Membrane Heat Pump Technology

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- An innovative cooling technology is in development to meet increased demand for chemical–refrigerant–free cooling device that resolves increased energy consumption issue for air conditioning. For this, eco–friendly dehumidification module design technology is developed to make a device using membrane that is operated under a vacuum condition.
- Technology to make high–temperature and humidity air to low–temperature and humidity air using membrane module

Client / Market

- Building air conditioning (cooling) device and system business

Necessity of this Technology

- Technology that dramatically improves the efficiency of existing air–conditioning equipment is needed
- An innovative HVAC technology was demanded to resolve increased energy consumption for air conditioning following enhanced quality of life.
- A new concept of HVAC technology was needed to surpass the existing vapor compression cycle.
- Other than the vapor compression type cooling cycle that is considered an energy overconsuming device, the membrane heat pump technology for HVAC system operated with a vacuum pump without a compressor is required.

Technical Differentiation

- Double the energy efficiency potential and eco–friendlessness compared to existing vapor compression HVAC
- Removes latent heat load in the air using the membrane and then performs cooling to improve the efficiency significantly

Energy Efficiency Ratio	Existing Vapor Compression Type HVAC	Membrane Heat Pump
Functional aspect	– Average EER of 12 to 13 (COP 3.5 to 4)	– Average EER of 20 to 24 (COP 6 to 7) (twice the vapor compression type)
Applied field	– Need condensate discharge function – Health issue from condensate	– Can be used as dehumidification facility
Control	– Cannot control cooling/dehumidification independently	– Independent control of temperature/humidity – Efficient handling of partial load
Refrigerant	– HCFC/HFC refrigerant (high GWP) – High pressure system – leakage issue	– Working fluid: Water (no environmental impact) – Low pressures system – Pipe cost reduced

DESIRED PARTNERSHIP

Technology Transfer | Licensing | Joint Research | Other

TECHNOLOGY READINESS LEVEL [TRL]

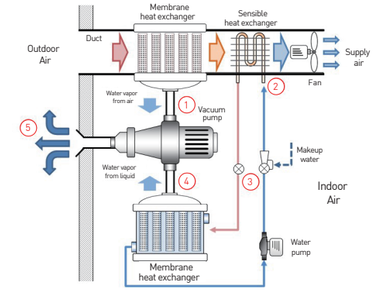
Research, basic explanation | Project concept or idea development | Technology idea verification | Prototype development | Trial product production/ evaluation in similar environment | Pilot field demonstration | Development and optimization of commercial model | Commercial product demonstration | Mass production and initial market launch

- Working fluid is simply "Water (H_2O)" that has no impact on the environment.
- By removing latent heat load in the air, efficiency is improved by approximately twice compared to existing vapor compression type.
- With the dehumidification part and the cooling part, temperature and humidity can be controlled separately, and performance is excellent under the partial load condition.

Excellence of Technology

- Acceptable reliability for dehumidification module and cooling module
- Secured mechanical/chemical performance properties for long hours in vacuum condition
- Confirmed similar/superior performance in the standard cooling condition compared to existing vapor compression cycle
  * System COP at KS C 9306 condition: Exceeds 4.5
  ※ (Reference) COP of vapor compression air conditioner: Below 3.5

Lab Scale Membrane Heat Pump System Diagram



Current Intellectual Property Right Status

PATENT

- Membrane Dehumidification Module and Dehumidification Apparatus Using the Module (KR2018–0001093)
- Indirect Evaporation Cooling Apparatus (KR2017–0162828)
- Membrane Dehumidification Module and Heat Pump Using the Module (KR2016–0166637)

KNOW–HOW

- Membrane dehumidification module analysis/design technology
- Membrane cooling module analysis/design technology
- Membrane heat pump cycle analysis/design technology