



- (51) **International Patent Classification:**
C12M 1/00 (2006.01)
- (21) **International Application Number:**
PCT/US2015/032057
- (22) **International Filing Date:**
21 May 2015 (21.05.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
62/001,241 21 May 2014 (21.05.2014) US
- (71) **Applicant:** CH2M HILL, INC. [US/US]; 9191 South Jamaica Street, Englewood, Colorado 80112 (US).
- (72) **Inventors; and**
- (71) **Applicants :** AUSTIN, David [US/US]; 9191 South Jamaica Street, Englewood, Colorado 80112 (US). JOHN-SON, Bruce [US/US]; 9191 South Jamaica Street, Englewood, Colorado 80112 (US).
- (72) **Inventors:** BOLTZ, Joshua P.; 9191 South Jamaica Street, Englewood, Colorado 80112 (US). DAIGGER, Glen T.; 9191 South Jamaica Street, Englewood, Colorado 80112 (US).
- (74) **Agents:** KANABER, Kerith M. et al.; Dorsey & Whitney LLP, 1400 Wewatta Street, Suite 400, Denver, Colorado 80202 (US).
- (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, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, 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, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, 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, 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:

— as to the identity of the inventor (Rule 4.17(i))

[Continued on next page]

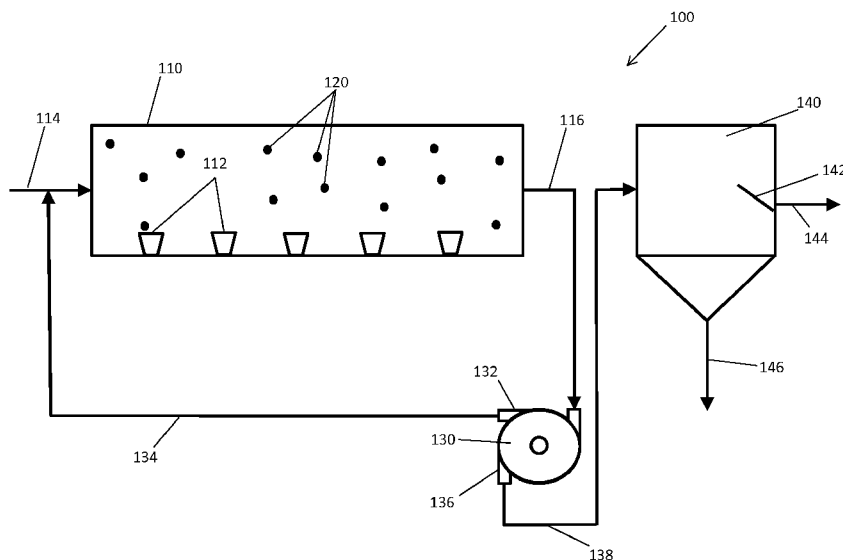
(54) **Title:** BIOFILM MEDIA, TREATMENT SYSTEM AND METHOD OF TREATMENT

FIG. 1

(57) **Abstract:** Described herein are systems and methods for treatment of contaminated water employing a mobile supported biofilm. The treatment systems include a bioreactor, a mobile biofilm disposed within the bioreactor, and a solid-solid separation unit attached to the bioreactor. The solid-solid separation unit is adapted to receive an effluent stream from the bioreactor, wherein the effluent contains the mobile biofilm, and separate at least a portion of the mobile biofilm from the effluent and return it to the bioreactor.



- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

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

(88) Date of publication of the international search report:
3 March 2016

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/32057

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C12M 1/00 (2015.01)

CPC - C12M 27/02; C12M 35/04; C12M 21/04

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)

CPC (C12M27/02; C12M35/04; C12M21/04; C02F3/12; C02F3/06; C02F3/10; C02F1/5245; C02F1/683; C02F1/56; C02F1/5236; Y02W10/15; Y10S210/906; Y10S210/903; C02F3/302; C02F3/085; C02F3/301; C02F2003/001; C02F3/1263; C02F3/06; C02F3/30; C02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC (435/289.1; 210/605; 210/150; 210/629; 210/903; 210/259; 210/630; 210/615; 210/906; 210/622; 210/631; 210/151; 210/608; 210/626; 210/616; 166/265; 210/170.01; 210/512.2; 210/611; 210/610; 210/602; 210/220; 261/100; 210/650; 210/713; 210/615; 210/150;Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatBase, Google Patents/Scholar - Terms: biofilm mobile carrier sludge wastewater solid-liquid separation solid-liquid recycle bioreactor hydrocyclone lignocellulosic negative positive charged ammonia absorb second first sequence order change sewage substratum movable screen sieve mesh settler recirculate reuse reactor cation anion NH4+ absorb retain

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2002/079103 A2 (DARTON et al.) 10 October 2002 (10.10.2002)	1-3, 6, 8 and 15
Y	pg 2, ln 3-8; pg 6, ln 2-5; pg 21, ln 8-32; pg 22, ln 1-25; pg 24, ln 18-32; pg 25; pg 26, ln 1-11; figures 2 and 5; abstract	7 and 9-14
A		4-5 and 16-21
Y	US 2011/0146976 A1 (HACKWORTH et al.) 23 June 2011 (23.06.2011) para [0005], [0023]	7
Y	US 2013/0233792 A1 (BROWN, III) 12 September 2013 (12.09.2013) para [0026], [0068]-[0070], [0088]	9
Y	US 2005/0082222 A1 (AUSTIN) 21 April 2005 (21.04.2005) para [0064]; abstract	10-14
A	US 2004/0079692 A1 (COTE et al.) 29 April 2004 (29.04.2004) para [0089]-[0093]; figure 12	4-5
A	US 2009/0014387 A1 (PROBST) 15 January 2009 (15.01.2009) para [0034], [0073], [0074], [0079]; figure 3A; claim 1	4-5
A	US 2013/0068688 A1 (AGER et al.) 21 March 2013 (21.03.2013) para [0010]	16-21

☒ Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

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

"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

12 September 2015 (12.09.2015)

Date of mailing of the international search report

06 OCT 2015

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-8300

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 15/32057

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2014/0008280 A1 (HUSAIN et al.) 9 January 2014 (09.10.2014) para [0013], [0045]	16-21
A	US 6,926,830 B2 (HO et al.) 9 August 2005 (09.08.2005) -- the entire opinion	1
A	US20130319940 A1 (JOSSE et al.) 5 December 2013 (05.12.2013) -- the entire opinion	1

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 15/32057

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
---please see supplemental box---

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-21

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.