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制冷剂分液器分配特性的实验研究 [刊, 中]

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摘 要 分液器是制冷系统中重要的辅助设备, 分液不均会引起换热器面积不能充分利用, 制冷能力下降, 蒸发器出风温度不均, 膨胀阀阀芯振动等问题, 合理选择和设计分液器对制冷系统高效运行有着重要的意义。文中介绍了压降式、离心式和贮液式三种分液器的工作原理, 并且通过实验定量地研究了质量流量 50~110 kg/h, 入口干度 0.1~0.3 工作条件下, 质量流量和入口干度对三种分液器分配特性的影响, 引入各支路间质量和干度的标准偏差 STD_m 和 STD_x 评估分液均匀性。实验结果表明, 当质量流量从 50 kg/h 增大到 110 kg/h 时, 三种分液器的 STD_m 减小, 质量流量的均匀性得到改善。其中对压降型和离心式的影响较大, STD_m 分别降低了 77%和 51%, 而对贮液型的影响较小, STD_m 降低了 21%。当入口干度增大时, 分液均匀性有所下降。

关键词 分液器; 两相流; 分配均匀性; CFD

Experimental Investigation on the Distribution Performance of Refrigerant Distributors

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Abstract Refrigeration mal-distribution in a distributor located at the inlet of a heater exchanger plays an important role in the heat exchanger performance. This paper proposes a test method to measure the mass flow rate and quality of each branch tube after distributor. Three types of distributors (pressure drop; centrifugal and reservoir) were manufactured and tested. It was found that with the increase of mass flow rate, the performance of distributor improved. The pressure drop and centrifugal type is more sensitive than reservoir one. With the increase of inlet quality, the performance of distribution deteriorates. The flow behavior of two-phase refrigerant such as phase distribution and separation phenomena was studied by CFD, which helped investigate how the geometry factors influence the distribution performance.

Keywords distributor; two-phase; distribution uniformity; CFD

船舶摇摆振动对传热和制冷系统的影响研究述评 [刊, 中]

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摘 要 渔船发动机尾气制冷系统和核动力舰船的自然冷却系统在海洋条件下的安全稳定性是关乎其应用的重要问题。研究海洋条件下的流动与换热特性对提高制冷系统的稳定性具有重要意义。文中综述了海洋条件下船舶的摇摆与晃动对储液容器、换热器的热传递以及制冷系统的影响的研究现状。大量研究表明, 海洋条件下摇摆与晃动会对流动与换热造成影响, 而传热传质的强化或削弱依具体海况(摇摆和晃荡的剧烈程度)而不同。渔船尾气吸收式制冷系统在比较恶劣的海洋条件下将受到较大的影响。通过在储液容器(如吸收器、发生器)中增加阻尼板或阻尼网, 可有效抑制储液容器内部液面波动, 提高系统运行稳定性。

关键词 船舶; 振动; 摇摆; 换热; 吸收; 储液容器

A Review of the Influence of Ship Vibration and Rolling on Heat Transfer and Flow Performance of the Refrigerating Systems Onboard

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Abstract The safety and stability of the refrigerating systems onboard have a great effect on the application of refrigerator driven by waste heat from fishing vessels and the natural cooling system used in nuclear powered vessels, which infers the importance of studying the performance of heat transfer and flow at ocean conditions. This study gives a brief review of the influence of ship vibration and rolling motions at sea on the performance of heat and mass transfer in fluid-filled tanks and refrigerating systems. Investigations on great amount researches indicate that effect of vibration and rolling motions on heat and mass transfer and flow characteristics depends on the level of vibration and rolling. The absorption refrigeration system can be easily affected at ocean conditions except during mild vibrations while researchers also found that by adding baffles or porous medium to the liquid tank can effectively improve the stability of fluid-filled tanks.

Keywords ship; vibration; rolling; heat transfer; absorption; fluid-filled tank

低含湿量冰蓄冷系统的核心过程研究 [刊, 中]

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摘 要 冰蓄冷技术是一种有潜力的节能技术, 流态冰是实现冰蓄冷的良好选择。利用低含湿量制取流态冰的冰蓄冷系统可以克服现有流态冰制取方法的缺点。系统通过溶液除湿循环降低水蒸气分压力, 水滴在此环境中持续蒸发至过冷状态, 之后使用传统过冷水法的解冷器获取流态冰。溶液除湿过程与水滴蒸发过冷过程是系统的两个重要组成部分, 经过对两个过程的实验研究, 结果验证了新系统的可行性并揭示了进一步优化的方法; 同时, 实验中得到了冰晶颗粒, 这也显示了系统的应用前景。

关键词 冰蓄冷; 流态冰; 溶液除湿; 蒸发

Research on the Key Processes of a Low Humidity Ice Storage System

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Abstract Ice storage is a promising technology for energy saving. Ice slurry is favorable material for ice storage. To overcome the shortcomings of the present method of ice slurry production, a new ice storage system is developed to produce ice slurry with low humidity. It drives a liquid desiccant cycle to obtain an environment of low water vapor

pressure. Droplets keep on evaporating in such an environment and become super-cooled. Then the super-cooled state will be released with a releaser to get ice slurry in the same way of the conventional super-cooled water method. The system mainly consists of two important processes, liquid dehumidification and evaporative super-cooling. These two processes were investigated by experiments. The results prove the feasibility of the new system and expose some method for future optimization. Meanwhile, Ice was formed in the experiments, which shows a good potential of the system.

Keywords ice storage; ice slurry; liquid dehumidification; evaporation

R245fa 传热性能实验 [刊, 中]

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摘 要 蒸发器和冷凝器的传热性能是影响制冷机组和双工质发电机组做功效率的关键因素, 为了提高中低温余热在热泵机组和地热双工质发电系统中的利用效率, 本文选用 R245fa 循环工质, 对满液式蒸发器和冷凝器进行实验研究, 分别讨论热水温度进口温度对蒸发器和冷凝器的传热系数、蒸发压力和冷凝压力的影响。研究结果表明, 在工质流量和冷却水流量保持不变的条件下, 蒸发器传热系数随着热水进口温度和温差的增大而减小, 冷凝器的传热系数随着热水进口温度的增加先增大后减小, 蒸发器传热系数可以达到 2500 W/(m²•℃); 蒸发器压力和汽轮机前后的压差随着热水出口温度的增加而增加, 热水流量对蒸发压力和冷凝压力的变化浮动较小。

关键词 R245fa; 蒸发器; 冷凝器; 传热性能; 中低温余热; 余热利用

Research on the Heat Transfer Experiment of R245fa

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Abstract The heat transfer performance of evaporator and condenser is the key factor which has an effect of the power efficiency on the refrigeration and power generation units. An experimental investigation of evaporator and condenser heat transfer with different inlet and outlet hot water temperature was conducted. The cycle working fluid was R245fa. The experiment showed that the evaporator heat transfer coefficient decreased and condenser heat transfer coefficient increased first and then decreased with increasing inlet hot water temperature. The higher heat water temperature, the higher evaporation pressure; Evaporator heat transfer coefficient can reach to 2500 W/(m²•℃).

Keywords R245fa; evaporator; condenser; heat transfer performance; mid-low temperature resource; waste heat utilization
地下水流动对地埋管热作用距离影响的研究 [刊, 中]
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摘 要 地埋管换热器周围温度场随着运行时间变长不断向远处扩散, 地下水流动使得埋管热作用距离沿流动方向大大增加。通过饱和含水层内地埋管换热模型, 得到了地下水流动作用下埋管热作用距离的近似表达式, 分析了地下水流速、土壤导热系数和孔隙率对热作用距离的影响。借助于地埋管热作用测试平台, 分析了地下水流动作用下埋管热作用距离和热恢复特性, 结果表明: 地下水流动使得埋管热作用距离远大于纯导热模式, 且热作用距离在埋管轴向不同埋深处大小不一, 建议在地下水流速大于 $1 \times 10^{-6} \text{ m/s}$ 的地质区域, 沿地下水流动方向设置埋管间距为 8~10 m。
关键词 地下水流动; 地埋管换热器; 热作用距离
Effects of Groundwater Flow on Temperature Plume Distance of Borehole Heat Exchanger Mao Jinfeng Li Yong Zhang Hua Geng Shibin Han Xu (PLA University of Science & Technology, Nanjing, 210007, China)
Abstract In the ground source heat pump (GSHP) system, the temperature around the borehole heat exchangers (BHEs) would continue to spread further with running time, in addition the groundwater flow would have an important impact on the thermal dispersion. Based on the heat transfer model considering groundwater flow in aquifers, the approximate analytical expression of temperature plume distance was obtained, the factors including groundwater flow velocity, subsurface thermal conductivity and porosity affecting on the temperature plume distance were analyzed by comparing with infinite line source (ILS) model. The results from test platform showed that the temperature plume distance under the groundwater flow velocity was greatly larger than the distance under the pure conductive model and it was different along the axial direction of BHE. In the zone with the groundwater velocity larger than $1 \times 10^{-6} \text{ m/s}$, the distance of 8-10m between the boreholes was recommended for design along the groundwater flow direction.
Keywords groundwater flow; borehole exchanger; temperature plume distance
润滑油循环率对活塞式制冷压缩机性能影响的实验研究 [刊, 中]

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摘 要 论文用实验的方法研究了润滑油循环率对活塞式制冷压缩机工作性能的影响。为了确保实验分析的准确性,测试系统采用了双油分的装置,使排气后的制冷剂和润滑油尽量完全分离,制冷剂以纯冷媒的形式再次进入压缩机的吸气。实验中采用 Sanyo 某型号压缩机进行测试,其结果表明润滑油循环率随着压缩机注油量的增加而增加,油循环率对压缩机的制冷量、功率、COP 以及排气温度均有影响,较低的油循环率使得压缩机具有较高的制冷量和 COP,同时排气温度也比较高,较高油循环率则使压缩机的制冷量和 COP 下降。因此一定要选择与压缩机相匹配的注油量,控制油循环率在一个合理的范围内,这样既能使润滑油起到有效的润滑作用,保证压缩机正常工作,又能使压缩机获得最佳的性能指标。

关键词 润滑油; 制冷压缩机; 油循环率; 性能

Experimental Study on the Effect of Oil Circulation Rate on the Performance of Reciprocating Refrigeration Compressor

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Abstract This paper studied the effect of oil circulation rate on the performance of reciprocating refrigeration compressor by means of experiments. In order to ensure the experiment accuracy, double oil separators were adopted in the testing system. In this way, the refrigerant was almost separated completely from the mixture of refrigerant and oil and entered again into the suction of the compressor. A model of Sanyo compressor was used to carry out a series of experiments. The results showed that the oil circulation rate was increased with the increase of the amount of oil injection, the oil circulation rate effected the refrigerant capacity, power, COP and discharge temperature. The performance of compressor and discharge temperature was increased with the lower oil circulation rate and vice versa. Therefore, the proper quantity of oil should be injected into the compressor, where a good lubrication condition was formed, the reliability and performance of compressor were guaranteed and a better economy can be obtained.

Keywords oil; refrigeration compressor; oil circulation rate; performance

低温保护剂热物性分析与冰晶的显微研究 [刊, 中]

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摘 要 低温保存过程中，冰晶的形成和生长是造成细胞损伤的主要因素之一。本文研究低温保护剂在降温过程中冰晶的生长规律，方法是应用低温显微镜系统，观察低温保护剂溶液的浓度及不同添加物对于冰晶生长和形状的影响，并利用差示扫描量热法(DSC)研究了溶液的熔融相变过程的变化。低温显微实验表明：低温保护剂溶液结晶形状、大小与溶液的浓度和添加溶质（糖或糖醇）有关，溶液浓度高，形成的冰晶小，对细胞损伤小，添加山梨醇的混合液冰晶形状细小，减轻了冰晶对细胞结构的物理损伤。 DSC 实验表明：在四种低温保护剂中 5 %Me2SO 与山梨醇混合液（体积比）熔融温度最低，热焓值最小，溶液形成的冰晶最少，因此对细胞的低温损伤最轻。 关键词 热物性；差示扫描量热法；低温保护剂(Me2SO)；山梨醇
Analysis of Thermal and Crystallization in Cryoprotective Agents Yang Bo Liu Baolin Shen Li Zhang Sishi （School of medical instrument and food engineering, University of Shanghai for Sci & Tech. Shanghai, 200093,China） Abstract Ice crystal formation is one of the factors that causes cell damage during crvopreservation process. Ice crystal will provide fundamental information for the development of appropriate cryopreservation protocols. Effects of concentration and properties of solutions for the growth and shape of ice crystals were studied by using a cryomicroscopy system, change on the solution of phase transition was analysis by the use of differential scanning calorimetry (DSC) instrument. The experiment of cryomicroscopy demonstrates that the shape and size of the crystal of CPA are related to the concentration of the solution and the addition of the solute, small ice crystals cause little damage to the cells with the high concentration, and reduces physical damage to the cellular structure with an appropriate ratio of sorbitol and Me2SO. Furthermore, DSC demonstrates that the mixture of 5%Me2SO and 0.4Msorbitol for cryopreservation achieved a satisfactory outcome , the temperature, the enthalpy, the crystal were even better than other three solution. Therefore the injury of cells has slightest. Keywords thermophysical property; DSC; cryoprotective agents; dimethyl-sulfoxide(Me2SO); sorbitol

几何结构对喷射器性能影响的 CFD 分析及实验研究 [刊, 中]

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摘 要 通过采用 CFD 模拟, 并结合实验, 考察了以 R236fa 为工作流体的喷射器性能。研究了喷射器结构对其性能的影响。模拟所需的喷射器几何结构简化为三维中心对称结构, 计算选用 Shear Stress Transport (SST) 模型。经研究表明: 在给定工作参数条件下, 喷嘴出口端长度 D1 以及喷射器喷嘴出口与混合段出口之间距离 D2 均存在一个最佳值, 此时喷射系数达到最大; 而喷射器性能随其扩散室出口角度 α 的增加而降低。

关键词 喷射器; 三维模型; SST 模型; R236fa

CFD Analysis and Experimental Study on the Effect of Geometries for the Performance of an Ejector

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Abstract The ejector performance is numerically and experimentally investigated using R236fa as working fluid to analyze the influence of the critical geometries of ejector. The ejector used in the simulation has simplified three-dimensional centrosymmetric structure and the Shear Stress Transport (SST) turbulence model has been used. The results show that when the operating parameters conditions are given, both of the length of nozzle outlet (D_1) and the distance of nozzle exit to mixing chamber (D_2) have an optimal value. At this point, the entrainment ratio reaches the maximum. While the angles of diffuser (α) increase, the performance of ejector decline.

Keywords ejector; three-dimensional model; SST model; R236fa y

水-乙醇混合工质振荡热管的传热特性研究 [刊, 中]

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摘 要 分别对充液率 45%、55%、62%、70%下水、乙醇两组分按体积比 13:1、2:1、1:1、1:2、1:13 混合而成的二元混合工质振荡热管的传热特性进行了实验研究,并与水和乙醇纯工质在相同充液率下的传热特性进行对比,结果表明,小充液率时,水-乙醇混合工质振荡热管烧干时热阻较纯工质小,大充液率时,水纯工质传热特性优于水-乙醇混合工质及乙醇纯工质。分析实验结果得出,水-乙醇二元混合工质振荡热管传热特性与充液率及混合工质配比有关,配比对传热特性的影响主要表现为气液平衡、物性及缔合作用。

关键词 传热传质; 振荡热管; 混合工质; 热阻

Experimental Study on Thermal Performance of Pulsating Heat Pipe with Aqueous Ethanol Fluids

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Abstract Heat transfer characteristics of Pulsating Heat Pipe (PHP) with fill ratio of 45%, 55%, 62%, 70% were researched experimentally for aqueous ethanol with volume ratio of 13:1, 2:1, 1:1, 1:2, 1:13 as working fluids. Experimental results indicated that, with lower fill ratio, the thermal resistance of aqueous ethanol PHP was better than that of water or ethanol PHP; and with higher fill ratio, the characteristics of heat transfer using water as pure working fluid were better than that of using ethanol pure working fluid or aqueous ethanol fluids. It was found out from experimental results that, the heat transfer characteristics of PHP depended on the fill ratio of working fluids and the volume ratio of the two components which related to vapor-liquid balance, physical properties and the association of molecules.

Keywords heat and mass transfer; pulsating heat pipe; mixed working fluids; thermal resistance

分流板开孔面积对微通道平行流蒸发器性能的影响 [刊, 中]

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摘 要 采用数值模拟与实验研究相结合的方法,以 R134a 为工质,研究了微通道平行流蒸发器内入口处分流板的开孔面积变化时,对蒸发器的流动和换热性能的影响。研究结果表明:随着分流板上的开孔孔径增大,蒸发器内的流动阻力会降低,制冷剂流量分配的均匀性变差,而制冷量却先增加后减小。分流板的开孔孔径存在一个最佳值,此时蒸发器内的阻力损失低,

制冷剂流量分配均匀性好，两者的匹配性最好，使得蒸发器的制冷量达到最大。此蒸发器中入口分流板的最佳开孔面积约为 150.7mm²

关键词 微通道蒸发器；分流板；开孔面积；对流换热

Effects of Open Area of Holes in Deflector on Performance of Micro-channel Evaporator with Parallel Flow

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Abstract The numerical simulation and experimental methods were used to study the efficiency of flow distribution and pressure drop of the micro-channel evaporators with parallel flow. R134a was as the working fluid. The results show that: with the same deflector structure, as the open area of holes in the deflector increased, the pressure drop of the evaporator decreased, while the flow distribution uniformity of refrigerant deteriorated, but the cooling capacity of evaporator is first increased and then decreased. There is an optimum open area of holes in deflector to the micro-channel evaporator with parallel flow, then the pressure drop and flow distribution uniformity get to the best matching, lead to the cooling capacity being the max. For the micro-channel evaporator with parallel flow type, the optimum open area of holes in the first deflector is about 150.7mm².

Keywords micro-channel evaporator; deflector; open area of holes; convective heat transfer

地铁站台活塞风附壁射流起始段的实测和实验验证 [刊，中]

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摘 要 为了从机理上探究站台活塞风分布规律，通过理论建模、现场实测和液体缩尺模型实验相结合的方法，提出并验证了站台活塞风起始段符合附壁射流理论模型。其中，对上海某地铁站台层的现场实测较好验证了站台活塞风起始段自由剪切区的理论模型，理论与实测数据的标准差在 0.326 和 0.542 之间；液体缩尺模型实验对站台活塞风起始段边界层区、势流核心区 and 自由剪切区理论模型进行了验证，三区吻合较好，标准差在 0.071 和 0.746 之间。上述研究证明了站台活塞风附壁射流理论起始段的正确性。

关键词 站台活塞风；附壁射流起始段；现场实测；液体缩尺模型实验

The Field Measurement and Experimental Verification of Subway Platform Piston Wind Attached Jet Theory

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Abstract To study the platform piston wind distribution characteristics from the mechanism, it is put forward that the characteristics of

platform piston wind conform to the attached jet theory, combining the theory modeling, field measurement and liquid scale model test. Based on the field measurement in a subway station in Shanghai, the field test data fit well with the theory calculation results in the initial segment of platform piston wind. The standard deviation between theory calculation and field measurement is between 0.326 and 0.542. The liquid scale model test is set up to verify the related mathematical model during the boundary layer district, potential flow core area and free shear zone in the initial segment. The model test results have good agreement with theory calculation with the standard deviation between 0.071 and 0.746. It is proved by above research works that the platform piston wind could be taken as the attached jet initial segment.

Keywords the platform piston wind; initial segment of the attached jet; field measurement; liquid scale model test

R134a 空气源热泵热水器实验研究与性能分析 [刊, 中]

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摘 要 对一台工质为 R134a 的空气源热泵热水器样机进行了实验测试, 研究了在环境温度为 20/15℃ 工况下, 最佳充灌量 (1500g) 的 70%, 85%, 100% 和 115% 下的系统特性, 并在最佳充灌量下研究了膨胀阀开度分别为 30%, 45%, 60% 时的系统性能。结果表明系统性能随充灌量增加呈先增大后减小趋势。膨胀阀开度对系统逐时 COP 影响较大, 在水箱温度超过 32℃ 时, 增大膨胀阀的开度可以提高系统的 COP。此外, 基于实验研究, 论文对系统 (火用) 损失进行了分析。结论表明系统主要的 (火用) 损失分布在压缩机和冷凝器。系统 (火用) 效率随着水箱温度的升高而不断减小, 在开度为 30% 和 60% 下, 系统 (火用) 效率分别下降约 8% 和 10% 左右。

关键词 空气源热泵热水器; 充灌量; 膨胀阀开度; R134a; (火用) 分析

Experimental Investigation and Performance Analysis on R134a Air Source Heat Pump Water Heater

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Abstract Experiments of an air source heat pump water heater(ASHPWH) using R134a prototype were carried out and analyzed the effects of improper refrigerant charge and incorrect TXV opening on the system. The performance of the system were measured in combinations of four refrigerant charges of 70%, 85%, 100% and 115% of the optimal value and three TXV opening of 30%, 45% and 60% of full opening at ambient temperature of 20/15℃. The results showed that the system COP was increased to a point and then tended to decrease, the expansion valve opening had a significant impact on performance, it was found that increasing the TXV opening can enhance COP when water temperature above 32℃. Based on the experimental investigations, an exergy analysis was conducted to evaluate the thermodynamic performance of the system and components in this study. It was found that exergy losing of the system was mainly occurred in the compressor and condenser. The system exergy efficiency was decreased with water temperature increased, it was decreased by 8% and 10% respectively when the expansion valve opening was 30% and 60%.

Keywords ASHPWH; refrigerant charge; TXV opening; R134a; exergy analysis

新型无接触热阻空调换热器性能研究 [刊，中]

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摘 要 将不同形状的波纹翅片与无接触热阻技术结合研制了波纹型无接触热阻换热器，并利用 CFD 仿真软件进行对比分析尖角波纹翅片和圆角波纹翅片空气侧换热性能及阻力特性，寻找较好的翅片形状。按照仿真结果生产无接触热阻尖角波纹翅片空调换热器实验样件，进行实验测试，实验结果表明：翅片表面换热系数仿真结果与实验结果较为一致，整体误差在 10% 以内，仿真结果能基本反映翅片表面的实际换热情况。引入强化传热指标，通过仿真结果计算可知，在不同风速下强化传热指标 DEC 均大于 1，说明尖角波纹翅片的传热效果优于圆角波纹翅片。

关键词 无接触热阻；波纹翅片；强化传热

Performance Research of Air-conditioning Heat Exchanger Without Heat Contact Resistance

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Abstract By combining the without heat contact resistance technology with different corrugated fins, the new kinds of fin has been developed. The surface heat transfer coefficient and friction coefficient of fins was calculated by CFD software in order to find the different between sharp corner corrugated fins and rounded corner corrugated fins. The sample of heat exchanger was made and the performance was tested in wind tunnel experimental system. Compared the simulation and experiment result, we found that they have good consistency and the errors between them are less than 10%. The simulation result can reflect the real heat transfer situation between the fins of exchanger. Evaluation of heat transfer enhancement was adopted. The result showed that the DEC always bigger than 1 in different wind speed, so the performance of sharp corner corrugated fins is better than rounded corner corrugated fins.

Keywords without heat contact resistance; corrugated fins; heat transfer enhancement

处理工艺对四种速冻蔬菜品质的影响 [刊, 中]

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摘 要 以加工后样品内维生素 C (Vc) 和可溶性固形物 (total soluble solid, TSS) 剩余含量为评价指标, 分析速冻加工过程中切分大小、漂烫和速冻速率对速冻样品蔬菜 (马铃薯、胡萝卜、西兰花和洋葱) 品质的影响。研究结果表明: 速冻速率在一定范围内对蔬菜 Vc 和 TSS 含量无明显影响; 切块较大可有效保持蔬菜中的 Vc 和 TSS; 速冻前的漂烫过程明显增大了胡萝卜和洋葱 Vc 和 TSS 的损失, 而马铃薯和西兰花则更适合于漂烫后再速冻的加工方式。

关键词 漂烫; 速冻速率; 维生素 C; 可溶性固形物

Effects of the Processing on the Quality of Four Kinds of Vegetable

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Abstract Contents of vitamin C (Vc) and total soluble solids (TSS) were determining to analyze the effect of processing like segmentation, blanching and freezing rate on the quality of four kinds of vegetable including potato, carrot, broccoli and onion. The results show that the freezing rate within a certain range shows no significant effect on Vc and TSS of these four vegetables, the larger cuts of vegetables can effectively maintain the content of Vc and TSS and the blanching before quick-freezing causes a greater loss to

Vc and TSS of carrots and onions, but it is more suitable for potato and broccoli to maintain the content of Vc and TSS.

Keywords blanching; quick-frozen rate; vitamin C; total soluble solid(TSS)

蒸发器出口过热度对汽车空调性能影响的实验研究 [刊，中]

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摘 要 蒸发器出口过热度是制冷系统运行状态的一种特殊表征，为了研究在汽车空调中，蒸发器出口过热度对于蒸发器能力和系统影响的大小，本文在标准汽车空调实验台下实验，通过一种新型电子膨胀阀对蒸发器出口过热度进行控制，研究蒸发器出口过热度对于汽车空调性能、COP 等参数的影响，研究结果表明，蒸发器能力随蒸发器出口过热度的减小而增大，在本文研究的系统中蒸发器的能力最多能被提升 19.4%，系统 COP 随蒸发器出口过热度的减小先增大后减小，存在最大值，在本文研究的系统中系统 COP 最多能被提升 17.8%。

关键词 汽车空调；过热度；能力；COP

Experimental Study on the Effect of Superheat on Performance of Automotive Air-conditioning

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Abstract Superheat of evaporator outlet is a symbol of state of air-conditioning, in order to study the effect on the performance of evaporator and system in automotive air-conditioning, a serial experiments have been done. A new kind of valve has been used to control the superheat in the standard automotive air-conditioning bench, and the effect of superheat on the performance has been study. The results show, capacity of evaporator increases with the decreasing of superheat, and it can reach 19.4% in the study's system. COP increases to a maximum value then decreases with the decreasing of superheat of evaporator outlet, and it can reach 17.8% in the studied system.

Keywords automotive air-conditioning; superheat; capacity; COP

波纹填料在蒸发式冷凝器中的流场与传热特征分析 [刊，中]

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摘 要 利用 CFD 软件对蒸发冷凝器中波纹填料间的气流速度、压力、温度以及含湿量进行了模拟计算。分析了不同填料间距、进口气流速度、喷淋水流量对空气含湿量、进出口压差、填料表面传热系数变化的影响，并将模拟结果与实验数据进行对比，两者误差在 5% 以内。结果表明：随着填料间距增大，填料出口处空气含湿量先增加后减少，进出口压差从 900Pa 降为 50Pa；当进入填料的气流速度变大时，表面传热系数随之变大，出口空气含湿量从 24 g/kg 减少到 23 g/kg；喷淋水流量增加，出口空气含湿量从 23.1 g/kg 升至 24 g/kg，表面传热系数则从 15.2 W/（m²•K）减为 14.6 W/（m²•K）。填料间距选择为 6mm，气流速度设置为 2m/s 以及喷淋水流量为 0.025kg/s 时，空气和冷却水间的热质传递效果最好且机组能耗低。

关键词 蒸发式冷凝器；传热传质；波纹填料；数值模拟

Analysis on Flow Field and Heat Transfer of Corrugated Filler Used in Evaporative Condenser

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Abstract The CFD software was applied to conduct the numerical simulation for predicting the air velocity, pressure, and temperature, humidity ratio in the corrugated filler which was used in evaporative condenser. And then studies on influencing factors of humidity ratio, pressure difference and surface heat transfer coefficient, i.e., filler space, air velocity and mass flux of cooling water were conducted. Simulation results were verified through experiments, and the error was less than 5%. The results showed that with the increasing filler space, humidity ratio of outlet air decreased after the first increase, and pressure difference decreased from 900Pa to 50Pa. Surface heat transfer coefficient increased with increasing air velocity, and humidity ratio of outlet air decreased from 24 g/kg to 23 g/kg. With the increase of mass flux of cooling water, humidity ratio of outlet air changed from 23.1 g/kg to 24 g/kg and surface heat transfer coefficient decreased 15.2 W/（m²•K）to 14.6 W/（m²•K）. It contributed to heat and mass transfer and lower energy consumption when filler space was 6mm, air velocity was 2m/s and mass flux of cooling water was 0.025kg/s.

Keywords evaporative condenser; heat and mass transfer; corrugated filler; numerical simulation

曲面通道内组合涡发生器的强化传热及结构优化研究 [刊，中]

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摘 要 对螺旋曲面通道壁面内设置三角翼和椭圆柱两种组合涡发生器进行了研究。利用计算流体软件 FLUENT 进行数值模拟，在雷诺数 Re 为 4000~7000 范围内，研究组合间距 s、三角翼攻角 α 、椭圆柱攻角 β 对换热的影响。由正交实验对涡发生器的结构进行整体优化，得出影响换热因素的主次顺序及优化组合结构，并通过实验测试比较优化结构与常规结构的综合强化换热效果。实验结果表明当 s=90mm、 $\alpha=45^\circ$ 、 $\beta=45^\circ$ 时的综合换热效果最佳，与常规结构相比，其强化换热效果提高了 18.9%~38.3%，从而验证了模型的正确性和有效性。

关键词 换热器技术；组合结构优化；正交实验；强化传热

Study on Enhanced Heat Transfer and Structural Optimization of Combination Vortex Generator in Warped Surface Channel

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Abstract The arrangement configuration of delta wing and elliptical cylinder were cautiously carried out on spiral warped channel wall layers of combination vortex generator. Based on numerical simulation FLUENT to study the influence of three parameters on heat transfer, including assembly distance s , triangle wing angle of attack α and elliptical cylinder angle of attack β which were discussed within the Reynolds number Re range from 4000 to 7000. Then using Orthogonal experiment methods to optimize the vortex generator structure entirely, obtaining the order of priority and optimum composition structure on heat transfer. Comparing with experimental test, the intensified heat transfer effect was reinforced by optimizing structure and normal structure of composite. The results show that $\alpha=45^\circ, \beta=45^\circ, s=90\text{mm}$ can have the comprehensive effect on heat exchanger optimum. what's more, the intensified heat transfer is higher 18.9%~38.3% than ordinary .Therefore, the accuracy and validity had been confirmed definitely.

Keywords heat transfer technology; optimum combination structure; orthogonal test ; enhanced heat transfer

HFO-1234ze 在空气源热泵热水器中替代 R417A、R22 的研究 [刊, 中]

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摘 要 首先从热物性、ODP、GWP、工质毒性、可燃性方面对 HFO-1234ze、R417A、R22 三种制冷剂进行对比, 并进行理论计算, 初步分析 HFO-1234ze 制冷剂运用在空气源热泵热水器上的可行性。然后, 在焓差法实验室内, 对分别采用 HFO-1234ze, R417A 和 R22 作为制冷工质的空气源热泵热水器进行名义工况下的性能测试, 对三种制冷剂的吸排气温度, 吸排气压力, 压缩机输入功率、制热量、性能系数进行对比分析。本文研究结果显示 HFO-1234ze 可以作为 R417a 与 R22 在热泵热水器中的替代制冷剂。 此次研究为热泵热水器的工质选择提供参考。

关键词 空气源热泵热水器; HFO-1234ze; 工质替代; 性能优化

Research on HFO-1234ze Replacing R417A and R22 Used in HPWH

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Abstract HFO-1234ze, R22 and R417A were compared with each other from aspect of thermal properties, ODP, GWP, toxicity, flammability and so on. Theoretical feasibility of HFO-1234ze used in heat pump water heater was analyzed through theoretical calculation. A experiment is carried out on the air resource heat pump water heater using HFO-1234ze, R22, and R417a under standard

conditions. Suction and discharge pressure, suction and discharge temperature, compressor input power, thermal heating capacity, and coefficient of performance had been analyzed. The result shows that HFO-1234ze has well applicability using in heat pump water heater. This research provides the references for the refrigerant selection of the heat pump water heater.

Keywords air source heat pump water heater, HFO-1234ze, alternative refrigerant, performance optimization

真空冷却过程中气泡生长对水的失重率的影响 [刊, 中]

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摘 要 为了找到一种非接触式的降低真空冷却失重率的方法, 本文首先借助高速相机研究了圆管内水的失重机理。然后, 在此基础上研究了不同降压方案对不同管径(直径分别为 27 mm, 22 mm 和 12 mm)内水的失重率的影响。结果发现: 1)水的失重主要是汽弹对液态水的弹射作用引起; 2)在闪点附近适当地降低真空泵抽速可以显著地降低失重率(降幅可达到 72%); 3)在闪点附近降低抽速时, 圆管的直径越小, 水的失重越大。

关键词 真空冷却; 失水率; 抽速; 管径

Effect of Bubble Development on the Weight Loss Rate of Water during the Vacuum Cooling Process

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Abstract To find a non-contact method that can reduce the weight loss of food during the vacuum cooling process, the mechanism of the water losing in tuber was studied firstly with the help of a high speed camera. Then, the effect of different depressurization schemes on the water loss in different tubers (with diameters of 27 mm, 22 mm and 12 mm respectively) was studied based on the above conclusion. The results show that: 1) most of the lost water is launched out by the taylor bubble in the tube; 2) slowing the vacuum speed suitably while the total pressure is close to the flash point can reduce the weight loss significantly (the decreasing ratio was 72%); 3) using the tube with a smaller diameter can caused a higher weight loss when the pressure is close to the flash.

Keywords vacuum cooling; weight loss; pump speed; tube diameter

R417A 在水平双侧强化管外沸腾换热研究 [刊, 中]

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摘 要 对 3 根双侧强化管在饱和温度为 8 ℃工况下进行了水平管外 R417A 沸腾换热特性研究。采用 Wilson 热阻分离法得到管外沸腾表面传热系数, 并对实验结果进行了热阻分析。实验结果表明: 管内轧制出 0.32~0.34 mm 的螺旋槽道, 可以使管

内对流传热系数提高到光管 Gnielinski 公式计算值的 2.524~2.658 倍。相同管型的强化换热表面，其沸腾传热系数随壁面温差变化的趋势相似，肋密度 42fpi 的 E30 管沸腾传热系数比 50fpi 的 E32 管大 4.5%，表明沸腾传热系数的大小及变化趋势与肋密度（孔隙直径）及管型密切相关。双侧强化管外 R417A 沸腾换热，管外热阻约占总热阻的 70%，管外仍需进一步强化，才能明显提高总体传热性能。R417A 在强化管外沸腾传热系数仅为近似条件下其主要组分 R134a 的三分之一，表明混合工质沸腾换热与纯工质有较大差异。

关键词 双侧强化管；R417A；沸腾换热

Study of Boiling Heat Transfer of R417A on Horizontal Doubly-enhanced Tubes

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Abstract Experimental studies of boiling heat transfer of R417A on three single horizontal doubly-enhanced tubes have been conducted at the saturation temperature of 8 °C. A modified Wilson plot technique was used to obtain the boiling heat transfer coefficients, and the thermal resistance analysis was conducted. The results indicate that the intube heat transfer coefficients of the three enhanced tubes are within 2.524-2.658 times as those of smooth tube, which were rolled 0.32-0.34 mm high spiral channel. For the same type of enhanced heat transfer surface, the trends of boiling heat transfer coefficient with the wall temperature difference are similar. Boiling heat transfer coefficients of tube E30 (42 fin per inch) are 4.5 percent higher than those of tube E32(50 fpi) at the same temperature difference. It is indicated that the boiling heat transfer coefficient and its trend were closely related with fin density (pore diameter) and tube type. Boiling heat transfer of R417A on doubly- enhanced tubes, the outer thermal resistance was about 70% of the total thermal resistance, further enhancement was useful for improving the overall heat transfer performance. Boiling heat transfer coefficient of R417A is only one third of R134a at approximate conditions, R134a is the main component of R417A, indicating that the boiling heat transfer of mixed refrigerants are quite different with pure refrigerants.

Keywords doubly-enhanced tubes; refrigerant 417A; boiling heat transfer