



(11)

EP 4 825 998 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
21.10.2026 Bulletin 2026/43

(51) International Patent Classification (IPC):
C22B 3/24 (2006.01) **C22B 26/12** (2006.01)
C22B 3/06 (2006.01)

(21) Application number: **24904411.6**

(52) Cooperative Patent Classification (CPC):
C22B 3/06; C22B 3/24; C22B 26/12

(22) Date of filing: **12.12.2024**

(86) International application number:
PCT/KR2024/096865

(87) International publication number:
WO 2025/127846 (19.06.2025 Gazette 2025/25)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

- **KIM, Juyoung**
Pohang-si, Gyeongsangbuk-do 37859 (KR)
- **PARK, Woonkyoung**
Pohang-si, Gyeongsangbuk-do 37859 (KR)
- **YANG, Heok**
Pohang-si, Gyeongsangbuk-do 37859 (KR)
- **JUNG, Myungwon**
Pohang-si, Gyeongsangbuk-do 37859 (KR)
- **KIM, Ryutae**
Pohang-si, Gyeongsangbuk-do 37859 (KR)

(30) Priority: **14.12.2023 KR 20230182332**

(71) Applicant: **POSCO Holdings Inc.**
Pohang-si, Gyeongsangbuk-do 37859 (KR)

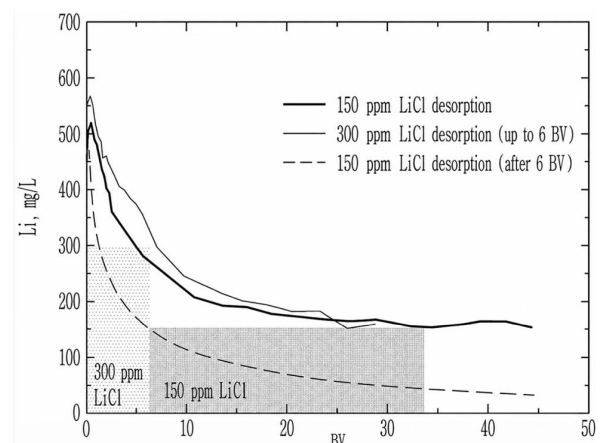
(74) Representative: **Pfenning, Meinig & Partner mbB**
Patent- und Rechtsanwälte
Theresienhöhe 11a
80339 München (DE)

(72) Inventors:
• **HEO, Jungho**
Pohang-si, Gyeongsangbuk-do 37859 (KR)

(54) **METHOD FOR ADSORBING/DESORBING LITHIUM**

(57) The present invention relates to a method for adsorbing and desorbing lithium, and may provide a method for adsorbing and desorbing lithium, comprising: an adsorption step of passing a lithium-containing solution through an aluminum-based adsorbent to obtain an adsorbent onto which lithium has been adsorbed; and a desorption step of passing a medium through the adsorbent onto which lithium has been adsorbed to obtain a lithium-containing desorption solution, wherein the medium used in the desorption step includes a salt.

【Fig. 1】



EP 4 825 998 A1

Description

[TECHNICAL FIELD]

[0001] The present invention relates to a method for adsorbing and desorbing lithium.

[BACKGROUND ART]

[0002] Recently, with the rapid growth of related markets such as electric vehicles, demand for lithium secondary batteries has been rapidly increasing. Accordingly, demand for lithium hydroxide, which is one of lithium raw materials that are key raw materials of lithium secondary batteries, has also been rapidly increasing.

[0003] Such lithium hydroxide is produced by using lithium carbonate produced in limited regions such as Chile or Argentina, chemically converting the lithium carbonate with calcium hydroxide or the like, and then producing lithium hydroxide therefrom, and it is known that lithium hydroxide cannot be directly produced from raw materials.

[0004] Accordingly, there is an urgent need to develop a technology capable of economically and efficiently preparing lithium hydroxide from a lithium-containing solution.

[0005] As one of such methods, selective adsorption and desorption technology of lithium using an adsorbent has been studied.

[DETAILED DESCRIPTION OF THE INVENTION]

[Technical Problem]

[0006] In a technology for recovering lithium through adsorption and desorption of lithium using an adsorbent, an object of the present invention is to provide a process capable of effectively recovering lithium by providing a more effective desorption technology.

[Technical Solution]

[0007] Hereinafter, various embodiments of the present invention will be described in detail with reference to the accompanying drawings so that a person having ordinary skill in the art to which the present invention pertains can easily practice the present invention. The present invention may be embodied in various different forms and is not limited to the embodiments described herein.

[0008] In order to clearly describe the present invention, parts not related to the description are omitted, and the same reference numerals will be used for the same or similar components throughout the specification.

[0009] In addition, throughout the specification, when a part is referred to as "comprising" a certain component, this means that the part may further comprise other components, rather than excluding other components, unless specifically stated to the contrary.

[0010] Hereinafter, a method for adsorbing and desorbing lithium according to embodiments of the present invention will be described in detail with reference to the drawings.

[0011] First, a step of adsorbing lithium from a lithium-containing solution is performed.

[0012] Specifically, the lithium-containing solution is passed through an aluminum-based adsorbent to adsorb lithium onto the aluminum-based adsorbent.

[0013] In this case, the lithium concentration of the lithium-containing solution may be in a range of 0.04 g/L to 2.0 g/L, and more specifically 0.1 g/L to 1.0 g/L. When the lithium concentration of the lithium-containing solution is less than 0.1 g/L, an adsorption rate may be slow, thereby reducing productivity. In addition, when the lithium concentration of the lithium-containing solution exceeds 2.0 g/L, productivity increases, but the amount of adsorbent consumed increases, thereby relatively reducing economic efficiency. Accordingly, it is preferable that the lithium concentration included in the lithium-containing solution satisfy the above range.

[0014] The aluminum-based adsorbent is used to adsorb lithium dissolved in the lithium-containing solution, and may include, for example, aluminum hydroxide. When the aluminum-based adsorbent including aluminum hydroxide is used as in the present embodiment, there are advantages in that the amount of lithium dissolved in the lithium-containing solution that is adsorbed is high, aluminum loss is hardly caused in a desorption process to be described below, the lifespan of the adsorbent is long, and economic efficiency of the lithium extraction process is excellent.

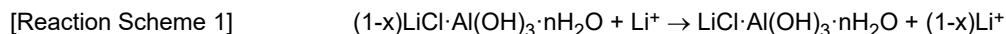
[0015] In addition, the aluminum-based adsorbent may be a molded body including adsorbent powder and a binder.

[0016] The adsorbent powder may be, for example, adsorbent powder including aluminum hydroxide. Advantages of using adsorbent powder including aluminum hydroxide are the same as described above.

[0017] The binder is used to prepare the adsorbent powder into a molded body having an appropriate form, and

serves to bind the adsorbent powder together. The binder may include, for example, at least one of polyvinyl chloride (PVC), polysulfone, and polyaniline. In particular, in the present embodiment, the binder preferably includes polyvinyl chloride (PVC), which can provide excellent bonding force between adsorbent powders.

[0018] Meanwhile, the step of passing the lithium-containing solution through the aluminum-based adsorbent to adsorb lithium onto the aluminum-based adsorbent includes, for example, a reaction represented by Reaction Scheme 1 below.



[0019] Next, a step of obtaining a lithium-containing desorption solution is performed.

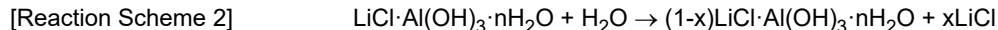
[0020] Specifically, a medium (for example, distilled water or an aqueous solution including a lithium salt) may be passed through the aluminum-based adsorbent onto which lithium has been adsorbed, thereby obtaining a lithium-containing desorption solution.

[0021] In this case, the amount of distilled water passed through the aluminum-based adsorbent onto which lithium has been adsorbed may be, based on the volume of the adsorbent, 0.5 times to 100 times, and more specifically 2 times to 40 times, the volume of the adsorbent.

[0022] When the desorption process is performed using distilled water in an amount of less than 0.5 times the volume of the adsorbent with respect to the aluminum-based adsorbent onto which lithium has been adsorbed, there is a problem in that the amount of lithium adsorbed onto the adsorbent that is desorbed decreases. In addition, when distilled water in an amount exceeding 100 times the volume of the adsorbent is used, there is a problem in that lithium desorbed in the desorption process is diluted, and the concentration of lithium included in the lithium-containing desorption solution is lowered.

[0023] The concentration of lithium included in the lithium-containing desorption solution obtained by the above-described method may be in a range of 0.2 g/L to 2.0 g/L, and more specifically 0.4 g/L to 1.0 g/L. When the lithium concentration included in the lithium-containing desorption solution satisfies the above range, a recovery rate of lithium hydroxide obtained after a subsequent process to be described below is excellent.

[0024] The step of passing distilled water through the aluminum adsorbent onto which lithium has been adsorbed to obtain a lithium-containing desorption solution includes, for example, a reaction represented by Reaction Scheme 2 below.



[0025] With respect to such a lithium adsorption and desorption process, an embodiment of the present invention may provide a more specific desorption method.

[0026] An embodiment of the present invention provides a method for adsorbing and desorbing lithium, the method comprising: an adsorption step of passing a lithium-containing solution through an aluminum-based adsorbent to obtain an adsorbent onto which lithium has been adsorbed; and a desorption step of passing a medium through the adsorbent onto which lithium has been adsorbed to obtain a lithium-containing desorption solution, wherein the medium used in the desorption step includes a salt.

[0027] When a medium including a lithium salt, rather than simply distilled water, is used as the medium as described above, the concentration of lithium in the obtained desorption solution may be increased. Such improvement in lithium concentration in the desorption solution can reduce the load of a subsequent concentration process.

[0028] In addition, an embodiment of the present invention provides a method for adsorbing and desorbing lithium, the method comprising: an adsorption step of passing a lithium-containing solution through an aluminum-based adsorbent to obtain an adsorbent onto which lithium has been adsorbed; and a desorption step of passing a medium through the adsorbent onto which lithium has been adsorbed to obtain a lithium-containing desorption solution, wherein the desorption step is performed a plurality of times, the plurality of desorption steps include a front-end desorption step and a rear-end desorption step, and concentrations of salts in media used in the front-end desorption step and the rear-end desorption step are different from each other.

[0029] Specifically, after the adsorption step, multi-stage desorption is performed using a medium. In this case, when the lithium concentration in the medium is changed based on a predetermined section, the lithium concentration of the finally obtained lithium desorption solution may be increased.

[0030] When the lithium concentration of the desorption solution is high, this means that the amount of water to be removed in a subsequent concentration step is reduced, and thus process burden of a subsequent process can be greatly improved.

[0031] Specifically, the concentration of the salt in the medium of the front-end desorption step may be higher than the concentration of the salt in the medium of the rear-end desorption step. In the concentration of the salt in the medium, the reference salt may be a lithium salt.

[0032] In this case, the number of front-end desorption steps may be determined by comparing the lithium concentration of a front-end desorption solution obtained through the front-end desorption step with the lithium concentration of a rear-end desorption solution obtained through the rear-end desorption step.

[0033] As described above, when the desorption solution is obtained, the desorption step is performed a plurality of times, and in this case, the lithium concentrations in the desorption solutions obtained in respective steps are compared to define a predetermined step as the front-end desorption step, and the concentration of the lithium salt in the medium at this time may be increased.

[0034] That is, a high-concentration medium may be used up to a predetermined desorption step, and a relatively low-concentration medium may be used in the desorption step from a certain reference time point onward.

[0035] In this case, when calculating the lithium concentration in the desorption solution, the lithium concentration included in the medium may be excluded, so that the calculation may be based on the amount of lithium desorbed by the adsorbent.

[0036] This is because, when a high-concentration medium is used in the desorption step, the lithium concentration in the obtained desorption solution is affected not only by lithium desorbed from the adsorbent but also by the lithium concentration in the medium. That is, this is to exclude the influence of the medium and consider only the influence of adsorption and desorption.

[0037] Specifically, the front-end desorption step may be maintained until a range in which a difference in lithium concentration between the front-end desorption solution and the rear-end desorption solution is 0.1 g/L or more.

[0038] The medium may be an aqueous solution including at least one of lithium chloride, lithium sulfate, and lithium borate.

[0039] A lithium concentration in the medium used in the front-end desorption step may be 0.2 g/L to 0.4 g/L, and a lithium concentration in the medium used in the rear-end desorption step may be 0.2 g/L to 0.1 g/L.

[0040] The method may further comprise concentrating the entire desorption solution obtained through the front-end desorption step and the rear-end desorption step.

[0041] Concentration efficiency of the concentration step may be improved by 80% or more.

[0042] The concentration efficiency may be calculated as follows. Specifically, efficiency when concentrating a finally obtained desorption solution is compared between a method in which concentrations of lithium salts in media of the front-end desorption step and the rear-end desorption step are differently controlled as in an embodiment of the present application, and an existing method in which concentrations of lithium salts in media of these steps are maintained the same.

[0043] Specifically, the concentration efficiency may be calculated as a ratio of energy when the method according to an embodiment of the present application is used, relative to energy required for concentration when the concentration of the lithium salt in the medium is made the same.

[0044] When the desorption step is performed by the method according to an embodiment of the present application, the lithium concentration in the final desorption solution is high, and thus the amount of water to be removed by concentration is significantly reduced, thereby enabling efficient process design.

[Advantageous Effects]

[0045] In a technology for recovering lithium through adsorption and desorption of lithium using an adsorbent, the present invention provides a process capable of effectively recovering lithium by providing a more effective desorption technology.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0046]

FIG. 1 shows lithium concentration data according to BV of multi-stage desorption steps according to an embodiment and a Comparative Example of the present invention.

FIG. 2 shows results of analyzing an actual lithium desorption amount according to desorption depending on BV according to Examples and Comparative Examples.

FIG. 3 shows results of analyzing an actual lithium concentration in a desorption solution according to desorption depending on BV according to Examples and Comparative Examples.

[MODE FOR CARRYING OUT THE INVENTION]

[0047] Hereinafter, embodiments of the present invention will be described in detail. However, these are provided as examples, and the present invention is not limited thereby, and the present invention is only defined by the scope of

the claims to be described below.

Examples

[0048] A brine having the composition shown in Table 1 below was prepared.

[Table 1]

Analyzed Element	Li (g/L)	Ca (g/L)	Mg (g/L)	B (g/L)	K (g/L)	Na (g/L)
Content	0.07	20.0	1.4	0.3	6.5	48.0

[0049] The adsorbent column was 100 mL, and desorption was performed at a level of about 3 L. The front-end was performed at about 6 BV (~0.6 L), and the rear-end was performed at 6 BV to 30 BV (0.6 L to 3 L).

[0050] At this time, desorption was performed under a condition in which an amount of a medium used for performing one desorption step was defined as 1 bed volume (BV).

[0051] The front-end desorption step was performed up to 6 BV, and the rear-end desorption step was performed from 7 BV to a level of 30 BV.

[0052] At this time, desorption was performed under each of three conditions.

[0053] In the first condition, desorption was performed using distilled water in all steps.

[0054] In the second condition, desorption was performed using a lithium chloride aqueous solution having a concentration of 0.15 g/L in all steps.

[0055] In the third condition, the concentration of lithium chloride in the medium used in the front-end desorption step was 0.3 g/L, and the concentration of lithium chloride in the medium used in the rear-end desorption step was 0.15 g/L.

[0056] FIG. 1 shows lithium concentration data according to BV of multi-stage desorption steps according to an embodiment and a Comparative Example of the present invention.

[0057] In FIG. 1, a dotted line represents data obtained by performing desorption using distilled water, and a thick line represents data obtained using a medium having the same lithium concentration in all desorption steps.

[0058] In addition, a thin line represents Example data in which multi-stage desorption steps were performed, and in this case, it can be confirmed that the lithium concentration was high at most BVs.

[0059] However, this may be regarded as the lithium concentration in the desorption solution in most steps being increased due to an influence of the lithium concentration in the medium because a high-concentration medium was used initially.

[0060] FIG. 2 shows results of analyzing an actual lithium desorption amount according to desorption depending on BV according to Examples and Comparative Examples.

[0061] In this case, the data of FIG. 2 are values calculated in consideration of the amount of lithium in the medium, and it can be seen that, in the initial BV, the amount of lithium desorbed from the adsorbent is rather smaller than that of the Comparative Example.

[0062] This is presumed to be because, due to the influence of lithium in the medium, additional adsorption may occur together with desorption, and the lithium concentration of the medium may act as an inhibiting factor for desorption.

[0063] However, what should be noted in the results of FIG. 2 is that, when desorption is finally performed up to the rear-end desorption, the amount of desorbed lithium eventually becomes the same.

[0064] Specifically, it can be confirmed that, in the initial stage, the Example in which lithium is introduced at 0.3 g/L and discharged at 0.57 g/L has a smaller desorption amount than the Comparative Example in which lithium is introduced at 0.15 g/L and discharged at 0.47 g/L.

[0065] However, when desorption is performed up to about 30 BV, it can be confirmed that the total amount of effective desorption is almost the same. It was found that, in a range of about 18 BV, the same amount of desorption can be sufficiently expected.

[0066] That is, this means that, even when the media of the front-end and rear-end are used differently as in the Example, the fact that all lithium in the adsorbent is eventually desorbed does not change.

[0067] FIG. 3 shows results of analyzing an actual lithium concentration in a desorption solution according to desorption depending on BV according to Examples and Comparative Examples.

[0068] The results of FIG. 3 are also values considering the influence of lithium concentration in the medium, like FIG. 2.

[0069] As can be seen from FIG. 3, it can be confirmed that the lithium concentration in the desorption solution obtained in all desorption steps was higher in the Example.

[0070] Specifically, at 28.8 BV, the lithium concentration in the desorption solution was 244 mg/L in the Example and

212 mg/L in the Comparative Example. This is an effect in which the Example is improved by 87%.

[0071] This means that the Example is 87% more effective than the Comparative Example in terms of the amount of water to be removed when concentrating to the same concentration.

[0072] That is, the Example and the Comparative Example eventually desorb the same amount of lithium, but the Example obtains a desorption solution having a higher concentration.

[0073] The present invention is not limited to the above Examples, and may be prepared in various different forms. A person having ordinary skill in the art to which the present invention pertains will understand that the present invention may be embodied in other specific forms without changing the technical spirit or essential features of the present invention. Therefore, the above-described Examples should be understood as illustrative in all respects and not restrictive.

Claims

1. A method for adsorbing and desorbing lithium, comprising:

an adsorption step of passing a lithium-containing solution through an aluminum-based adsorbent to obtain an adsorbent onto which lithium has been adsorbed; and
a desorption step of passing a medium through the adsorbent onto which lithium has been adsorbed to obtain a lithium-containing desorption solution,
wherein the medium used in the desorption step comprises a salt.

2. The method for adsorbing and desorbing lithium of claim 1,

wherein the desorption step is performed a plurality of times,
wherein the plurality of desorption steps comprise a front-end desorption step and a rear-end desorption step, and
wherein concentrations of salts in media used in the front-end desorption step and the rear-end desorption step are different from each other.

3. The method for adsorbing and desorbing lithium of claim 2,

wherein the concentration of the salt in the medium of the front-end desorption step is higher than the concentration of the salt in the medium of the rear-end desorption step.

4. The method for adsorbing and desorbing lithium of claim 3,

wherein, in the concentration of the salt in the medium, a reference salt is a lithium salt.

5. The method for adsorbing and desorbing lithium of claim 3,

wherein the number of front-end desorption steps is determined by comparing a lithium concentration of a front-end desorption solution obtained through the front-end desorption step with a lithium concentration of a rear-end desorption solution obtained through the rear-end desorption step.

6. The method for adsorbing and desorbing lithium of claim 5,

wherein, when calculating the lithium concentration in the desorption solution, a lithium concentration included in the medium is excluded, so that the calculation is based on an amount of lithium desorbed by the adsorbent.

7. The method for adsorbing and desorbing lithium of claim 5,

wherein the front-end desorption step is maintained until a range in which a difference in lithium concentration between the front-end desorption solution and the rear-end desorption solution is 0.1 g/L or more.

8. The method for adsorbing and desorbing lithium of claim 2,

wherein the medium is an aqueous solution comprising at least one of lithium chloride, lithium sulfate, and lithium borate.

9. The method for adsorbing and desorbing lithium of claim 2,

wherein a lithium concentration in the medium used in the front-end desorption step is 0.2 g/L to 0.4 g/L, and a lithium concentration in the medium used in the rear-end desorption step is 0.2 g/L to 0.1 g/L.

10. The method for adsorbing and desorbing lithium of claim 2, further comprising:
concentrating an entire desorption solution obtained through the front-end desorption step and the rear-end desorption step.

5 **11.** The method for adsorbing and desorbing lithium of claim 10,
 wherein concentration efficiency of the concentration step is improved by 80% or more.

10

15

20

25

30

35

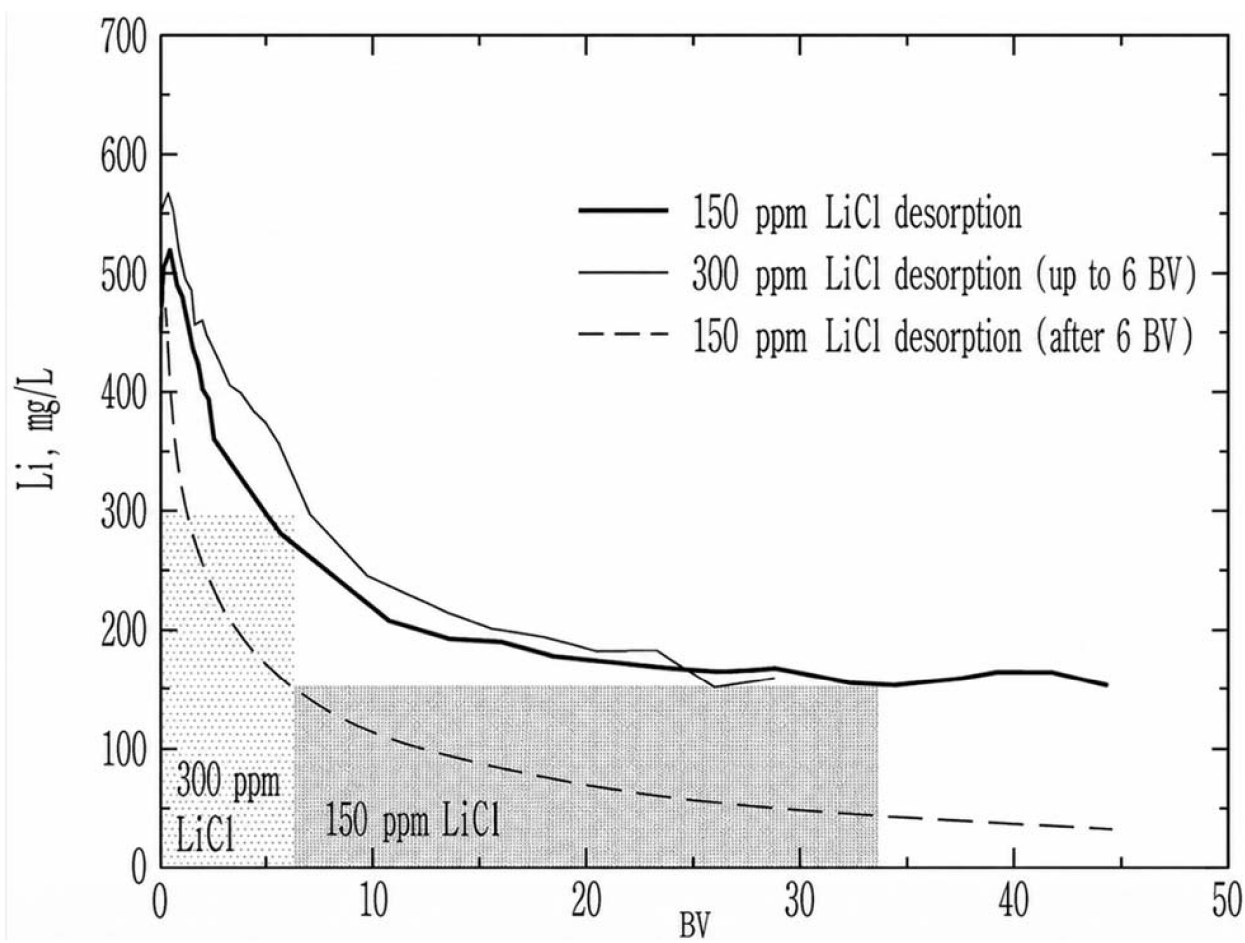
40

45

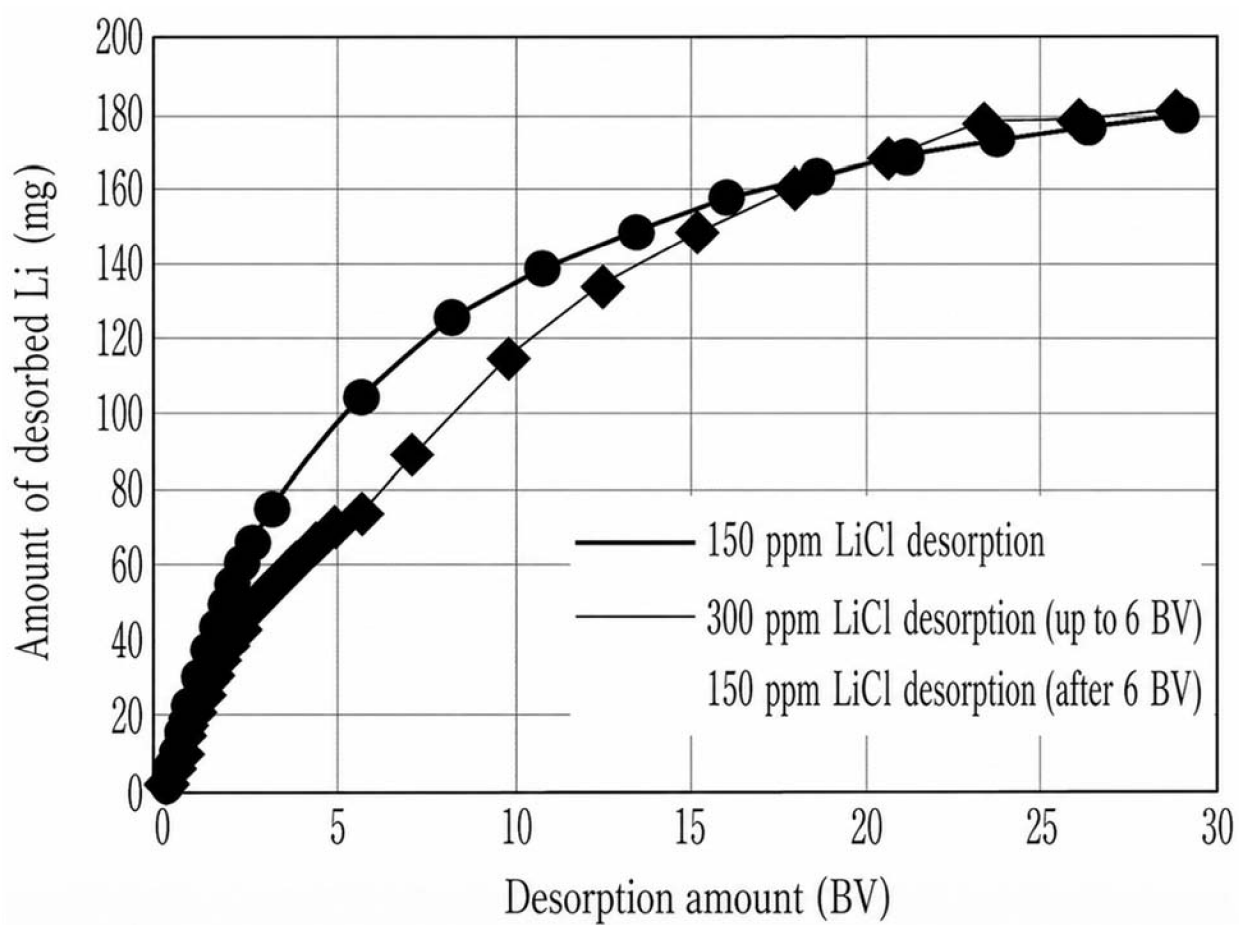
50

55

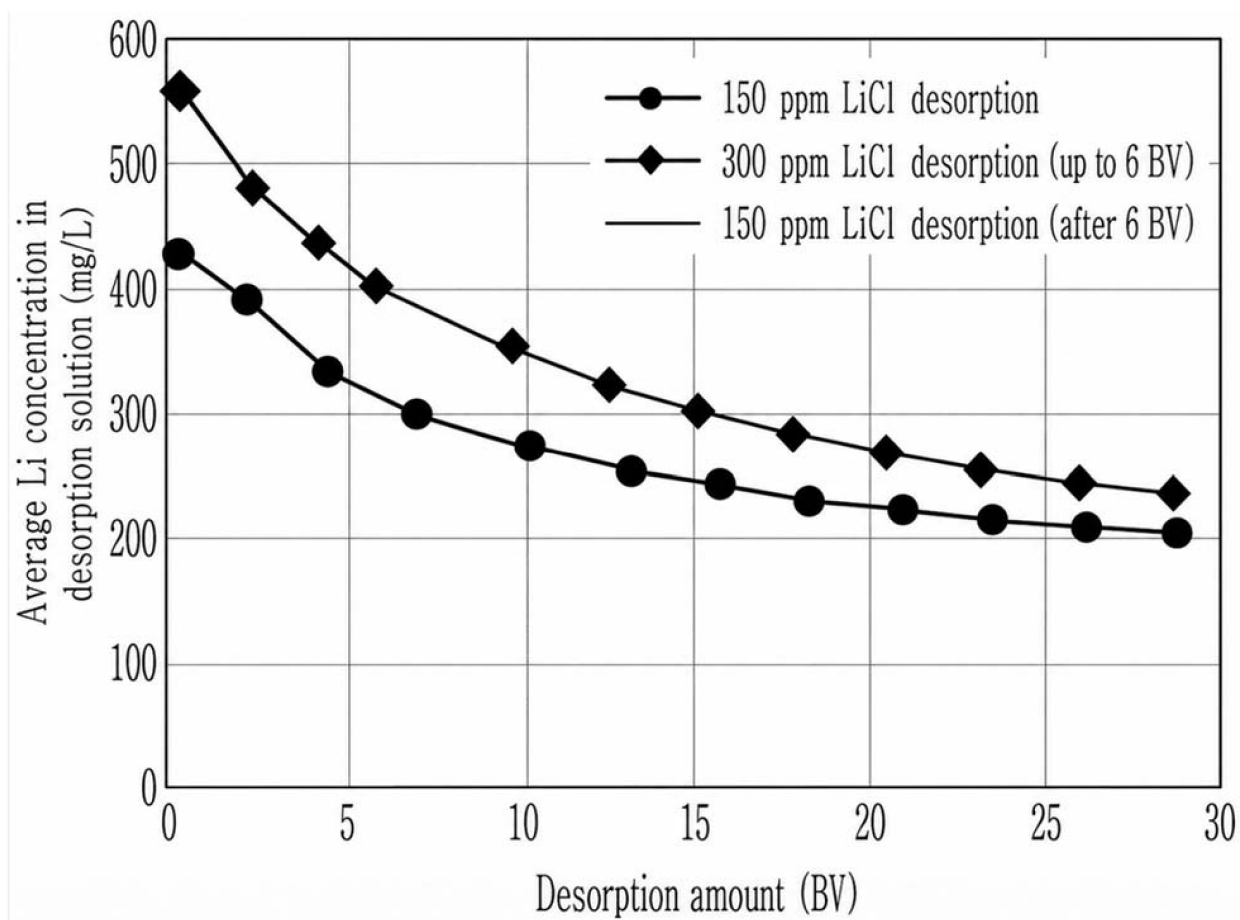
【Fig. 1】



【Fig. 2】



【Fig. 3】



INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/096865

A. CLASSIFICATION OF SUBJECT MATTER

C22B 3/24(2006.01)i; C22B 26/12(2006.01)i; C22B 3/06(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C22B 3/24(2006.01); B01D 61/00(2006.01); B01J 20/08(2006.01); C01B 25/30(2006.01); C01D 15/08(2006.01);
C22B 26/12(2006.01); C22B 7/00(2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models: IPC as above

Japanese utility models and applications for utility models: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS (KIPO internal) & keywords: 리튬 회수(lithium recovering), 흡착(adsorption), 탈착(desorption), 염(salt), 복수
(multi), 농도(concentration)**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	KR 10-2018-0043792 A (ALBEMARLE CORPORATION) 30 April 2018 (2018-04-30) See paragraphs [0044] and [0049]-[0051].	1 2-11
A	CN 112538575 A (BYD COMPANY LIMITED) 23 March 2021 (2021-03-23) See paragraphs [0041]-[0054].	1-11
A	CN 116281908 A (QINGHAI INSTITUTE OF SALT LAKES, CHINESE ACADEMY OF SCIENCES) 23 June 2023 (2023-06-23) See claim 1.	1-11
A	YANG, Y. et al. Investigation on desorption process in fixed bed for lithium recovery. Separation and Purification Technology. 2022, vol. 281, thesis no. 119596, inner pp. 1-9 (online publication: 28 August 2021). See abstract and inner page 7.	1-11

☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

19 March 2025

Date of mailing of the international search report

19 March 2025

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon Building 4, 189 Cheongsaro, Seo-gu, Daejeon 35208

Facsimile No. +82-42-481-8578

Authorized officer

Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR2024/096865

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN 115784271 A (ZIJIN MINING GROUP CO., LTD. et al.) 14 March 2023 (2023-03-14) See claims 1 and 4.	1-11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2024/096865

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
KR	10-2018-0043792	A	30 April 2018	AR	102366	A1	22 February 2017
				AU	2015-408086	A1	15 March 2018
				AU	2015-408086	A1	09 March 2017
				CA	2994738	A1	09 March 2017
				CL	2018000519	A1	08 June 2018
				CN	107949541	A	20 April 2018
				JP	2018-535309	A	29 November 2018
				JP	6681975	B2	15 April 2020
				US	10648061	B2	12 May 2020
				US	2018-0245180	A1	30 August 2018
				WO	2017-039724	A1	09 March 2017
CN	112538575	A	23 March 2021	None			
CN	116281908	A	23 June 2023	None			
CN	115784271	A	14 March 2023	None			