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Professor Youngjune Park's research team has developed a new way to turn seawater into fresh water using ice that doesn't melt at room temperature

- GIST (President Seung Hyeon Moon) Professor Youngjune Park's research team from the School of Earth Sciences and Environmental Engineering has developed a new way to effectively remove dissolved substances containing salts from seawater by using carbon dioxide, the main culprit of global warming, to form a gas hydrate in a form of ice that does not melt at room temperature.
- During the formation of salts such as sodium chloride (NaCl), gas hydrates * are excluded from the crystal structure. This process can be used for the desalination of seawater because only pure water and carbon dioxide remain after dissolving solid gas hydrates.

* gas hydrate: solid hydrate formed by water molecules at low temperature and high pressure

- However, the low-temperature and high-pressure conditions required for the formation of gas hydrates have hindered practical application due to the significant amount of energy required. Generally, the gas hydrate formation promoter used to improve this is capable of forming

a gas hydrate at a relatively low temperature and atmospheric pressure. However, because it is highly soluble in water, it is necessary to separate the promoter to obtain pure water. This increases the processing costs.

- The research team compared and analyzed the spectroscopy, thermodynamics, and reaction velocity characteristics of the gas hydrate in reacting to carbon dioxide by using hydrocarbons with very low solubility in water.
- The results have confirmed that cyclopentanone **, a type of cyclical ketone *, shows twice as fast deterministic and high gas hydrate conversion rates, respectively, when compared to cyclopentane ***, a widely known formative facilitator.

* cyclic ketones: cyclic organic compounds containing carbon of the carbonyl group (s) in the ring

** cyclopentanone: cyclic ketone consisting of 5 carbon atoms and 8 hydrogen atoms

*** cyclopentane: cyclic hydrocarbons consisting of 5 carbon atoms and 10 hydrogen atoms

- For the first time, this phenomenon caused by the nucleotide addition reaction of cyclophosphate has been identified as a very unique form of hydration by the ketone functional group as a guest molecule * during gas hydrate formation.

* guest molecules: substances of low molecular weight (eg, carbon dioxide, cyclopentanone, etc.) that are occupied in the lattice space of water molecules formed by gas hydrates

- If the promoter agent proposed in this study is added, it is expected that gas hydrates can be formed reliably under high temperature conditions and that a large amount of gas hydrate can be formed over time, thereby overcoming much of the technical shortcomings of the existing gas hydrate-based desalination process.

- Professor Youngjune Park said, "The environmental importance of the gas hydrate desalination technology is increasing as it can address the global issue of water shortage and handle carbon dioxide, a major

contributor to global warming. Future research is expected to provide a hybrid high-efficiency seawater desalination technology combined with existing technologies."

- The research was led by Professor Youngjune Park with Sujin Hong, Seokyeon Moon, Yunseok Lee, and Seungin Lee with support from the Basic Science Research Program through the National Research Foundation of Korea and was published in the prominent *Chemical Engineering Journal* on January 22, 2019.

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