

論文 / 著書情報  
Article / Book Information

|                   |                                                                                                                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 題目(和文)            | 空気除湿野膜の開発です                                                                                                                                                                                    |
| Title(English)    | Development of Membranes for the Air Dehumidification Applications                                                                                                                             |
| 著者(和文)            | KUDASHEVA Alina                                                                                                                                                                                |
| Author(English)   | Alina Kudasheva                                                                                                                                                                                |
| 出典(和文)            | 学位:博士(工学),<br>学位授与機関:東京工業大学,<br>報告番号:甲第10624号,<br>授与年月日:2017年9月20日,<br>学位の種別:課程博士,<br>審査員:伊東 章,久保内 昌敏,多湖 輝興,谷口 泉,下山 裕介                                                                         |
| Citation(English) | Degree:Doctor (Engineering),<br>Conferring organization: Tokyo Institute of Technology,<br>Report number:甲第10624号,<br>Conferred date:2017/9/20,<br>Degree Type:Course doctor,<br>Examiner:,,,, |
| 学位種別(和文)          | 博士論文                                                                                                                                                                                           |
| Category(English) | Doctoral Thesis                                                                                                                                                                                |
| 種別(和文)            | 論文要旨                                                                                                                                                                                           |
| Type(English)     | Summary                                                                                                                                                                                        |

## 論文要旨

### THESIS SUMMARY

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|--------------------------|----------------------|----|--------------------------------------------|--------------------------------|
| 専攻 :<br>Department of    | Chemical engineering | 専攻 | 申請学位 (専攻分野) :<br>Academic Degree Requested | 博士<br>Doctor of (Engineering ) |
| 学生氏名 :<br>Student's Name | Kudasheva Alina      |    | 指導教員 (主) :<br>Academic Advisor(main)       | Ito Akira                      |
|                          |                      |    | 指導教員 (副) :<br>Academic Advisor(sub)        |                                |

### 要旨 (英文 800 語程度)

Thesis Summary (approx.800 English Words )

This thesis is divided into 7 chapters. In chapter 1 the fundamentals of the air dehumidification process were introduced along with the motivation and objectives of this research.

In chapter 2, the membrane module developed for the air dehumidification on the lab scale is represented in conjunction with the requirements for the membrane materials. Membrane performance evaluation methods, including equations, are presented and also experimental part, such as membrane preparation, dehumidification test, water adsorption and membrane viscosity measurements, is described.

In chapter 3, application and efficiency of the biopolymers composite membranes for the air dehumidification are presented. In particular, five types of bio-materials (polysaccharides and protein) were used as a membrane base material and then 30wt% of hygroscopic salt was added in the membrane solution to improve the water sorption properties of the membrane. In this study, it was confirmed that for most of the biopolymers, addition of hygroscopic salt improved the water adsorption and therefore led to an enhanced water recovery performance. In addition, another type of the hygroscopic additive from the class of Metal Organic Frameworks was used for the composite membrane preparation. It was found that overall membrane efficiency of such composite is better as compared to that of the composite, containing hygroscopic salt.

In chapter 4, application of aqueous salt solution liquid membranes and the liquid membrane stability over time is presented along with the discussion of various nanoparticle materials tested as a liquid membrane's supporting additive. In addition, analysis of the water recovered from the air via dehumidification process was performed in order to trace presence of the membrane supporting material nanoparticles and the presence of salt. This analysis demonstrated that water recovered from the air is not contaminated with the membrane materials confirming the membrane stability and environmental friendliness of the process.

In chapter 5, four types of the ionic liquids were applied for the dehumidification membranes. The impact of the cation and anion type on the water sorption and ability of membrane to extract water from the air was investigated. Study on the solubility and diffusivity of water vapor was performed and the experimentally obtained water and air permeabilities through the liquid membrane were compared to that predicted by Solution-Diffusion model. In addition, amines were mixed with the ionic liquid in preparation of liquid membrane and the effect of amine presence on the membrane efficiency was discussed.

In chapter 6, the effect of the experimental operating conditions on the air dehumidification performance is demonstrated. In particular, the impact of the different flow rates of sweep air, the operating temperature and the variation in permeate side pressure are studied in details, as well as the effect of the membrane thickness. Finally, the best operating conditions for the developed membrane dehumidification system were obtained promising an increase in dehumidification performance by 2-3 times in high air humidity range.

In final chapter 7, summary of all the experimental data and investigation of the effect of boundary layer, that is formed at the membrane surface, are presented and compared to that of membrane dehydration efficiency data available in literature. Also research conclusions are delivered along with the proposal of the future directions for the improvement of the air dehumidification efficiency by hygroscopic membranes.

備考 : 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。

Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1 copy of 800 Words (English).

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