

Cooling tower water recovery and reuse technology



Technologies for water recovery and reuse of cooling tower



Patent title Cooling tower cooling water recovery facility
Patent application No. KR 10-2018-0130335(2018.10.30) / 10-2096279(2020.03.27)

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Authority status Registered

Patent title White lead reduction cooling tower using separation membrane, heat exchange system having cooling tower, and method for operating same
Patent application No. KR 10-2016-0133382(2016.10.14) / 10-1878562(2018.07.09)

Inventor Korea Institute of Energy Research / Lee Hyung-geun, Choi Won-kil, Jeon Jedeok, Park Jongsoo
Authority status Registered

Technicality

Technology overview

A heat exchange facility technology in which heat is absorbed from a cooling device necessary for stable operations of heat generating devices in industrial fields and buildings and maintenance of basic performance of air conditioning facilities and the heat is finally released to the atmosphere. Heat exchange and water recovery are performed by designing a moisture separation module according to the cooling tower operation requirements. The recovered moisture is coated so that only moisture can selectively permeate through a composite separation membrane, and thus it is possible to reduce dehumidification and white lead.

Development background and problem to be solved

- White lead generated from cooling towers is not harmful to the environment, but is the subject of complaints due to indirect damage such as reduced sunlight in the surrounding area and freezing on the ground. Thus, a technology related to a plume reduction cooling tower for reducing white lead is being actively developed.
- Considering the characteristics of moisture discharged from a cooling tower, collection is performed through a drying tower, and only moisture is selectively separated to fundamentally prevent the generation of white lead. The collected moisture can be recycled as cooling tower supplement water or the like.

Excellence and discrimination of technology

Excellence of technology

- The technology is an energy-saving system which is environmentally-friendly and causes low installation and maintenance costs.
- 15% water reduction and outdoor 0°C white lead reduction are simultaneously achieved through the development of multi-phase flow CFD technologies in cooling towers and dehumidification/regeneration technologies.
- A water collection composite separation membrane has the world's highest water permeability performance (0.48 kg/m²·h) and has excellent domestic and international competitiveness.
- A moisture loss in cooling towers is reduced by 20% or more compared to existing ones to reduce power plant operating costs and solve water shortage problems and white lead problems.
- By dramatically reducing white lead, visual anxiety factors of cooling tower white lead are eliminated and civil complaints are resolved.

Discrimination of technology

- A multi-phase flow CFD technology required for designing a water collection and reuse cooling tower is developed.
- A 20-30% high airflow fan/channel technology compared to existing ones is developed by applying a biomimetic fan blade design technique.
- By coating a functional material on the surface of a water collection separation membrane, only moisture can be selectively permeated.
- Since there is no temperature change when humidity is reduced, energy of 56% can be saved compared to existing dehumidifiers.

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Implementation method

According to the present invention,

- A dehumidification/regeneration module technology supplies and evaporates external air to high-temperature cooling water, and stores and discharges condensed moisture through indirect heat exchange between humidified air and external air.
- At this time, only moisture can be discharged through a collection pipe by selectively absorbing and separating moisture by a drying tower for lowering the humidity of a fluid and a composite separation membrane installed to allow the fluid to pass between an inlet and an outlet for the fluid.

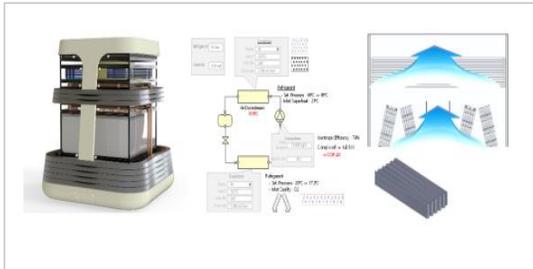


Figure 1 Application example of a dehumidification/regeneration module technology in a cooling tower

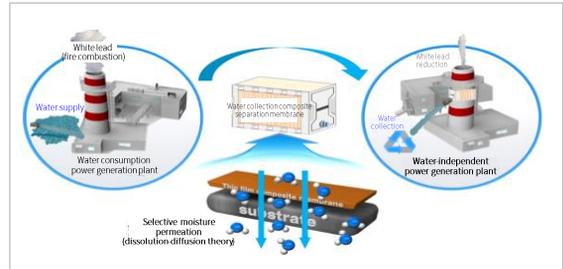


Figure 2 Water collection composite separation membrane using selective moisture permeation principles

Degree of technology completion (TRL)

Degree of technology completion: TRL6 (Full Scale prototype development stage)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

Utilization

Utilization field and applied product

Utilization field

- Cooling tower
- Indoor dehumidification facility
- Dehumidification and air conditioning



Figure 1 Cooling tower water collection facility

Applied product

- Cooling tower water collection and white lead reduction device
- Separation membrane dehumidification system
- Household dehumidifier



Figure 2 Separation membrane dehumidification system and home dehumidifier

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Technology trend

- A cooling technology of a next-generation cooling tower is closely related to the efficiency of a process. It is necessary to establish and practice energy policies centered on energy efficiency improvement and continuous research with economic feasibility while simultaneously solving energy and environmental problems, thereby securing a high-performance cooling tower without performance degradation, a white lead reduction function cooling tower, a corrosion-resistant cooling tower, and the like.
- As technologies related to cooling towers, the importance of high-efficiency and greenhouse gas reduction is highlighted with technologies such as the development of a shape structure without clogging of fillers, the prevention of recirculation performance degradation, a serial/parallel heating coil method, and heat pumps. In particular, a heat pump market is rapidly growing.
- Kyung-in Machinery, Kiturami Bumyang Air Conditioning, Seongji Air Conditioning Technology, etc. are concentrating on revitalizing the market to solve the problem of white lead. In particular, Kyung-in Machinery developed the "GX counterflow cooling tower", a new concept complex white lead reduction device for heating after dehydration, focusing on a washing machine process. In addition, providing an optimal design method after thoroughly examining the overall system facilities and operation methods of a cooling tower seems to be the most effective way to revitalize the market.

Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	KR 10-2017-00139972 (2017.10.26) / 10-1958702 (2019.03.11)	Method for coating hollow fiber membrane using interfacial polymerization
KOR	KR 10-2019-0046852 (2019.04.22) / 10-2144742 (2020.08.10)	Cooling tower using heat pump

Market prospect

Target market size and prospect

The size of the global cooling tower market was USD 3.2 billion and 80.9 million (about KRW 3.7 trillion) as of 2016, and has recorded a significant growth as the volume of heavy industries expanded. In particular, the market occupies the largest proportion in the field of thermal power generation. In the market, the European cooling tower market grew by 16% in 2018 to EUR 130 million, and mostly open cooling towers are the most popular, accounting for 2/3 of the European cooling tower market including Germany, Italy, France, UK, and Poland.

With rapid industrialization and rising demands for electricity, the demands for cooling towers are expected to increase with the growth of a number of heavy industries including refineries, chemicals, and pulp paper. In addition, the global energy management system market is expected to reach USD 31.9 billion in 2020 from USD 17.2 billion in 2016, and the domestic market is expected to reach about KRW 1 trillion in 2020.

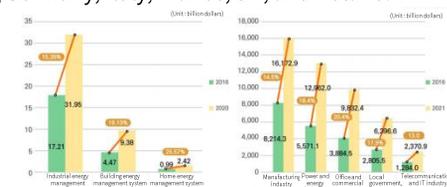


Figure Market size of the global energy management system market

<Data: The 4th Energy Technology Development Plan Innovation Roadmap_Industrial Efficiency>

Technology transfer query

Technology transfer process



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