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(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, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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(54) Title: METHOD AND APPARATUS FOR ON-LINE ESTIMATION AND FORECASTING OF SPECIES CONCENTRATION DURING A REACTION

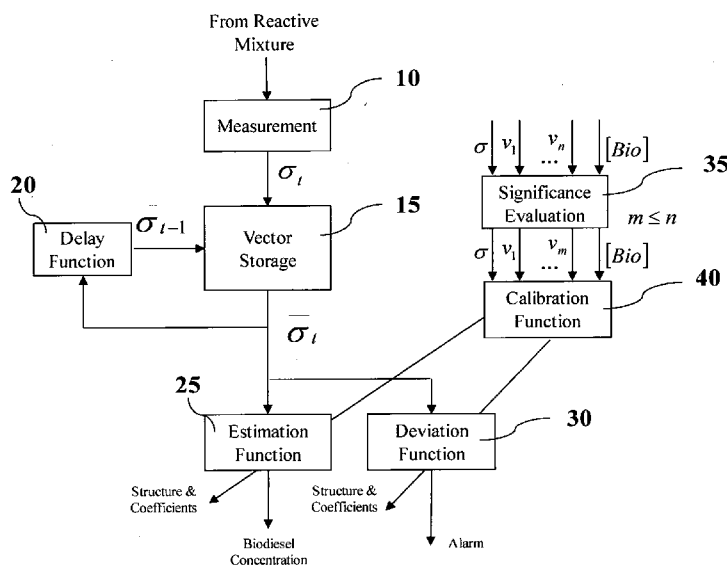


FIG 1.

(57) Abstract: The present invention provides a method and apparatus for on-line measurement and forecasting of a species concentration while a reaction is taking place, based on the measurement of the electrical conductivity of the reacting volume, and using such measurement to evaluate a first mathematical function relating such value to the concentration of the species in the reacting volume. The evaluation of the first mathematical function requires as inputs: electrical conductivity trajectory, time elapsed, and other significant process variables; it generates as outputs the estimated actual species concentration and at least one forecasted concentration value. This method and apparatus also provides an alarm based on the electrical conductivity measurement and a second mathematical function to indicate that the reaction is deviating from the desired behavior to another reaction pattern.

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2009/007398

A. CLASSIFICATION OF SUBJECT MATTER

INV. G01N27/10 G01N27/06 G05B13/00
ADD.

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)

G01N G05B

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	AGUADO, D; ZARZO, M; SECO, A; FERRER, A: "Process understanding of a wastewater batch reactor with block-wise PLS" ENVIRONMETRICS, vol. 18, 29 January 2007 (2007-01-29), pages 551-560, XP002579236 DOI: 10.1002/env.828 * abstract; figure 2 Introduction; Conclusions page 553, paragraph 2 -----	1-6
X	WO 02/12129 A1 (SIEVERS INSTR INC [US]; KOSENKA PAUL P [US]; NEILL KEVIN J O [US]; GOD) 14 February 2002 (2002-02-14)	7-9
Y	claim 21; figures 2,8,9,11 ----- -/--	10-22

☒ 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

"E" 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

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

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"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

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	NEUMANN, J; FAHLENKAMP, H; SCHLÜTER, S; DEERBERG, G: "Fault Detection and Diagnosis in Chemical Plants Using Neural Agents" CHEMICAL ENGINEERING & TECHNOLOGY, vol. 26, no. 12, 17 November 2003 (2003-11-17), pages 1241-1246, XP002596242 DOI: 10.1002/ceat.200301887 the whole document	10-22
A	DE 42 27 727 A1 (BUNA AG [DE] BUNA GMBH [DE]) 24 February 1994 (1994-02-24) the whole document	10-22
A	DE 40 06 689 A1 (RUDOLPH KARL ULRICH PROF DR DR [DE]) 1 August 1991 (1991-08-01) * abstract; figures 1,2 column 2, line 21 - line 25 column 3, line 6 - line 27	1-6
A	GB 2 165 360 A (XERTEX CORP) 9 April 1986 (1986-04-09) * abstract; figure 1 page 3, line 41 - line 45	1-6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2009/007398

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 all searchable 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 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.:

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 PCT/ISA/ 210

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

1. claims: 1-6

Process monitoring a chemical process using a conductivity sensor

2. claims: 7-22

Procedure for estimating the concentration of species of an chemical reaction

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2009/007398

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0212129	A1	14-02-2002	AU 8472901 A 18-02-2002
			CN 1443138 A 17-09-2003
			DE 10196488 B4 19-04-2007
			DE 10196488 T0 11-09-2003
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			JP 61172058 A 02-08-1986