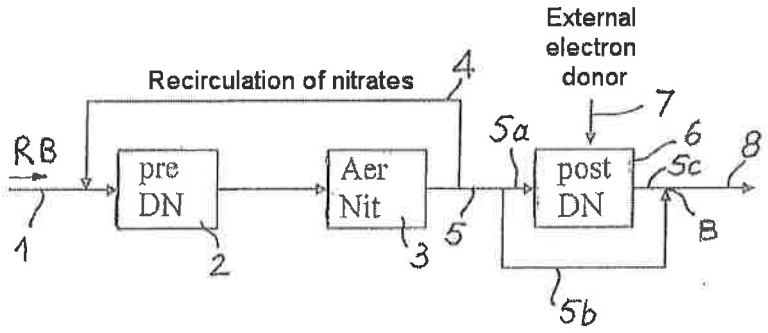
External
electron
donor
Recirculation of nitrates
RB
pre
DN
Aer
Nit
post
DN
1
2
3
4
5
5a
5b
5c
6
7
8
B

FIG. 1

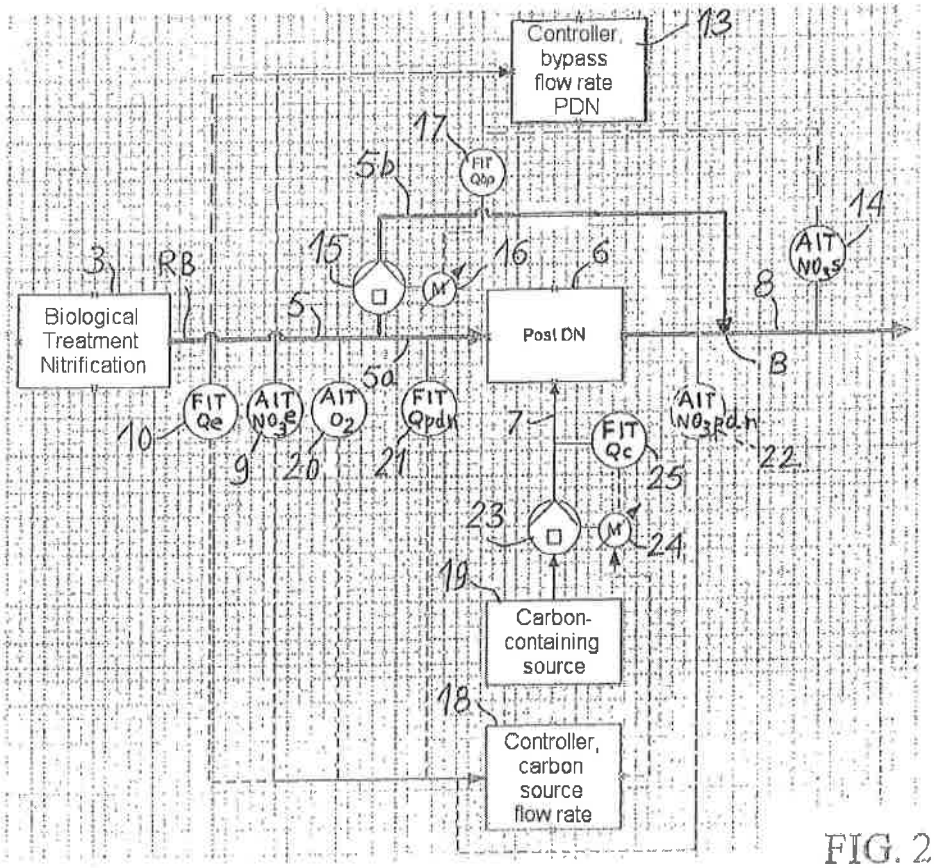
Controller,
bypass
flow rate
PDN
13
17
FIT
Qbp
5b
14
AIT
NO3
15
16
M
3
RB
6
Biological
Treatment
Nitrification
5
Post DN
8
5a
B
FIT
Qe
AIT
NO3e
AIT
O2
FIT
Qpdn
AIT
NO3Pdn
10
9
20
21
7
FIT
Qc
22
25
23
M
24
19
Carbon-
containing
source
18
Controller,
carbon
source
flow rate

FIG. 2

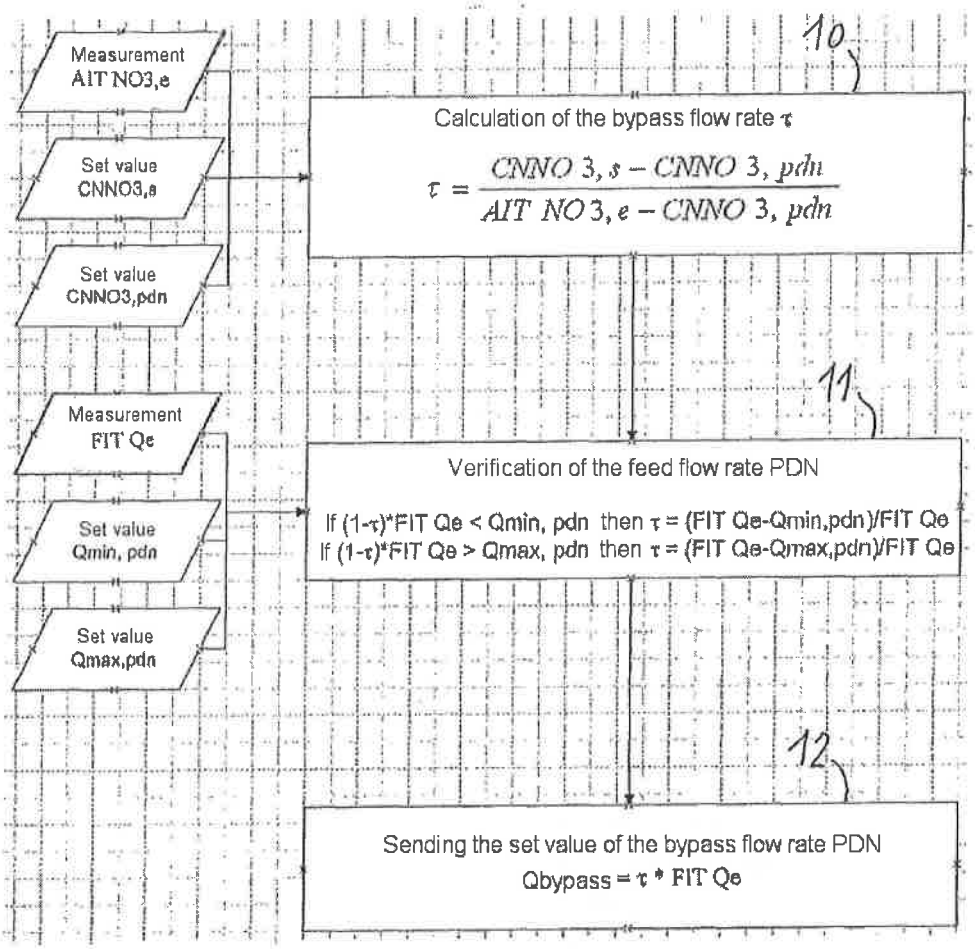
Measurement AIT NO3,e
Set value CNNO3,s
Set value CNNO3,pdn
Measurement FIT Qe
Set value Qmin, pdn
Set value Qmax,pdn
10
Calculation of the bypass flow rate τ
$\tau = \frac{CNNO\ 3, s - CNNO\ 3, pdn}{AIT\ NO\ 3, e - CNNO\ 3, pdn}$
11
Verification of the feed flow rate PDN
If (1-τ)*FIT Qe < Qmin, pdn then τ = (FIT Qe-Qmin,pdn)/FIT Qe
If (1-τ)*FIT Qe > Qmax, pdn then τ = (FIT Qe-Qmax,pdn)/FIT Qe
12
Sending the set value of the bypass flow rate PDN
Qbypass = τ * FIT Qe

FIG. 3

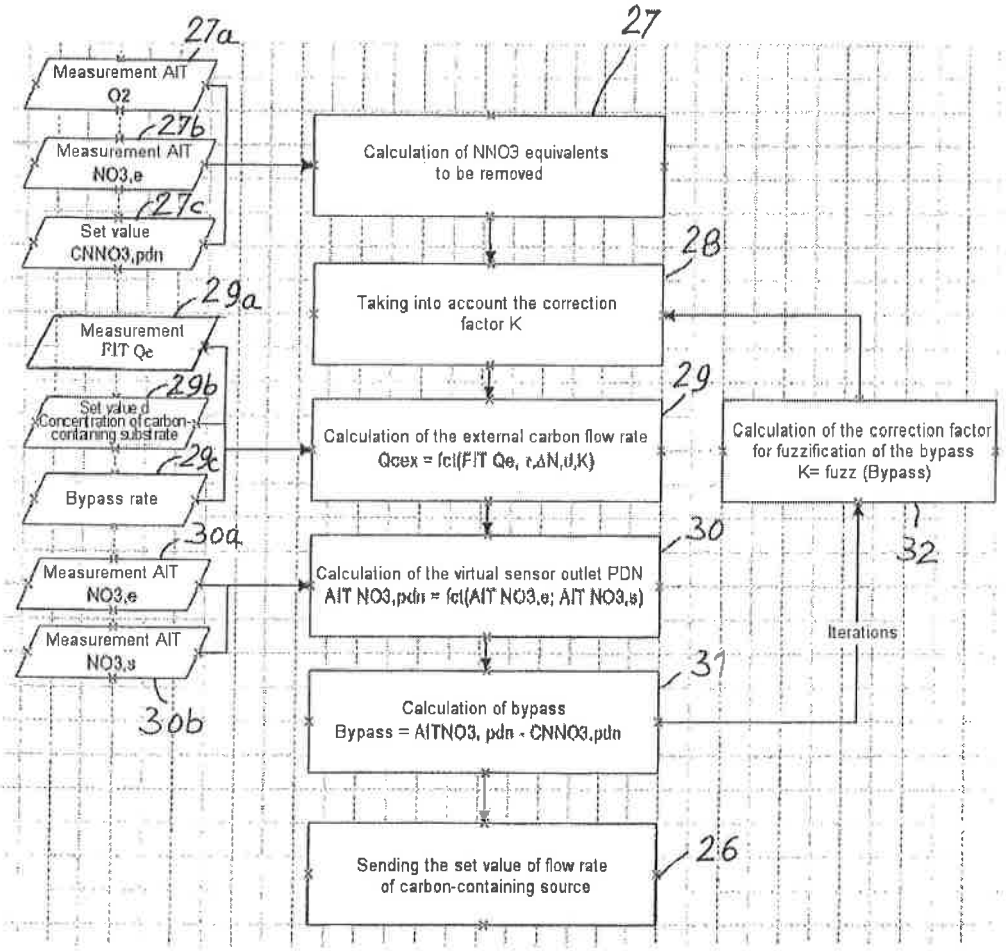
27a
27
Measurement AIT O2
27b
Measurement AIT NO3,e
27c
Set value CNNO3,pdn
Calculation of NNO3 equivalents to be removed
28
Taking into account the correction factor K
29a
Measurement FIT Qe
29b
Set value d Concentration of carbon-containing substrate
29c
Bypass rate
29
Calculation of the external carbon flow rate Qcex = fct(FIT Qe, r,ΔN,d,K)
Calculation of the correction factor for fuzzification of the bypass K= fuzz (Bypass)
32
30a
Measurement AIT NO3,e
Measurement AIT NO3,s
30b
30
Calculation of the virtual sensor outlet PDN AIT NO3,pdn = fct(AIT NO3,e; AIT NO3,s)
Iterations
31
Calculation of bypass Bypass = AITNO3, pdn - CNNO3,pdn
Sending the set value of flow rate of carbon-containing source
26

FIG. 4

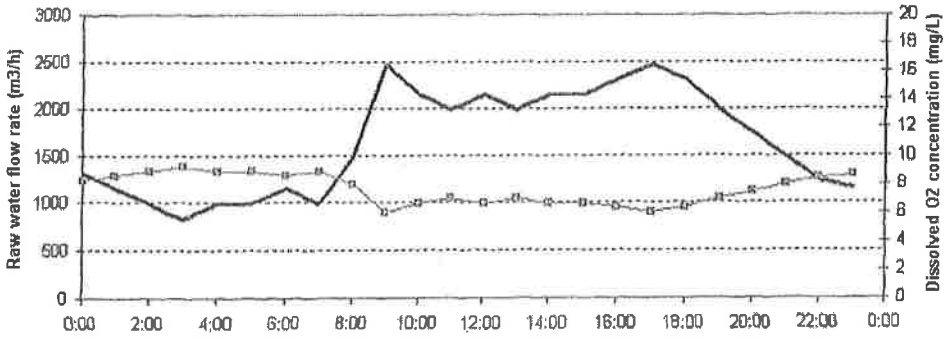
Raw water flow rate (m3/h)
3000
2500
2000
1500
1000
500
0
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Dissolved O2 concentration (mg/L)
20
18
16
14
12
10
8
6
4
2
0

FIG. 5

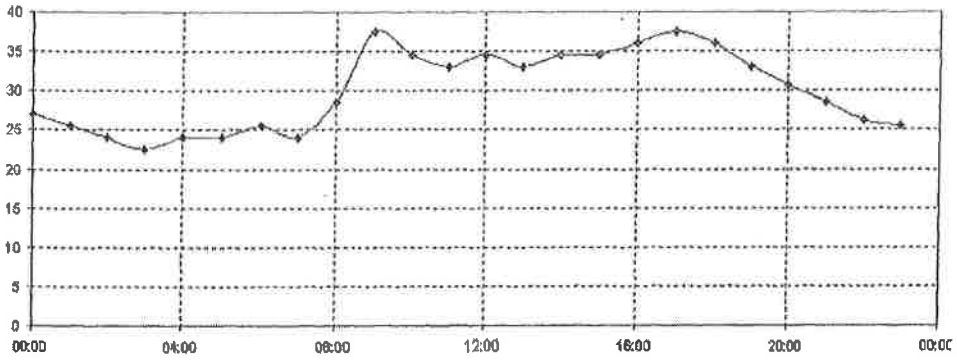
40
35
30
25
20
15
10
5
0
00:00
04:00
08:00
12:00
16:00
20:00

FIG. 6