

主办单位: 中国制冷学会
国际刊号: ISSN0253-4339
发行单位: 中国制冷学会秘书处
境内定价: 人民币 15 元

主管单位: 中国科学技术协会
国内刊号: CN11-2182/TB
出版单位: 《制冷学报》杂志社有限公司
境外定价: 美元 10 元

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大压差下静止氨水表面吸收特性研究 [刊, 中]

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摘 要 基于对大压差下静止氨水溶液表面吸收氨蒸气过程中热质传递现象的分析, 建立了该吸收过程传热传质相互耦合的数学物理模型。在氨蒸气压力不变的情况下, 推导出氨水溶液温度场、浓度场以及表征相界面传质的无量纲准则数的理论表达式, 结果证明: 相界面处氨浓度、温度均为定值, 该值只取决于吸收的初始条件。在引入氨水相平衡方程的前提下, 拟合出了传质准则数与初始压差、氨水溶液初始参数的半经验关联式, 获得了一定初始条件下时均传质量随时间的变化曲线。曲线显示: 在吸收开始时, 时均传质量最大, 随着吸收时间的增加, 时均传质量迅速下降。

关键词 氨水吸收; 传热传质; 数学模型; 传质关联式

Characteristic Research of Ammonia Vapor Absorption into the Surface of Stagnant Ammonia-water

Under Big Pressure Difference

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Abstract In this paper, heat and mass transfer during the process of ammonia vapor absorbed into the surface of stagnant ammonia-water solution under the condition of large pressure difference was studied. Physical and mathematical models of the absorption process with coupled heat and mass transfer were established. The temperature field, concentration field and the dimensionless number which represents the mass transfer at the interface were developed with constant ammonia vapor pressure. The results indicate that the concentration and temperature at the interface are fixed values which only depend on the initial conditions. By introducing the ammonia-water gas-liquid phase equilibrium equation, the semi-empirical correlation containing criterion number, initial pressure differential and initial parameters of ammonia-water solution was developed. The variation curve between time-averaged mass transfer and the absorption time was obtained. The curve shows that the time-averaged mass transfer is the largest at the beginning of the absorption and drops rapidly as the absorption time increasing.

Keywords ammonia-water absorption; heat and mass transfer; mathematical model; mass transfer correlation

基于运行策略的某复合式地源热泵系统运行优化分析 [刊, 中]

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摘 要 以华东地区的某大型客站复合式地源热泵系统为研究对象, 通过对系统的连续实地测试, 在其供冷季节的实测数据基础上, 分析系统运行策略对地源热泵地埋管换热性能和机组性能的影响, 提出其运行策略的优化途径, 并以系统仿真软件 TRNSYS 为平台, 搭建系统仿真模型, 通过模拟系统多年运行, 分析三种运行策略的可行性, 认为夜间间歇的地源热泵机组优先制冷的运行方式, 有利于系统的多年稳定运行, 是较优的运行策略。

关键词 复合式地源热泵系统; 运行策略; 地埋管换热特性; 运行数据; 系统模拟仿真

An Optimization of Operation Strategy on Hybrid Ground Source Heat Pump System

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Abstract Based on the measured data in the cooling season, this research analyzes the impact of the operation strategy of HGSHP (Hybrid Ground Source Heat Pump) system on the performance of heat pump unit and ground heat exchanger. The objective building is a large railway station in East China. And some possible ways of operation strategy to optimize the performance is proposed, then heat transfer characteristics of ground heat exchanger in 10 years under three operation strategies is compared through a system simulation on TRNSYS. It's concluded that the operation strategy that GSHP is at high priority with nocturnal intermittent for cooling is beneficial to a stable operation of HGSHP system.

Keywords hybrid ground source heat pump system;operation strategy;heat transfer characteristics of ground heat exchanger; measured data; system simulation

自复叠制冷系统中套管式冷凝器的应用研究 [刊, 中]

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摘 要 自复叠制冷系统广泛应用于小型制冷装置, 制取-40℃~-150℃之间的低温环境。套管式冷凝器在自复叠制冷系统中常用作冷凝设备, 其特性与结构深刻地影响着制冷装置系统。自动复叠制冷系统用套管式冷凝器为研究对象, 研究其冷凝过程特性和结构尺寸; 在冷凝压力 2.0 MPa, 当 R600a 和 R23 混合工质的质量分数为 7:3 时, 计算其冷凝负荷为 1610W; 根据混合工质和冷却水的换热系数, 确定套管式冷凝器长度为 4.842m。最后对不同冷凝水流量的吸气温度、排气温度、蒸发温度, 以及冷却水进出口温度进行了对比分析。

关键词 自动复叠制冷; 混合工质; 冷凝器设计; 套管式冷凝器

Study on Application of Double-pipe Condenser for Auto-cascade Refrigeration

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Abstract Auto-cascade refrigeration system is widely used to obtain low temperature environment between -40 ℃ ~ -150 ℃. Double-pipe condenser is commonly regarded for condensing equipment in auto-cascade refrigeration system, its characteristics and structure affects refrigeration equipment system deeply. An auto-cascade refrigeration system with double-pipe condenser as the research object, the condensing process characteristics and structure dimension were studied. At the condensing pressure of 2.0 MPa, the condensing load was 1610W when the mass fraction ratio of R600a and R23 was 7:3. The structure size of double-pipe condenser was 4.842m based on the heat transfer coefficient of mixed refrigerant and cooling water. At the end of the paper the suction temperature, exhaust temperature, evaporation temperature in different condensing water flow, and inlet and outlet temperature of cooling water were analyzed.

Keywords auto-cascade refrigeration; mixed refrigerant; condenser design; double-pipe condenser

制冷用水平降膜式蒸发器研究进展 [刊，中]

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摘 要 降膜式蒸发器目前已经在牛奶、制药、化工、海水淡化等行业取得了较为广泛的商业应用。它从 1990 年以后开始应用于制冷空调系统，目前针对制冷用水平降膜式蒸发器的研究目的主要是明确各个参数对蒸发器传热性能的影响以及他们之间的联系，由于降膜式蒸发器的独特结构和内部传热传质的复杂性，这些研究尚处于初步阶段。在表述其工作原理的基础上，针对水平降膜式蒸发器，着重讨论了布液器的结构与高度、管束（包括管径、管排数、管道表面形状）、制冷剂（流态、流量）等参数对其性能的影响。由于经验关联式在实际应用中的巨大优势，还总结了前人研究的关联式及其适用的范围，文章将为制冷用降膜式蒸发器的进一步研究和应用提供参考。

关键词 降膜式蒸发器；水平管；综述；传热

Research Progress of Horizontal Falling Film Evaporator in Refrigeration System

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Abstract The widely applications have been achieved for falling film evaporators in the fields of pharmaceutical, chemical, ocean desalinization industries. However, the employment in the refrigeration and air condition was just after 1990. As so far, the researches for falling film evaporator were mainly focused on figuring out the influence of the parameters, as well as the coupling among them. Nevertheless, due to the special configuration and complexity of heat and mass transfer in the falling film evaporator, the researches were still on the preliminary level. On the basis of the illustration of the operation mechanism, this paper discussed about the influence of configuration and height of the liquid feeder, evaporation tube (including radius, the bundles, enhanced surface), working fluid (flow pattern, flow rate) on the performance of the horizontal falling film evaporator. Consideration the great advantages of the empirical correlation in the practices, the heat transfer correlations and applied ranges were also presented. This paper can be a reference of future researches.

Keywords falling film evaporator; horizontal tube; review; heat transfer

一种全管束配水的蒸发式冷凝器及其风阻实验研究 [刊，中]

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摘 要 全管束配水方式的特点是对每根工艺管单独配水。实验研究了喷淋水量和迎面风速对全管束配水蒸发式冷凝器管外流动阻力的影响，并与常规集中配水方式进行了对比。实验是在喷淋量为 0.5~1.2 m³/h，迎面风速为 0.5~4.0 m/s 下进行。结果表明，在顺流及逆流状态下，喷淋量为 1.2 m³/h 时，全管束配水蒸发式冷凝器管外空气流动阻力比集中配水蒸发式冷凝器，平均减少 11.5% 及 49.7%。当逆流流动时，全管束配水空气流动阻力突增点的迎面风速为 3.5 m/s，高于集中配水蒸发式冷凝器。全管束配水蒸发式冷凝器与常规蒸发式冷凝器相比，应用于制冷系统中可节能 2% 左右。

关键词 蒸发式冷凝器；配水方式；管外流动阻力；实验研究

Experimental Study on Air Flow Resistance of an Evaporative Condenser with Water Distributed on Every Tube

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Abstract There are a lot of advantages when water is distributed on every tube respectively. The influences of the spray water flow rate and the air velocity on the air flow resistance of evaporative condenser with water distributed among the whole tube bundle structure were investigated, and conventional spraying water structure was also adopted to be compared. The experiment was carried out on the condition that the water flow rate was 0.5~1.2 m³/h and the air velocity was 0.5~4.0 m/s. The results show that the air flow resistance of this new structure decreases 11.5% at parallel-flow mode and 49.7% at counter-flow mode respectively. In addition, at counter-flow mode, the air flow resistance increases suddenly when the air velocity is 3.5m/s, which is higher than that of traditional evaporative condenser. Energy-save is about 2%, comparing with the conventional spray water structure when used in refrigeration system.

Keywords evaporative condenser; water distributed type; flow resistance; experimental investigation

受限空间中翅片管换热器的性能分析 [刊，中]

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摘 要 受限空间翅片管换热器，是指由于总体框架尺寸的限制，部分结构参数被限定的换热器。为研究此类翅片管换热器的在换热传质时的不同特性，基于空调箱中的有限空间结构模型，建立适用于此类换热器计

算的集总参数模型。利用二分迭代法求解的结果表明模型可高效精准地计算出翅片管换热器沿气流方向的排数，并且当任意工况参数或者结构参数发生变化时，此模型也可分析预测翅片管换热器的性能变化规律。利用实验数据对模型计算结果进行了对比验证：模型计算所得的各性能参数值与实验值吻合良好，其平均相对误差均小于 2%，最大相对误差均小于 8%。通过焓差实验台测定和分析翅片管换热器的制冷量和压降随工况参数和结构参数的变化规律，不仅优化换热器的设计，并为换热器运行调节方法的选取提供依据。

关键词 受限空间；翅片管换热器；设计模型；性能分析

Performance Analysis on the Fin-tube Heat Exchanger in Limited Space

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Abstract Because of restrictions on the size of the overall framework, heat exchangers with limited structure are called limited heat exchangers. Based on the limited model in air-handling unit, a lumped parameter model was established to study different performance of fin-tube heat exchangers. The dichotomy iteration was employed to solve the model. The results show that the model will not only design and calculate the number of tube rows along the airflow direction, but also analyze and predict the performance of fin-tube heat exchangers with variable condition and structure. The calculated results of the model were verified by the experimental data: the mean relative deviations are lower than 2% and the maximal relative deviations are lower than 8%. Experiments of enthalpy difference were conducted to analyze the heat transfer and friction characteristics of fin-tube heat exchangers with variable parameters, which optimize the design of the heat exchanger and provide the basis for the selection of heat exchanger operation method.

Keywords limited space; fin-tube heat exchangers; design model; performance analysis

纳米溴化锂溶液稳定性及其沸腾温度研究 [刊，中]

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摘 要 对既有溴化锂溶液、纳米微粒及其相应分散剂配制的纳米溶液，对比测试其与纯溴化锂溶液的表面张力和沸腾温度，探讨了该纳米溶液的热物性及其稳定性。实验发现，添加纳米微粒溶液的表面张力明显降

低，经过温度工艺处理后，发现溶液中纳米微粒的颗粒度降低，纳米微粒在溴化锂溶液中几乎完全溶解，纳米溶液显现出很好的稳定性，其表面张力和沸腾温度均比纯溴化锂溶液有所降低。研究表明，最佳组份配制的纳米溶液与纳米微粒和相关分散剂有关，经过严格温度处理工艺流程，可获得稳定性、热物性良好的纳米溴化锂溶液，有利于在工程中应用。

关键词 纳米溴化锂溶液；对比分析法；稳定性；沸腾温度

Study on Stability and Boiling Temperature of Nano-LiBr Aqueous Solution

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Abstract Based on nano-fluid made of lithium bromide(LiBr) aqueous solution, nano-particles and its relevant dispersants, the stability and thermal-physics properties of the nano-fluid were researched through a contrastive experimental method that surface tension and boiling temperature of nano-fluid and pure LiBr aqueous solution were tested respectively. It was discovered experimentally that the surface tension of solution added nano-particles reduces significantly and granularity of the nano-fluid decreases obviously through temperature processing. The nano-particles almost completely dissolves into LiBr aqueous solution, simultaneity the solution shows better stability and both its surface tension and boiling temperature both have a decrease compared with pure LiBr aqueous solution. The study shows that best composition nano-fluids is related to the types and contents of nano-particles and relevant dispersants. Through strict temperature processing, the nano-fluid has a better engineering application than the pure LiBr solution as its good stability and better thermal-physics properties.

Keywords nano-LiBr aqueous solution; comparative analysis approach; stability; boiling temperature

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摘 要 利用变频滚动转子式压缩机实验台, 研究了压缩机吸气带液对系统性能和排气温度的影响, 以寻求降低压缩机排气温度有效、安全的方法。结果表明了在大部分空调工况和运转频率下, 当吸气干度约为 0.95~0.98 时, 系统制冷量和 COP 达到最大值, 且压缩机的排气温度显著降低至吸气压力对应的饱和等熵压缩排气温度。考虑到运行的安全性, 吸气干度合适的范围为 0.95~0.98。

关键词 排气温度; 吸气干度; 滚动转子式压缩机; 实验研究

Experimental Study on Suction Refrigerant State and Discharge Temperature for Rolling Piston Compressor

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Abstract Influence of suction refrigerant state on system performance and discharge temperature was carried out through a variable speed rolling piston compressor test stand. Results show that under the most air-conditioning conditions and the most operating frequencies, when suction vapor quality is about 0.95~0.98, system capacity and COP will reach peak value, and discharge temperature will be effectively decreased to the corresponding theoretical discharge temperature of isentropic compression process. Considering running safety, the appropriate suction vapor quality should be among 0.95~0.98.

Keywords discharge temperature; suction vapor quality; rolling piston compressor; experimental study

电动汽车空调热泵型涡旋压缩机结构分析 [刊, 中]

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摘 要 为了解决电动汽车空调系统冬季采暖问题,并针对冬季空调工况下压缩机单级压比增大的运行特性,以涡旋压缩机的制热性能系数为热力学优化目标函数,确定了制冷剂循环系统中的最佳补气压力,优化了涡旋压缩机静涡旋盘上的中间补气口的几何位置和形状,使其具备了准双级压缩功能。将研发的热泵型电动涡旋压缩机安装于电动汽车空调系统,利用空气焓差法对系统进行了制热、制冷性能实验。实验结果表明,静涡旋盘结构优化后的热泵型电动涡旋压缩机,其制热和制冷能力可以满足 5 人座电动汽车司乘人员的冬季和夏季舒适性要求,并且具有较高的制热和制冷性能系数,从而提升了汽车空调系统热泵循环和制冷循环的热经济性,达到了节能的目的。

关键词 电动汽车空调; 涡旋压缩机; 热泵; 优化; 性能实验

Structural Analysis of Heat Pump Scroll Compressor for Electric Automobile Air-conditioning

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Abstract The presser ratio of compressor operating in winter is much greater than that in summer, which makes the heating by electric vehicle air conditioning system in winter a problem. In order to solve it, the coefficient of heating performance was taken as the thermodynamic optimization objective function of scroll compressor. The optical middle pressure of compensation refrigerant in the scroll compressor orifice accordingly. The geometric position and shape of compensation refrigerant orifice have been built, which makes the system working in a quasi two-stage compression. Based on the method of air enthalpy difference, the heating and refrigerating performance of heat pump type scroll compressor which was installed on the electric vehicle air conditioning system, had been conducted in refrigeration laboratory. After optimizing the structure of static scroll plate, the experimental results show that the capability of heating and cooling for the heat pump type electric scroll compressor could be met the comfort requirements of 5 seat electric vehicle in summer and winter, and the performance coefficients of heating and cooling have been improved accordingly.

Keywords electric automobile air-conditioning; scroll compressor; heat pump; optimization; performance experiment

反循环除霜对热泵用螺杆制冷压缩机性能影响的实验研究 [刊, 中]

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摘 要 双螺杆制冷压缩机由于其独特的优势已广泛应用于热泵产品中。针对风冷热泵用双螺杆制冷压缩机在反循环除霜过程中的性能特性进行了实验研究, 研究结果表明: 在进行反循环除霜时对压缩机的冲击比较大, 压缩机排气压力急剧下降到 0.65MPa 才逐渐上升, 而吸气压力先直线上升, 接着快速下降, 甚至到 0.1MPa, 然后才逐步上升, 并和排气压力一样出现了较为强烈的波动; 压缩机功率出现了类似排气压力的变化趋势; 吸、排气温度的变化则缓和许多, 排气温度先是由 90℃ 下降到 75℃, 然后逐渐上高, 最高至 100℃ 左右, 然后下降并逐渐趋于稳定, 而吸气温度先升高并保持一段时间, 然后逐渐下降; 系统制热量逐渐下降, 随后向循环水提供冷量, 随着制冷工况的进行, 供冷量先增加后逐渐降低并趋于稳定。对反循环除霜对制冷压缩机影响的研究为提高风冷热泵中压缩机的可靠性提供了实验依据。

关键词 反循环除霜; 风冷热泵; 螺杆制冷压缩机; 实验研究

Experimental Study on Effect of Reverse Cycle Defrost on the Performance of Screw Refrigeration Compressor

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Abstract Twin-screw refrigeration compressor has been widely applied because of its unique advantage in air-source heat pump. In this paper, the performance variation of the twin-screw refrigeration compressor during the reverse cycle defrost process has been studied by experiment. The results showed that the twin-screw refrigeration compressor would receive a marked impact because of the reverse cycle defrost behavior of the system. The discharge pressure of compressor would drop sharply to 0.65MPa and then rise gradually during the first half of reverse cycle defrost process, but the suction pressure would rise perpendicularly and then decrease rapidly, even to 0.1MPa, after that it would go up gradually in this period of time. In the second half of reverse cycle defrost process, the discharge pressure and the suction pressure would have a strong oscillation and then tend to steady. During the reverse cycle defrost process, the variation of the discharge temperature and the suction temperature would be slow and lag behind the changing of pressure. The discharge temperature would drop firstly from 90℃ to 75℃, and then up to 100℃, finally, decrease and tend to steady. However, the suction temperature would rise and keep the

high temperature for some time, and drop finally. The consumption power of compressor would have the similar experience as the discharge pressure. The heat capacity of this system would decrease and offer cooling capacity to environment. At that time, the frost on the fins would be melted.

Keywords reverse cycle defrost; air-source heat pump; twin-screw refrigeration compressor; experimental study

汽车空调旋叶式压缩机排气阀片的振动分析及优化 [刊, 中]

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摘 要 通过对旋叶式汽车空调压缩机排气阀片的运动分析,建立了阀片振动数学模型,分析了其固有频率和各点的振动位移,并结合 UG NX Nastran 模态计算结果,确定了排气阀片的固有频率和振型。基于振动分析的优化设计表明,阀片厚度选取为 0.305mm 时,压缩机制冷效率达到了最高点。而测试结果证明,压缩机的噪声和排气脉动也得到了最有效的控制,两者均都低于美国通用汽车公司“GMW 标准”的规定上限,表明排气阀片的振动分析与优化设计是合理的。研究结果对控制排气阀片振动,提高压缩机的制冷效率以及降低压缩机排气脉动和噪声等具有重要的实际意义。

关键词 汽车空调; 旋叶式压缩机; 排气阀片; 优化设计; 模态分析

Vibration Analysis and Optimization Design of Vane Compressor Discharge Valve for Car Air Conditioner

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Abstract By analyzing the motion of vane compressors for car air conditioner we proposed a mathematical model for the vibration of the discharge valve and determined its natural frequencies and mode shape in combination with the calculation using UG NX Nastran software. We show that the refrigeration efficiency can be maxima when the valve sheet takes the optimized thickness of 0.305 mm based on the vibration analysis. At the same time, test results revealed that the discharge flow pulsation and system noise are effectively controlled, and the both are lower than the upper limit of the "GMW Standard" of the U.S. General Motors Corporation. The study may be significant to enhance the refrigeration efficiency of the system and reduce discharge flow pulsation and noise of vane compressors.

Keywords automotive air conditioner; vane compressor; discharge valve; optimization design; modal

analysis
金属基复合吸附剂的吸湿性能测试 [刊，中]
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摘 要 金属基复合吸附剂是将复合吸附剂涂覆于铝箔表面制成。选用不同粒径的硅胶作为基质制作样片，发现在实验条件下，大粒径的硅胶有利于提高铝箔表面的吸附剂涂覆量。采用优选粒径的硅胶制作样片，并对比复合吸附剂样片和单一硅胶样片的吸湿性能。在材料初始完全干燥，且吸湿条件恒定的情况下，卤素盐复合吸附剂吸湿速率更快，且最大吸湿量比硅胶高 30%~45%，其中氯化锂复合吸附剂吸湿速率和最大吸湿量高于氯化钙复合吸附剂；在材料初始未进行干燥处理，且在吸湿，放湿工况周期性切换的情况下，复合吸附剂循环吸湿量比硅胶高出 70%~120%，且高相对湿度的吸湿条件下，氯化钙循环吸湿量比氯化锂复合吸附剂高。 关键词 除湿材料；金属基复合吸附剂；对比实验；动态吸湿性能
Hygroscopic Property of Metal Matrix Composite Desiccant Hu Leiming Ge Tianshu Jiang Yu Wang Ruzhu (Institute of Refrigeration and Cryogenics Engineering, Shanghai Jiao Tong University, Shanghai, 200240, China) Abstract The metal based composite adsorbent is made of composite adsorbent which is coated on the surface of the aluminum foil. Silica gel with different particle size is used as the matrix for production of samples. It is found that, in experimental conditions, large particle size contributes to the improvement of the coating amount on the surface of the aluminum foil. The silica gel of preferred particle size is adopted to make samples, and a comparison study of composite adsorbent and single silica gel samples is made. When the samples are completely dried and the environment condition is kept constant, compared with silica gel, the maximum moisture uptake of composite adsorbent is 30%-45% higher, within which the adsorption rate and maximum moisture uptake of lithium chloride composite adsorbent is higher than calcium chloride composite adsorbent. When the samples are not completely dried and the environment is periodically changes from adsorption condition to desorption condition, the cycle adsorption amount of composite adsorbent is 70%-120% higher than silica gel, and in high relative humidity conditions, calcium chloride composite adsorbent is higher than lithium chloride composite adsorbent. Keywords dehumidification materials; metal based composite adsorbent ; comparison experiment; adsorption property

近共沸制冷剂 R290/R134a PVTx 性质的实验研究 [刊, 中]	
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摘 要 为了获得混合制冷剂 R134a/R290 的热物性数据, 搭建了高精度 PVTx 实验系统。以 Burnett 法为基础, 测定了 R134a/R290 质量分数为 50%/50%、55%/45% 和 60%/40% 在温度为 252K-320K 的 PVT 性质, 并且拟合了三种不同配比的混合工质的气态维里方程。实验数据与方程的平均误差为 1% 左右, 具有较好的重合度。 关键词 R134a/R290; PVTx; 维里方程	
The Experimental Study of PVTx Properties of Near Aetropic Mixture Refrigerant R290 /R134a Yang Xi Qi Yingxia Chen Wei Zhang Hua (University of Shanghai for Science and Technology , Shanghai, 200093,China) Abstract In order to get the thermophysical properties of mixed refrigerants R134a/R290, the author built PVTx experimental system with high accuracy. Based on the Burnett method, the author measured the PVT properties of R134a/R290 with mass fraction 50%/50%, 55%/45%, 60%/40% in the range of 252K-320K, and fitted the gas virial equation of these mixed refrigerants. The average error between experimental data and equation is about 1%.It turned out that the experimental data agreed with the equations. Keywords R134a/R290; PVTx; virial equation	
冷冻脱硅氧烷系统非稳态缓冲期对比实验研究 [刊, 中]	
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摘 要 冷冻脱硅氧烷系统从开机到进入稳定运行状态存在一个较长的非稳态缓冲时间段, 这个过程降低了系统的脱硅氧烷处理效率和系统稳定性。这篇论文通过两组对比实验, 拟合出在缓冲时间段内两组蒸发器进、出口温度随时间变化的函数, 探讨了预冷器蒸发器之间的耦合关系和自身热惰性的影响因素, 以及这两个问题对非稳态缓冲期的影响结果。 关键词 冷冻脱硅氧烷系统; 非稳态; 实验研究; 耦合; 热惰性	
Contrast Experiment Study on Cryogenic Siloxane Removal System Characteristics of Unsteady	

Buffering Time

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Abstract Cryogenic siloxane removal system need a long unsteady buffering time from starting up state to stable operation state, this situation greatly reduced efficiency and stability of Cryogenic siloxane removal system. Two function was get by the two groups of contrast test; the functions are about evaporator temperature variation with time, and just can be used in unsteady buffering time . It is concluded that main reasons lead to a long unsteady buffering time were thermal inertia of precooler and evaporator and the coupling relationship of them.

Keywords siloxane removal system;unsteady state;experimental research; coupling;thermal inertia

一种新型热湿独立控制系统冬季工况下的实验研究 [刊，中]

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摘 要 热湿独立控制系统对显热和潜热负荷分开独立处理和控制，通常比传统热泵空调系统高效节能。在冬季工况下对一种新型的湿负荷处理系统(DESICA)以及其与 VRV 组合构成的热湿独立控制系统进行了实验测试，并将实验结果与传统全热交换器(HRV)和 VRV 构成的复合系统进行比较研究。研究表明：与传统 HRV&VRV 复合系统相比，DESICA&VRV 复合系统能提供更舒适的室内环境(室温 21℃左右，相对湿度 50%左右)；同时，DESICA&VRV 系统的能耗降低 9%。

关键词 热湿独立控制；舒适度；节能；实验研究；冬季工况

Performance Analysis of a Novel Temperature and Humidity Independent Control System under Winter Conditions

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Abstract Temperature and humidity independent control systems handle sensible load and latent load separately. They are usually more efficient and consume less energy than traditional air conditioning systems. In this paper, a novel humidity control system (DESICA), and the temperature and humidity independent control system constituted of DESICA and VRV (variable refrigerant volume air conditioning system), are studied through field experiment under winter conditions. Comparisons have been made to

common adopted joint heat recovery ventilator (HRV) and VRV system. The results show that DESICA&VRV system provides more indoor thermal comfort (21℃, 50%) and consumes 9% less energy than HRV&VRV system.

Keywords temperature and humidity independent control; thermal comfort; energy saving; field experiment; winter conditions

多级热电制冷器的数值模拟与实验研究 [刊，中]

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摘 要 对多级热电制冷器进行了理论分析。在三种不同工况下，运用 ANSYS 模拟四种不同类型热电制冷器的制冷温度，并搭建实验台进行了实验研究。模拟结果表明，热电制冷器热电对之间的距离对其制冷温度有影响，设计热电制冷器时，应对热电对距离进行优化设计。实验结果表明，实验用热电制冷器最佳工作电压为 12V，热电制冷器制冷温度受外界环境影响非常大，选择合适的绝热材料对制冷器制冷温度有重要影响。实验结果还表明，热电制冷器输入电流和功率随热端温度升高而减小，制冷温度和最大制冷温差随热端温度升高而增大。

关键词 多级热电制冷器；ANSYS 模拟；实验研究

Theoretical Simulation and Experimental Research on Multistage Thermoelectric Cooler

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Abstract Theoretical analysis of multistage thermoelectric cooler was done in this paper. The cooling temperatures of four different multistage thermoelectric coolers were obtained in three different conditions by ANSYS simulation software. A test bench was conducted to verify the simulation. The simulation results showed that the cooling temperature of thermoelectric cooler was influenced by the distance of the thermoelectric couple, and the distance of thermoelectric couple should be considered in designing the cooler. The test results showed that the optimal operating voltage of the thermoelectric cooler was equal to 12V. The refrigeration temperature was extremely influenced by the external environment. The insulation material had an important impact on the performance of multistage thermoelectric cooler. The test results also showed that the input current and power would decrease with the hot end temperature increasing; The largest temperature difference and cooling temperature would

increase with the hot end temperature increasing.

Keywords multistage thermoelectric cooler; ANSYS simulation; experimental research

真空冷冻干燥过程参数对酸化纸质文献冻干过程的影响 [刊, 中]

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摘 要 以酸化纸质文献为对象, 研究了真空冷冻干燥过程参数(加热板温度、纸质文献厚度、干燥室压强)对其冻干时间和品质的影响, 并采用 L9(33)正交实验得出各过程参数影响的主次顺序和除水比例。结果表明: 各过程参数的不同处理水平对纸质文献冻干时间和品质均有显著的影响, 且各过程参数影响主次顺序均为: 纸质文献厚度、加热板温度、真空室压强。本实验三因素取值范围内的冻干过程优化参数分别为: 纸质文献厚度 7mm, 加热板温度 25℃, 真空室压力 10~20Pa。

关键词 冷冻干燥; 脱酸保护; 纸质文献; 过程参数

Effect of Vacuum Freeze-drying Process Parameters on Acid Paper Literatures Ouyang Xinping

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Abstract Acid paper documents are selected as the research subject, and the influence of procedure parameters (heating temperature, paper document thickness, pressure in drying room) on freeze-drying time and quality were explored, and obtained the sequence of importance and dehydration rate by orthogonal method. The results indicate that the different treatment levels of procedure parameters had remarkable influence on both vacuum freeze-drying time and the quality, and the importance sequence of the three factors both as follows: paper documents thickness, heating temperature, and pressure in drying chamber. The optimal parameters were a thickness of 7mm, heating temperature of 25℃ and pressure of 10~20Pa by optimization analysis.

Keywords vacuum freeze-drying; deacidification protection; paper documents; procedure parameters

平衡环境型房间量热计凝结水量测量设计 [刊, 中]

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摘 要 量热计法室内侧制冷量计算公式, 未考虑测量中小冷量空调器制冷量时空气处理柜除湿造成的误差。为排除此误差对测试结果的影响, 采用称重法分别测量量热计内、外室加湿水及被测机的凝结水。利用基于称重法设计的量热计测得

5 台被测机的 2 组数据并进行分析,结果表明,当空调器的额定制冷量低于测试室输入功率时,空气处理柜的除湿量会增大测量偏差,且随着空调器制冷量的降低偏差增大。并对室内侧制冷量计算公式进行修正,以提高计算精确度。

关键词 房间型量热计; 称重法; 凝结水测量; 实验验证

The Design of Condensate Measurement for Balanced Ambient Room-type Calorimeter

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Abstract During the cooling capacity measurement of small and medium size air conditioner, the indoor cooling capacity calculation formula of room-type calorimeter didn't take the dehumidification of air handling cabinet into consideration. In order to eliminate the impact of this influence on the test results, the mass weighing method was proposed to measure the humidification water of inner and outer chamber of the calorimeter, as well as the condensate water of air conditioner under test respectively. By analyzing the two sets of test results of five test units which were tested by means of room-type calorimeter based on the mass weighing method: It turns out that, when the rated cooling capacity of the air conditioner under test is smaller than the input power of the test chamber, the test error is increased by the air handling cabinet's dehumidification amount, and the test error arises with the decrease of cooling capacity of air conditioner. The indoor cooling capacity calculation formula is modified to improve its accuracy according to the test results.

Keywords room-type calorimeter; weighing method; condensate measurement; validation

减湿预冷器对冷藏陈列柜风幕送回风状态的影响分析 [刊, 中]

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摘 要 以双风幕立式敞开式冷藏陈列柜为研究对象,研究减湿预冷器对冷藏陈列柜风幕送回风状态的影响。实验结果表明:在测试环境温度为 25℃,相对湿度为 60%条件下,冷藏陈列柜使用减湿预冷器后风幕送风温度没有明显变化,回风温度降低 5℃;内层风幕的送风相对湿度和回风相对湿度变化不大,外层风幕的送风相对湿度由 69%下降至 60%;外层风幕的送风焓值基本保持不变,而回风焓值降低 21.4%。回风温度和回风焓值的降低都可以有效降低陈列柜负荷。

关键词 食品冷藏技术; 陈列柜; 空气预冷器; 风幕

Effect of Pre-cooler on Supply and Return Air of Air Curtain in Display Cabinet

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Zhengzhou, 450002, China)

Abstract This study focused on a vertical open-type display cabinet with double air curtain, and investigated the effect of pre-cooler on supply and return air of air curtain in display cabinet. The experimental investigation was undertaken in the test room with temperature of 25℃ and relative humidity of 60% to characterize the effect of pre-cooler on supply and return air of air curtain in display cabinet. The results showed that: the temperature of the supply air was not obviously elevated, and the return air temperature was reduced by 5℃; the inner supply air and the return air relative humidity of air curtain changed little, the outer supply air relative humidity dropped from 69% to 60%; and the enthalpy of outer supply air kept a fixed value, and the enthalpy of the return air decreased by 21.4%. The decreases of return air temperature and enthalpy could lead to significant decrease in the display cabinet load.

Keywords food storage technology; display cabinet; pre-cooler; air curtain

辐射吊顶单元供冷量的理论计算模型及实验验证 [刊, 中]

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摘 要 根据辐射吊顶单元与周围环境的换热原理, 在对毛细管结构合理简化的基础上, 建立了毛细管型辐射吊顶单元供冷量的理论计算模型, 同时建立了两块辐射吊顶串联时的供冷量计算模型。搭建了实验台, 测试在室温 25℃, 供水温度 15~19℃时, 单块辐射吊顶单元以及两块辐射吊顶单元串联时的供冷量。测试数据与计算结果对比表明: 单块辐射吊顶单元以及两块串联时的理论计算供冷量吻合较好, 验证了理论计算模型的正确性。该计算模型可用来预测特定工况下辐射吊顶单元的供冷量。

关键词 辐射吊顶单元 ; 实验测试; 供冷量; 理论计算模型

Theoretical Calculation Model and Experimental Validation of the Radiant Ceiling Unit Cooling Capacity

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Abstract According to the heat transfer between radiant ceiling unit and surrounding environment, based on the reasonable simplification of configuration of radiant ceilings, set up theoretical calculation models of single piece of the capillary cooling radiant ceiling unit and two units in series combination to

calculate their cooling capacities. Then tests their cooling capacities under the condition of 25℃ room temperature, 15~19℃ supply water temperature. The comparison between measured data and calculation results show that theoretically calculated cooling capacity of single unit and of two series-connected units approach the experimental testing data, which shows that the theoretical calculation models are reasonable and feasible and can be used to predict the cooling capacities under real conditions.

Keywords radiant ceiling unit; experimental test; cooling capacity; theoretical calculation model