

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property  
Organization  
International Bureau

(43) International Publication Date  
10 October 2024 (10.10.2024)



(10) International Publication Number  
**WO 2024/210836 A1**

(51) International Patent Classification:

C02F 1/461 (2023.01) C02F 5/02 (2023.01)  
B01D 53/62 (2006.01) B01D 53/34 (2006.01)  
C25B 1/34 (2006.01) C02F 1/66 (2023.01)  
B01D 53/75 (2006.01) B01D 61/58 (2006.01)  
B01D 53/78 (2006.01) C02F 9/00 (2023.01)  
C02F 1/52 (2023.01)

(21) International Application Number:

PCT/SG2024/050220

(22) International Filing Date:

03 April 2024 (03.04.2024)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

10202300907V 03 April 2023 (03.04.2023) SG

(71) Applicant: **NANYANG TECHNOLOGICAL UNIVERSITY** [SG/SG]; 50 Nanyang Avenue, Singapore 639798 (SG).

(72) Inventors: **TU, Wei Han**; c/o Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798 (SG). **CHAN, Wei Ping**; c/o Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798 (SG). **LISAK, Grzegorz**; c/o Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798 (SG).

(74) Agent: **KINNAIRD, James Welsh**; Marks & Clerk Singapore LLP, Tanjong Pagar Post Office, P.O. Box 636, Singapore 910816 (SG).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG,

(54) Title: AN INTEGRATED RESOURCE RECOVERY AND CO-TREATMENT SYSTEM OF DESALINATION BRINE AND FLUE GAS VIA WASTE BRINE ELECTROLYSIS AND SUSTAINABLE CO<sub>2</sub> MINERALISATION (FROM BRINE TO NEWSEAWATER)

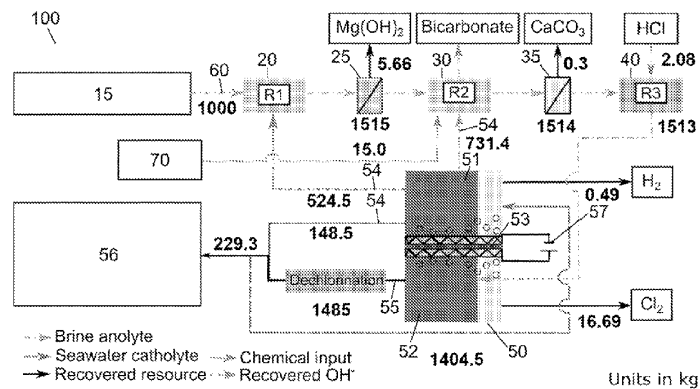


Fig. 1

(57) Abstract: Disclosed herein is a process for treating a desalination-rejected brine and a flue gas, the process comprising the steps of (a) subjecting a desalination-rejected brine to reaction with an alkali metal hydroxide to provide a precipitate comprising magnesium hydroxide and an alkaline brine, and separating the precipitate from the alkaline brine, (b) bubbling a flue gas comprising CO<sub>2</sub> into the alkaline brine to provide a precipitate comprising calcium carbonate and a softened brine, and separating the precipitate from the softened brine, (c) subjecting the softened brine to acidification by addition of an acid to provide an acidified brine having a pH of from 1 to 5, (d) providing the acidified brine to an anode compartment of a flow electrochemical cell and providing a seawater and/or a reclaimed seawater to a cathode compartment of the flow electrochemical cell and generating chlorine gas, an anode brine, hydrogen gas and an alkaline cathode brine, and (e) mixing the anode brine and the entirety or a third portion of the alkaline cathode brine together and subjecting the mixture to a dechlorination reaction to provide a reclaimed seawater. Also disclosed herein is an apparatus for treating a desalination-rejected brine and a flue gas.

[Continued on next page]

KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY,  
MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA,  
NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO,  
RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH,  
TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS,  
ZA, ZM, ZW.

**(84) Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

**Declarations under Rule 4.17:**

— *of inventorship (Rule 4.17(iv))*

**Published:**

— *with international search report (Art. 21(3))*