy-saving Analysis of Vapor Compression/Ejection Refrigeration

System

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Abstract The vapor compression/ejection refrigeration system (VCERS) is an energy-saving system which can reduce the loss of throttling expansion and the pressure ratio of compressor to improve the efficiency of the refrigeration system. The structure of ejector related with the evaporating and condensing temperature is researched and the energy-saving effects are compared with the compression refrigeration system from the refrigerating capacity, the compressor work and COP on five working conditions. The results indicate that the VCERS is more suitable for the low temperature working condition, the maximum increase of refrigerating capacity is about 29%, the maximum decrease of the compressor work is about 65% and the maximum increase of COP is about 63%.

Keywords VCERS; ejector; structure design; energy-saving analysis

直接吸收式太阳能集热纳米流体辐射特性实验研究[刊,中]

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摘 要 采用两步法配制了 Cu-H₂O、Co-H₂O、MWCNT-H₂O 三种纳米流体,利用紫外-可见-近红外分光光度计结合积分球原理测试了不同粒径、不同质量分数、不同光程的上述纳米流体在太阳能全波段(250nm<<2500nm)的透射率。结果表明,三种纳米流体的透射率都要比水的小,并且纳米流体的透射率随着粒径的增大以及质量分数的增加而降低,随着光程的减小而增大。在相同质量分数条件下,MWCNT-H2O 透射率最小,在250~775nm 波段,Co-H₂O 的透射率要高于 Cu-H₂O 的,而在775~1370nm 波段,Co-H2O 的透射率要低于 Cu-H₂O 的,表明不同粒子在不同波段具有不同的光吸收性能。

关键词 纳米流体;太阳能;辐射;透射率

Experimental Investigation on Radiation Characteristic of Nanofluids for Direct Absorption

Solar Thermal Energy Systems

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Abstract In this article, $Cu-H_2O$, $Co-H_2O$, $MWCNT-H_2O$ nanofluids were prepared through two-step method. The transmittance of nanofluids over solar spectrum (250 to 2500nm) was measured by the UV-Vis-NIR spectrophotometer based on integrating sphere principle. The factors of various particle size, mass fraction and optical path influencing transmittance of nanofluids were investigated. The experimental results show that the transmittance of the three nanofluids is much less than that of deionized water. The transmittance decreased with the nanoparticle size and mass fraction increasing, but increased with the optical path length reducing. With the same mass fraction, the transmittance of $MWCNT-H_2O$ nanofluids is the minimum. The transmittance of $Co-H_2O$ nanofluids is higher than that of $Cu-H_2O$ during $250\sim775$ nm wavelength, while inverse during $775\sim1370$ nm wavelength. It indicates that different particle has diverse light absorption properties during different wavelength.

Keywords nanofluids; solar energy; radiation; transmittance

纳米低温保护剂提高卵母细胞玻璃化保存效果的机理初探[刊,中]

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摘 要 纳米颗粒添加到低温保护剂中可能是未来低温保存的重要手段。采用添加了羟基磷灰石(HA)纳米颗粒的低温保护剂冷冻卵母细胞,使用低温显微镜观察了结晶、再结晶和融化时冰晶的形态和细胞的变化,同时记录各现象发生的温度。发现添加 0.05%HA 组在升温过程中再结晶不明显,且再结晶危险区较小,对细胞无损伤;而未添加 HA 组细胞在复温过程中受伤几率很高。结果表明纳米颗粒减少了复温过程中的再结晶可能是纳米低温保护剂提高细胞存活率的主要机理之一。

关键词 低温生物;重结晶;低温显微镜;纳米低温保护剂

Preliminary Study on the Mechanism of Promoting the Survival Rate of Vitrified Oocytes with Nano-cryoprotectants

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Abstract Adding nanoparticles into cryoprotectant may be an important means of cryopreservation in

future. The oocytes were cryopreserved using cryoprotectant containing hydroxyapatite (HA), the morphology of crystal and oocytes in the process of crystallization, recrystallization and thawing were observed using cryomicroscope system. In the mean time, the temperatures were recorded when every phase change occurred. It is found that cryoprotectant with 0.05%HA recrystallized implicitly with narrow danger zone during rewarming and hence little harm was done to oocytes. In contrast, the group without any HA nanoparticles tended to get harmed. In conclusion, the mechamism of nano-cryoprotectant promoted the survival rate of oocytes was that nanoparticles hindered the recrystallization of cryoprotectant in the process of rewarming.

Keywords cryobiology; crystallization; cryomicroscope; nano-cryoprotectan