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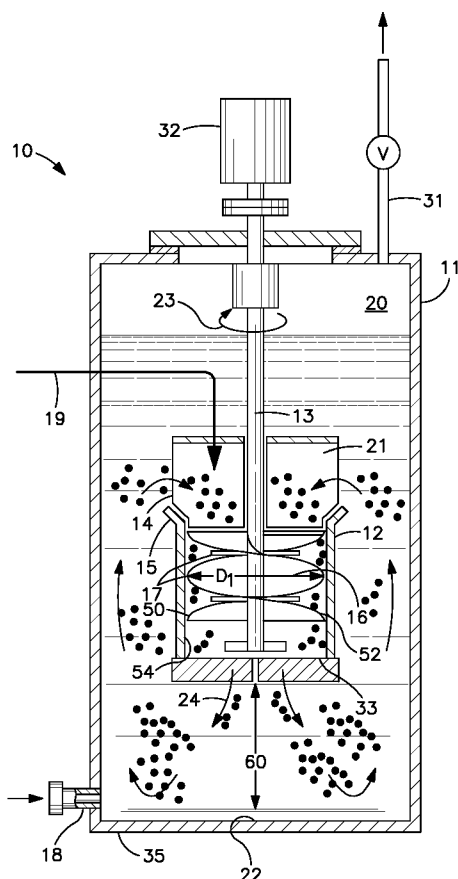
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[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR MIXING HIGH VISCOUS LIQUIDS WITH GAS



(57) Abstract: A system and method for mixing high viscous liquids with gas is provided. The disclosed embodiments include a reactor or mixing vessel (11) having a draft tube (12) disposed therein, a gas injection subsystem adapted to inject gas into the reactor or mixing vessel proximate the entrance of the (19) draft tube. The embodiments also include an agitator (16) disposed within the draft tube which makes the draft tube the primary site for the gas-liquid mixing. In particular, the agitator is adapted to create gas bubbles having an average diameter between about 0.3 mm and 3.0 mm which are then ejected into the reactor or mixing vessel. The mass transfer efficiency associated with the present system and method is enhanced from the combined effect of gas dissolution into the high viscous liquid within the draft tube and greater bubble residence time within the high viscous liquid.

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ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, **DK**, EE, ES, FI, FR, GB, GR, HU, IE, **IS**, **IT**, LT, LU, LV, MC, MT, NL, PL, PT, **RO**, SE, **SI**, SK, TR), OAPI (BF, **BJ**, CF, CG, CI, CM, GA, GN, GQ, GW, ML, **MR**, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))
 - as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(Ui))
- Published:**
- with international search report
 - before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report:**
17 July 2008

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER

INV. C02F3/12 C02F3/20 B01F13/00 B01F3/04 B01F7/00

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)

C02F BOIF

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

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

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 135 430 A (BERGMAN JR THOMAS JOHN [US] ET AL) 24 October 2000 (2000-10-24) claim 1 column 5, lines 11-15 column 5, lines 63-66 column 3, lines 42-57 column 4, lines 12-15	1-11
X	EP 0 099 078 A (UNION CARBIDE CORP [US]) 25 January 1984 (1984-01-25) claim 1 page 2, line 7 - page 3, line 5 page 4, lines 4-16 page 6, lines 12-28 page 7, lines 3-7 page 9, lines 28-33 figure 1	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

¹E" earlier document 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

¹P" 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

"X¹" 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 2008

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08/05/2008

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INTERNATIONAL SEARCH REPORT

International application No
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(^Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	US 4 919 849 A (LITZ LAWRENCE M [US] ET AL) 24 April 1990 (1990-04-24) claims 1,9 figures 1,2 column 8 , lines 30-32 column 3 , lines 8-14 column 3 , lines 30-34 column 4 , lines 32-36	7-11
X	WO 99/07460 A (RHONE POULENC AGROCHIMIE [FR]; HILLS BLAIR HOWARD [US]) 18 February 1999 (1999-02-18) claim 1 figures 1,4,5 page 1 , lines 11-17 page 2 , line 25 - page 4 , line 6 page 5 , lines 4,8-10 page 6 , lines 29-31 page 8 , lines 20-30	1-11
X	WO 98/31453 A (RHONE POULENC AGROCHIMIE [FR]) 23 July 1998 (1998-07-23) claims 1,10 page 4 , lines 1-8 page 5 , lines 17-27 page 3 , lines 2,9-32 page 6 , line 28 - page 7 , line 4 page 10 , lines 7,8	1-11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/084507

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:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an 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 reportcovers 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.:

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.

FURTHER INFORMATION CONTINUED FROM PCTASA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-6

A method of treating high-sol ids content material in an earation basin.

2. cl aims: 7-11

A method and a system for mixing a high viscous liquid with a gas.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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