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P03

中空糸膜コンタクターによるイオン溶液の二酸化炭素吸収特性

Carbon Dioxide Absorption Characteristics of Ionic Liquids by Hollow Fiber Membrane Contactor

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1. Introduction

A human produces carbon dioxide (CO_2) of about 1 kg/day[1]. In a closed environment such as spacecraft, space station, if carbon dioxide (CO_2) is not removed, elevated CO_2 concentration will affect crew performance and cause crew physiological issues. In the International Space Station (ISS), the main CO_2 removal systems are Carbon Dioxide Removal Assembly (CDRA) in US module and Vozdukh in Russian module. CDRA can reduce the partial pressure of CO_2 ($ppCO_2$) to about 4 mmHg[2]. However, this condition will affect crew health. If we can reduce below 2 mmHg $ppCO_2$, the risk of headache might be under 1 %[3].

Using ionic liquids for CO_2 removal would be promising to maintaining lower CO_2 concentration. However, ionic liquids cannot be used in microgravity as same manner on the ground. So, we employ fiber membrane contactors with the ionic liquid. In this paper, we examined the experimental equipment and conditions to clarify the adsorption characteristics of CO_2. In order to consider carbon dioxide removal systems using ionic liquid, we first need to understand the characteristics of carbon dioxide absorption and **desorption**.

2. Selection ionic liquid

Ionic liquids consist of cations and anions and are form of salt that hardly changed within a wide range of temperature and pressure. The way to strip CO_2 from the Ionic liquids is through a temperature or pressure swing cycle. This way is expected to maintain the same efficiency. The most remarkable characteristic of Ionic liquids is their regenerability without degradation.

The Ionic liquids selected for this research is 1-Ethyl-3-methylimidazolium Acetate(hereinafter, this is called [emim] [ac]) for CO_2 absorbent. This Ionic liquid is one of the Imidazolium-based Ionic liquids. These liquids have some of the advantage features for CO_2 absorption which has solubility of water and air, and high

selectivity for CO_2. In other words, Imidazolium-based Ionic liquids can be removed without significant atmospheric change, so it is expected to be use in spacecrafts.

[emim] [ac] is not the best Ionic liquids for CO_2 absorption, but [emim] [ac] using at research level has some advantages. [emim][ac] was sometimes chosen for CO_2 absorption research, so we can compare with them and use as reference.

3. Experimental equipment

Carbon dioxide removal system has two processes which is CO_2 absorption to [emim][ac] and desorption from [emim][ac]. In microgravity, it is difficult to separate gas from liquid. As this system will be use in space, membranes are used to separate liquids and gases in two processes. Also, the larger the contact area get, the greater the efficiency is. Therefore, in this study, we will clarify the possibility of increasing efficiency by using hollow-fiber membranes and increasing the contact area.

3.1. CO2 absorption

Figure 1 shows a conceptual diagram for the carbon dioxide absorption experiment. The orange and green lines represent air flow, and the black line represents Ionic liquids. Ionic liquids circulate through the hollow fiber membrane and piping. On the other hand, air comes from a gas cylinder and released into the room through a hollow fiber contactor. The air that passed from gas cylinder to the hollow fiber contactor is the gas before CO2 was removed. The air from the hollow fiber contactor to the room is after CO2 removed. The temperature of the incubator during the experiment is low.

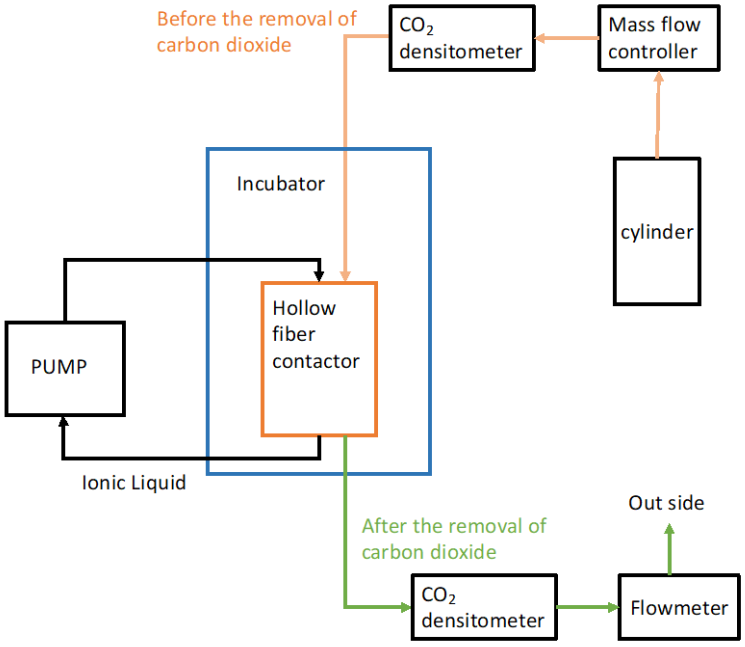

Figure 1. Conceptual diagram of experimental equipment for carbon dioxide absorption

3.2. **CO2 desorption**

Figure 2 shows a conceptual diagram for the carbon dioxide desorption experiment. The orange and green lines represent air flow, and the black line represents Ionic liquids. Ionic liquids circulate through the hollow fiber membrane and piping. On the other hand, Carbon dioxide is released to the outside by thermal vacuuming through hollow fiber membranes. The temperature of the incubator is high during the experiment.

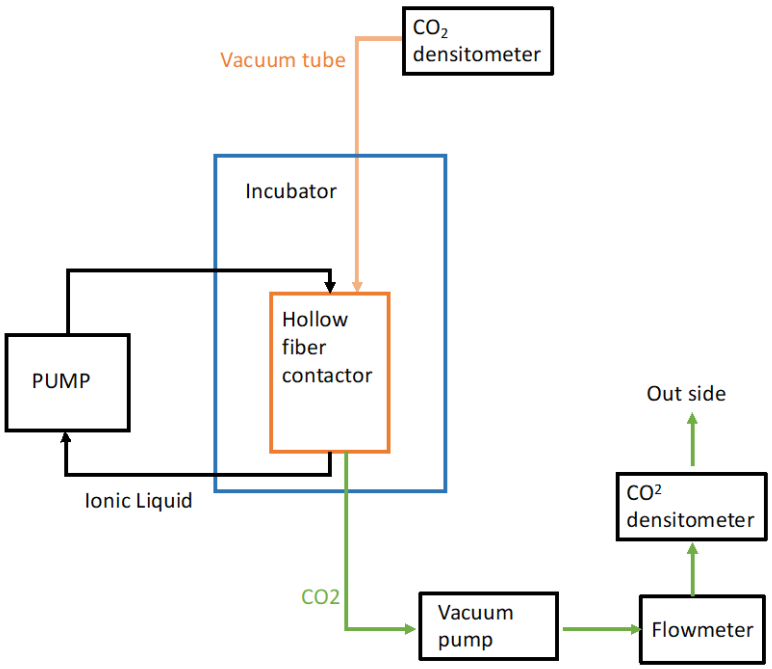

Figure 2. Conceptual diagram of experimental equipment for carbon dioxide desorption

4. Experiment plan

The experiment will be conducted using the equipment described in section 3. There are many parameters that can be changed, such as ionic solution flow rate, air flow rate, and temperature of the contactor. One of the values that may affect the efficiency is the flow velocity of the ionic liquid, and set it as a parameter. **Table 1** shows the experimental conditions.

Table 1. Experimental conditions

Number	Velocity of ionic liquid[mL/min]	Velocity of air (contain CO_2)[mL/min]	Incubator temperature(high temperature&low temperature)[℃]
1	30	2000	80&20
2	10	2000	80&20

References

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