

Universitat Autònoma de Barcelona

MELISSA collaboration agreement ECT/FG/CB/95.205

ESTEC/CONTRACT 11549/95/N2/FG

-TECHNICAL NOTE 25.320-

NITRIFYING COMPARTMENT STUDIES

Starting of the nitrifying reactor.

Version : 1

Issue : 0

PEREZ J.; MONTESINOS J.L. ; GODIA F.
Dpt. Enginyeria Química
Universitat Autònoma de Barcelona
08193 Bellaterra, Barcelona, Spain

OCTOBER 1996

STARTING OF THE NITRIFYING REACTOR. PHASE 1.2

In order to maintain MELISSA loop operation, a control system is being developed that will be able to control each subcompartment and, at a higher level, will be responsible for maintaining the whole system stable. This system (denominated system station), has two main functions, at each compartment. The first one is the configuration and operation of the local control system and the second one is the communication and command of the P100 controllers. The P100 controllers are fully autonomous programmable devices able to manage four regulation loops (when using a VCC only). The system station is also able to communicate to other stations, without control possibilities, but which have access to the process data through the local network. This allows to monitor and store the process data.

For the control of the MELISSA loop the system has to optimize the values of a group of parameters in order to assure an optimal behaviour. As the system is in development the user has to develop and test its own control laws and incorporate them in the control system. This is a possibility offered by the MDC100 software from INDUSTAR as it is implemented in the third level of control, the so called general purpose station (GPS). This station allows to develop specific software applications, using C language, that can be used to control the system. It is in this station where the software for the control system is developed.

Taking the work already performed by MATRA and FSC ltd. as a starting point, the software architecture has been reviewed (TN 25.5). This covers the upgrade of the software so that it could control all the four compartments and perform a global control. The software has been extended for all the compartments - screen, declarations and main loop. A reliable alarm system has been set. Moreover, signal treatment and disk storage has been included. Among other software improvements, graphical data display, help system and file management system allowing file copying, moving and removal, modification of the network test routine to avoid the program to stop when the net is physically disconnected and possibility for a several simultaneous monitoring stations has been also included.

In figure 1, the main screen for the GPS is presented with the different MELISSA compartments and its corresponding flow-sheet diagram. The MELISSA-help system for the

GPS is shown in figure 2 with the respective comments for the various key functions.

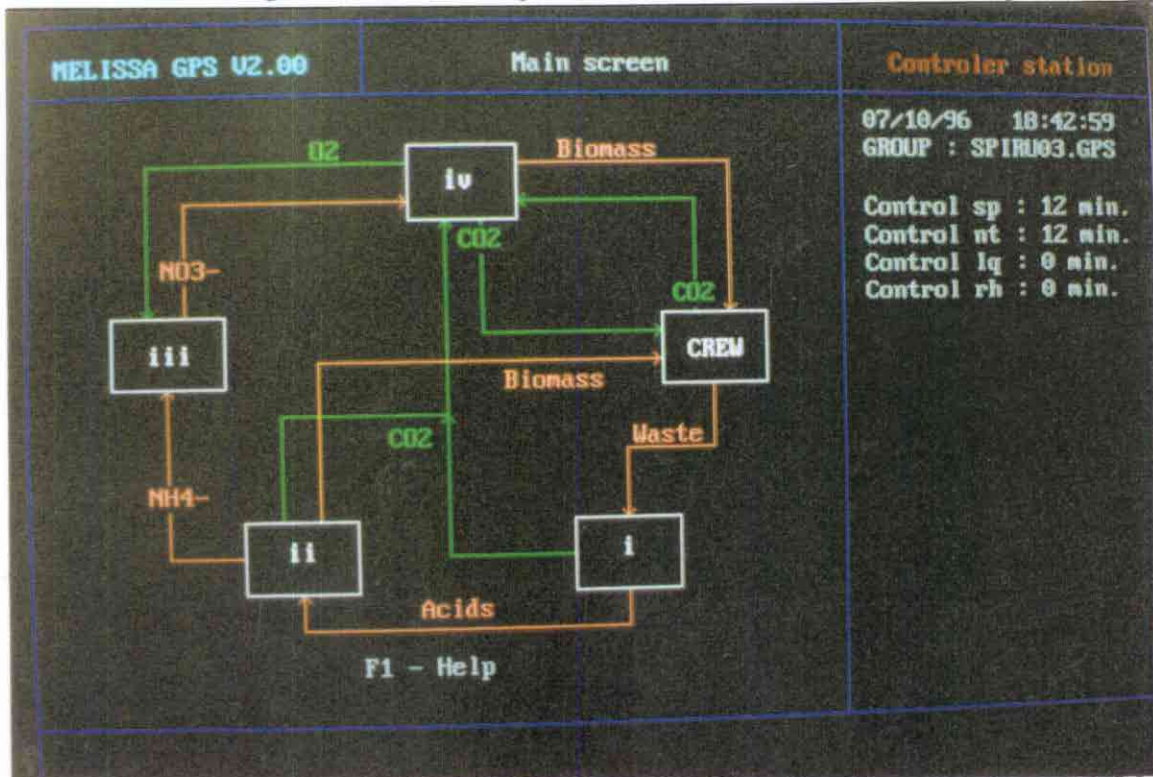


Figure 1. Flow-sheet diagram for the MELISSA system.

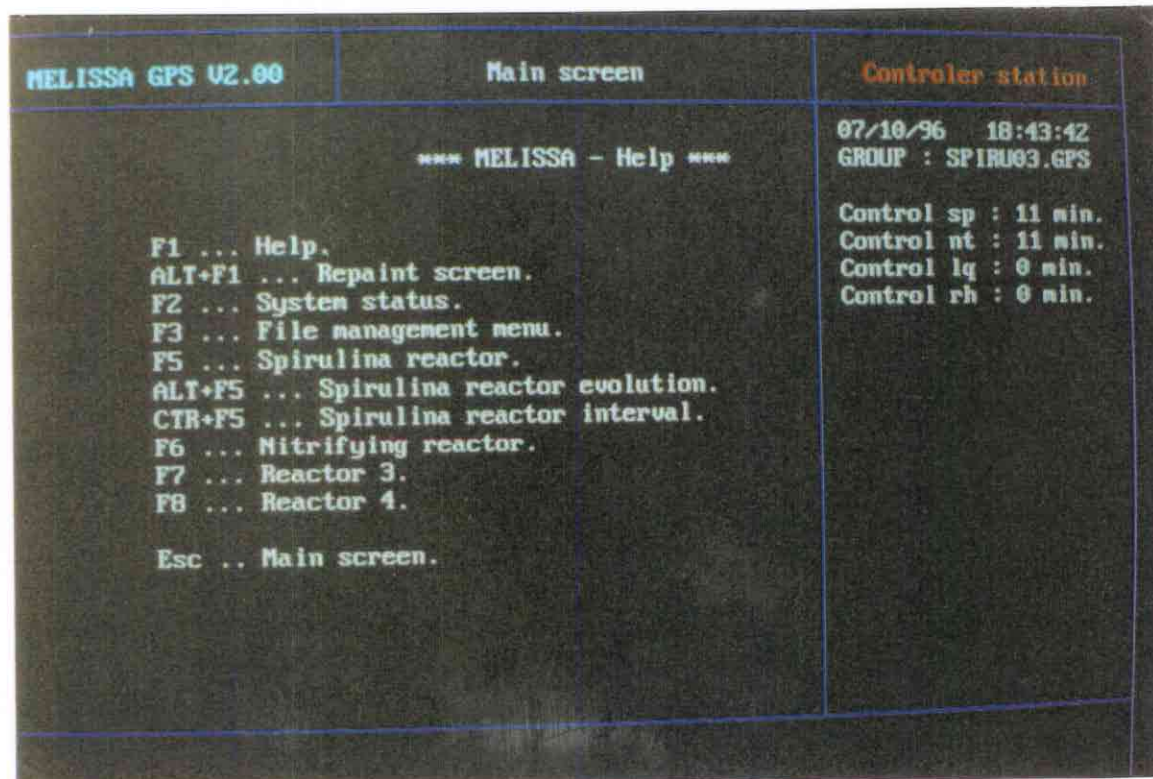


Figure 2. MELISSA-help system.

The time-evolution graph and a table for the key parameters in *Spirulina* compartment are displayed in Figures 3 and 4.

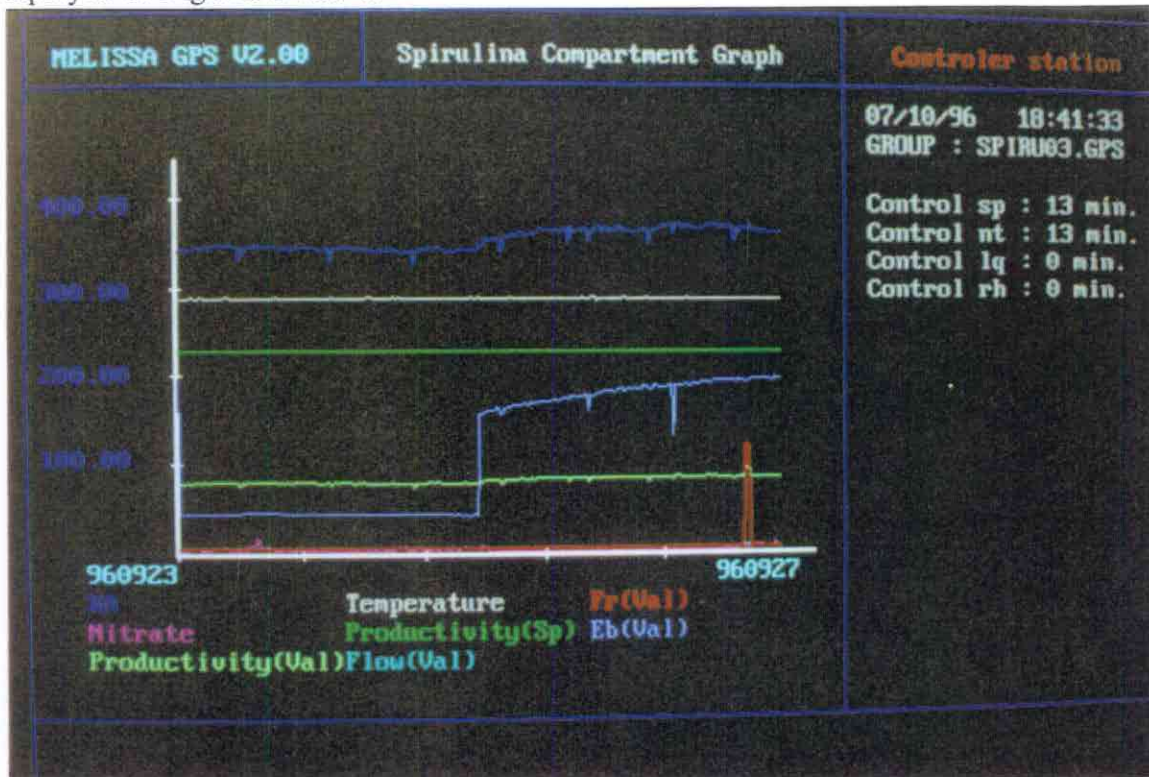


Figure 3. Time-evolution graph for key parameters in *Spirulina* compartment.

MELISSA GPS U2.00		Spirulina compartment		Controller station	
				07/10/96	18:42:01
				GROUP : SPIRU01.GPS	
				Control sp : 13 min.	
				Control nt : 13 min.	
				Control lq : 0 min.	
				Control rh : 0 min.	
		Value	SetPoint		
Biomass (ng/l)		419.8	200.1		
Nitrate (ng/l)		0.0	6.6		
Eb (l/n2)		200.4	6.3		
Fr (l/n2)		10.0	10.0		
		Setpt	Model	Realised	Measured
Productivity (ng/h)		28.00	47.17	28.35	47.36
Flow (l/h)		0.113		0.113	
Acquisition of ALARMS ...					

Figure 4. Table of key parameters from *Spirulina* compartment.

In respect to the starting of the nitrifying reactor, the third step to be conducted consists in the integration of the different control loops within the general structure of the control system, in particular, the system and general purpose stations (GPS). This step is performed after the completion of the two previous ones, comprising the operability of the packed bed reactor and the test of the control loops (TN 25.310). Also the GPS station has been configured in order to support the control laws of the nitrifying compartment. This has been done in connection with WP 25.5. Moreover, variables, screens and other interface and graphic capabilities have been defined, configured and tested in the system and user stations to be possible the whole managing of the system.

Software documentation is presented in this TN 25.320. The variables used for the packed bed bioreactor in the nitrifying compartment are listed in the following pages. All this variables are also defined as variables of the data base 1. Hence, variables are not listed twice. As output of this workpackage the packed bioreactor is just ready to perform control tests.

1. LIST OF VARIABLES AND COMMANDS

The process data generated by the system are supplied from the control equipment. Therefore it is important to define a list of the process variables sent by the equipments and transmitted to the application programs, these are the input variables. In addition to those input variables, it is also necessary to define all the associated alarm conditions, output variables and commands sent to the equipments, and also the calculated variables. Each of them will be associated with an identifier called TAG for input variables and COMMAND for output variables.

So the definitions that have to be done are:

- Digital tags (DI,DO)
- Analog tags (AI,AO)
- Digital commands (DO), this includes the commands available to the user and those calculated and sent by the control software.
- Analogic command, commands available to the user or calculated by the control system.

The system manages three different kinds of analogic commands:

- regulation (LOOP). The set point, output value, ratio, bias, and loop state have to

be define as analogic variables.

- Present value (PV) of the corresponding control loop.
- Set point (SPC) of the corresponding control loop.
- virtual discrete (VD,IS)
- memory location code (LOC)

All of these variables may be used to animate the synoptics and the control panels.

With this list is possible to define the input variables from equipments and the associated alarm conditions. This list of variables contains the main "repères", that means the main input and virtual variables.

LIST OF VARIABLES

variable	labelled	tr	équi	té zo et	@API
AI--0301	DO top	21	103	MR	1 0
AI--0302	pH Fixed Bed Bottom	21	103	MR	1 0
AI--0303	DO bottom	21	103	MR	1 0
AI--0304	pH Fixed Bed Top	21	103	MR	1 0
AI--0309	Temperature Top	21	103	MR	1 0
AI--0310	Temperature Bottom	21	103	MR	1 0
AI--0311	Pressure top	21	103	MR	1 0
AI--0312	Not used	21	103	MR	1 0
AI--0401	NH4 concentration	21	104	MR	1 0
AI--0402	NO3 concentration	21	104	MR	1 0
AI--0403	Not used	21	104	MR	1 0
AI--0404	Not used	21	104	MR	1 0
AI--0409	Pressure TECH SEP	21	104	MR	1 0
AI--0410	Not used	21	104	MR	1 0
AI--0411	Not used	21	104	MR	1 0
AI--0412	Not used	21	104	MR	1 0

AO--0301	Input liquid pump	21	103	MR	1 0
AO--0302	Output liquid pump	21	103	MR	1 0
AO--0305	O2 mass flow meter	21	103	MR	1 0
AO--0306	Sampling pump speed	21	103	MR	1 0
AO--0401	Acid pump	21	104	MR	1 0
AO--0402	Base pump	21	104	MR	1 0
AO--0405	N2 mass flow meter	21	104	MR	1 0
AO--0406	CO2 mass flow meter	21	104	MR	1 0
DI--0421	Not used	11	103	MR	1 1 E
DI--0422	Not used	11	103	MR	1 1 E
DI--0423	Not used	11	103	MR	1 1 E
DI--0424	Not used	11	103	MR	1 1 E
DI--0429	Not used	11	103	MR	1 1 E
DI--0430	Not used	11	103	MR	1 1 E
DI--0431	Not used	11	103	MR	1 1 E
DI--0432	Not used	11	103	MR	1 1 E
DI--0421	NO3 analyzer	11	104	MR	1 1 E
DI--0422	NH4 analyzer	11	104	MR	1 1 E
DI--0423	Not used	11	104	MR	1 1 E
DI--0424	Not used	11	104	MR	1 1 E
DI--0429	Level sensors	11	104	MR	1 1 E
DI--0430	Not used	11	104	MR	1 1 E
DI--0431	Not used	11	104	MR	1 1 E
DI--0432	Not used	11	104	MR	1 1 E
DO--0321	Cooling valve	11	103	MR	1 1 E
DO--0322	Heater	11	103	MR	1 1 E
DO--0325	Air pump	11	103	MR	1 1 E
DO--0326	Safety valve	11	103	MR	1 1 E
DO--0421	Relay acid pump	11	104	MR	1 1 E
DO--0422	Relay base pump	11	104	MR	1 1 E
DO--0425	Relay selection level sensor	11	104	MR	1 1 E

DO--0426	Relay pulse level lecture	11	104	MR	1	1	E
IS--0361	Heater or cooling valve	11	103	MR	1	1	E
IS--0362	Not used	11	103	MR	1	1	E
IS--0363	Reset counter temperature	11	103	MR	1	1	E
IS--0364	Heater	11	103	MR	1	1	E
IS--0365	Not used	11	103	MR	1	1	E
IS--0366	Not used	11	103	MR	1	1	E
IS--0367	Not used	11	103	MR	1	1	E
IS--0368	Not used	11	103	MR	1	1	E
IS--0369	Not used	11	103	MR	1	1	E
IS--0370	Not used	11	103	MR	1	1	E
IS--0371	Not used	11	103	MR	1	1	E
IS--0372	Not used	11	103	MR	1	1	E
IS--0373	Not used	11	103	MR	1	1	E
IS--0374	Not used	11	103	MR	1	1	E
IS--0375	Not used	11	103	MR	1	1	E
IS--0376	Pressure bioreactor top > 80mb	11	103	MR	1	1	E
IS--0377	Not used	11	103	MR	1	1	E
IS--0378	Not used	11	103	MR	1	1	E
IS--0379	Not used	11	103	MR	1	1	E
IS--0380	Dev alarm (temperature loop)	11	103	MR	1	1	E
IS--0381	averaged temperature > 28°C	11	103	MR	1	1	E
IS--0382	IS380=IS381=1	11	103	MR	1	1	E
IS--0383	IS390=IS391=1	11	103	MR	1	1	E
IS--0384	Not used	11	103	MR	1	1	E
IS--0385	Not used	11	103	MR	1	1	E
IS--0386	Not used	11	103	MR	1	1	E
IS--0387	Not used	11	103	MR	1	1	E
IS--0388	Not used	11	103	MR	1	1	E
IS--0389	Not used	11	103	MR	1	1	E
IS--0390	O2 mass flow meter closed	11	103	MR	1	1	E
IS--0461	pH control counter	11	104	MR	1	1	E

IS--0462	pH control counter	11	104	MR	1	1	E
IS--0463	pH loop action	11	104	MR	1	1	E
IS--0464	Not used	11	104	MR	1	1	E
IS--0465	Not used	11	104	MR	1	1	E
IS--0466	Not used	11	104	MR	1	1	E
IS--0467	Ammonium calibration counter	11	104	MR	1	1	E
IS--0468	Ammonium calibration counter	11	104	MR	1	1	E
IS--0469	Not used	11	104	MR	1	1	E
IS--0470	Not used	11	104	MR	1	1	E
IS--0471	Not used	11	104	MR	1	1	E
IS--0472	Not used	11	104	MR	1	1	E
IS--0473	Not used	11	104	MR	1	1	E
IS--0474	Not used	11	104	MR	1	1	E
IS--0475	Not used	11	104	MR	1	1	E
IS--0476	Sensor lecture counter	11	104	MR	1	1	E
IS--0477	Relay sensor high/low	11	104	MR	1	1	E
IS--0478	Low sensor level	11	104	MR	1	1	E
IS--0479	High sensor level	11	104	MR	1	1	E
IS--0480	High level (IS480=1)	11	104	MR	1	1	E
IS--0481	Low level (IS481=0)	11	104	MR	1	1	E
IS--0482	Level alarm (IS482=1)	11	104	MR	1	1	E
IS--0483	Normal level (IS483=1)	11	104	MR	1	1	E
IS--0484	Not used	11	104	MR	1	1	E
IS--0485	Lecture pulse	11	104	MR	1	1	E
IS--0486	Lecture pulse	11	104	MR	1	1	E
IS--0487	Lecture pulse	11	104	MR	1	1	E
IS--0488	Not used	11	104	MR	1	1	E
IS--0489	Not used	11	104	MR	1	1	E
IS--0490	Not used	11	104	MR	1	1	E
LOC-0309	Input medium flow-rate	21	103	MR	1	1	E
LOC-0310	Not used	21	103	MR	1	1	E
LOC-0311	Not used	21	103	MR	1	1	E

LOC-0312	Not used	21	103	MR	1	1	E
LOC-0313	Not used	21	103	MR	1	1	E
LOC-0314	Not used	21	103	MR	1	1	E
LOC-0315	Not used	21	103	MR	1	1	E
LOC-0316	Not used	21	103	MR	1	1	E
LOC-0317	Not used	21	103	MR	1	1	E
LOC-0318	Not used	21	103	MR	1	1	E
LOC-0319	Not used	21	103	MR	1	1	E
LOC-0320	Not used	21	103	MR	1	1	E
LOC-0321	Not used	21	103	MR	1	1	E
LOC-0322	Not used	21	103	MR	1	1	E
LOC-0323	Not used	21	103	MR	1	1	E
LOC-0324	Not used	21	103	MR	1	1	E
LOC-0325	Not used	21	103	MR	1	1	E
LOC-0326	Not used	21	103	MR	1	1	E
LOC-0327	Not used	21	103	MR	1	1	E
LOC-0328	Not used	21	103	MR	1	1	E
LOC-0329	Not used	21	103	MR	1	1	E
LOC-0330	Not used	21	103	MR	1	1	E
LOC-0331	Not used	21	103	MR	1	1	E
LOC-0332	Not used	21	103	MR	1	1	E
LOC-0333	Not used	21	103	MR	1	1	E
LOC-0334	Not used	21	103	MR	1	1	E
LOC-0335	Not used	21	103	MR	1	1	E
LOC-0336	Not used	21	103	MR	1	1	E
LOC-0337	Not used	21	103	MR	1	1	E
LOC-0338	Not used	21	103	MR	1	1	E
LOC-0339	Not used	21	103	MR	1	1	E
LOC-0340	Not used	21	103	MR	1	1	E
LOC-0341	BIAS	21	103	MR	1	1	E
LOC-0342	1-BIAS	21	103	MR	1	1	E
LOC-0343	Not used	21	103	MR	1	1	E
LOC-0344	Not used	21	103	MR	1	1	E

LOC-0345	Not used	21	103	MR	1	1	E
LOC-0346	Not used	21	103	MR	1	1	E
LOC-0347	Not used	21	103	MR	1	1	E
LOC-0348	Not used	21	103	MR	1	1	E
LOC-0349	Not used	21	103	MR	1	1	E
LOC-0350	Not used	21	103	MR	1	1	E
LOC-0351	Not used	21	103	MR	1	1	E
LOC-0352	Not used	21	103	MR	1	1	E
LOC-0353	Not used	21	103	MR	1	1	E
LOC-0354	Not used	21	103	MR	1	1	E
LOC-0355	Not used	21	103	MR	1	1	E
LOC-0356	Not used	21	103	MR	1	1	E
LOC-0357	Not used	21	103	MR	1	1	E
LOC-0358	Not used	21	103	MR	1	1	E
LOC-0359	Not used	21	103	MR	1	1	E
LOC-0360	Not used	21	103	MR	1	1	E
LOC-0361	Not used	21	103	MR	1	1	E
LOC-0362	Not used	21	103	MR	1	1	E
LOC-0363	Not used	21	103	MR	1	1	E
LOC-0364	Not used	21	103	MR	1	1	E
LOC-0365	Not used	21	103	MR	1	1	E
LOC-0366	Not used	21	103	MR	1	1	E
LOC-0367	Not used	21	103	MR	1	1	E
LOC-0368	Not used	21	103	MR	1	1	E
LOC-0369	Not used	21	103	MR	1	1	E
LOC-0370	Not used	21	103	MR	1	1	E
LOC-0371	Not used	21	103	MR	1	1	E
LOC-0372	Not used	21	103	MR	1	1	E
LOC-0409	Not used	21	104	MR	1	1	E
LOC-0410	Not used	21	104	MR	1	1	E
LOC-0411	Not used	21	104	MR	1	1	E
LOC-0412	Not used	21	104	MR	1	1	E
LOC-0413	Not used	21	104	MR	1	1	E

LOC-0414	Not used	21	104	MR	1	1	E
LOC-0415	Not used	21	104	MR	1	1	E
LOC-0416	Not used	21	104	MR	1	1	E
LOC-0417	Not used	21	104	MR	1	1	E
LOC-0418	Not used	21	104	MR	1	1	E
LOC-0419	Not used	21	104	MR	1	1	E
LOC-0420	Not used	21	104	MR	1	1	E
LOC-0421	Not used	21	104	MR	1	1	E
LOC-0422	Not used	21	104	MR	1	1	E
LOC-0423	Not used	21	104	MR	1	1	E
LOC-0424	Not used	21	104	MR	1	1	E
LOC-0425	Not used	21	104	MR	1	1	E
LOC-0426	Not used	21	104	MR	1	1	E
LOC-0427	Not used	21	104	MR	1	1	E
LOC-0428	Not used	21	104	MR	1	1	E
LOC-0429	Not used	21	104	MR	1	1	E
LOC-0430	Not used	21	104	MR	1	1	E
LOC-0431	Not used	21	104	MR	1	1	E
LOC-0432	Not used	21	104	MR	1	1	E
LOC-0433	Not used	21	104	MR	1	1	E
LOC-0434	Not used	21	104	MR	1	1	E
LOC-0435	Not used	21	104	MR	1	1	E
LOC-0436	Not used	21	104	MR	1	1	E
LOC-0437	Not used	21	104	MR	1	1	E
LOC-0438	Not used	21	104	MR	1	1	E
LOC-0439	Not used	21	104	MR	1	1	E
LOC-0440	Not used	21	104	MR	1	1	E
LOC-0441	Not used	21	104	MR	1	1	E
LOC-0442	Not used	21	104	MR	1	1	E
LOC-0443	Not used	21	104	MR	1	1	E
LOC-0444	Not used	21	104	MR	1	1	E
LOC-0445	Not used	21	104	MR	1	1	E
LOC-0446	Not used	21	104	MR	1	1	E

LOC-0447	Not used	21	104	MR	1	1	E
LOC-0448	Not used	21	104	MR	1	1	E
LOC-0449	Not used	21	104	MR	1	1	E
LOC-0450	Not used	21	104	MR	1	1	E
LOC-0451	Not used	21	104	MR	1	1	E
LOC-0452	Not used	21	104	MR	1	1	E
LOC-0453	Not used	21	104	MR	1	1	E
LOC-0454	Not used	21	104	MR	1	1	E
LOC-0455	Not used	21	104	MR	1	1	E
LOC-0456	Not used	21	104	MR	1	1	E
LOC-0457	Not used	21	104	MR	1	1	E
LOC-0458	Not used	21	104	MR	1	1	E
LOC-0459	Not used	21	104	MR	1	1	E
LOC-0460	Not used	21	104	MR	1	1	E
LOC-0461	Not used	21	104	MR	1	1	E
LOC-0462	Not used	21	104	MR	1	1	E
LOC-0463	Not used	21	104	MR	1	1	E
LOC-0464	Not used	21	104	MR	1	1	E
LOC-0465	Not used	21	104	MR	1	1	E
LOC-0466	Not used	21	104	MR	1	1	E
LOC-0467	Not used	21	104	MR	1	1	E
LOC-0468	Not used	21	104	MR	1	1	E
LOC-0469	Not used	21	104	MR	1	1	E
LOC-0470	Not used	21	104	MR	1	1	E
LOC-0471	Not used	21	104	MR	1	1	E
LOC-0472	Not used	21	104	MR	1	1	E
PV--0301	No control variable	21	103	MR	1	0	
PV--0302	No control variable	21	103	MR	1	0	
PV--0303	DO average	21	103	MR	1	0	
PV--0304	pH average	21	103	MR	1	0	
PV--0305	No control variable	21	103	MR	1	0	
PV--0306	No control variable	21	103	MR	1	0	

PV--0307	Temperature average	21	103	MR	1 0
PV--0308	Pressure fixed bed top	21	103	MR	1 0
PV--0401	No control variable	21	104	MR	1 0
PV--0402	No control variable	21	104	MR	1 0
PV--0403	No control variable	21	104	MR	1 0
PV--0404	NH4 concentration	21	104	MR	1 0
PV--0405	no control variable	21	104	MR	1 0
PV--0406	no control variable	21	104	MR	1 0
PV--0407	NO3 concentration	21	104	MR	1 0
PV--0408	no control variable	21	104	MR	1 0
SPC-0301	no active control loop	21	103	MR	1 0
SPC-0302	no active control loop	21	103	MR	1 0
SPC-0303	DO set point	21	103	MR	1 0
SPC-0304	pH set point	21	103	MR	1 0
SPC-0305	no active control loop	21	103	MR	1 0
SPC-0306	no active control loop	21	103	MR	1 0
SPC-0307	Temperature set point	21	103	MR	1 0
SPC-0308	no active control loop	21	103	MR	1 0
SPC-0401	no active control loop	21	104	MR	1 0
SPC-0402	no active control loop	21	104	MR	1 0
SPC-0403	no active control loop	21	104	MR	1 0
SPC-0404	NH4 set point	21	104	MR	1 0
SPC-0405	no active control loop	21	104	MR	1 0
SPC-0406	no active control loop	21	104	MR	1 0
SPC-0407	no active control loop	21	104	MR	1 0
SPC-0408	no active control loop	21	104	MR	1 0
VD--0341	Not used	11	103	MR	1 1 E
VD--0342	Not used	11	103	MR	1 1 E
VD--0343	Not used	11	103	MR	1 1 E
VD--0344	Not used	11	103	MR	1 1 E

VD--0345	Not used	11	103	MR	1 1 E
VD--0346	Not used	11	103	MR	1 1 E
VD--0347	Not used	11	103	MR	1 1 E
VD--0348	Not used	11	103	MR	1 1 E
VD--0349	Overpressure valve	11	103	MR	1 1 E
VD--0350	Not used	11	103	MR	1 1 E
VD--0351	Not used	11	103	MR	1 1 E
VD--0352	Not used	11	103	MR	1 1 E
VD--0353	Not used	11	103	MR	1 1 E
VD--0354	Not used	11	103	MR	1 1 E
VD--0355	Not used	11	103	MR	1 1 E
VD--0356	Not used	11	103	MR	1 1 E
VD--0441	Not used	11	104	MR	1 1 E
VD--0442	Not used	11	104	MR	1 1 E
VD--0443	Not used	11	104	MR	1 1 E
VD--0444	Not used	11	104	MR	1 1 E
VD--0445	Not used	11	104	MR	1 1 E
VD--0446	Not used	11	104	MR	1 1 E
VD--0447	Not used	11	104	MR	1 1 E
VD--0448	Not used	11	104	MR	1 1 E
VD--0449	Not used	11	104	MR	1 1 E
VD--0450	Not used	11	104	MR	1 1 E
VD--0451	Not used	11	104	MR	1 1 E
VD--0452	Not used	11	104	MR	1 1 E
VD--0453	Not used	11	104	MR	1 1 E
VD--0454	Not used	11	104	MR	1 1 E
VD--0455	Not used	11	104	MR	1 1 E
VD--0456	Not used	11	104	MR	1 1 E

LIST OF COMMANDS.

This list contains output variables. These variables have to be defined previously in the LIST OF VARIABLES. With this list it is possible to define the digital and analogic

commands available for the user or evaluated for the system.

command	labelled	cc	équi	té	zo	VL
LOC-0309	Input medium flow-rate	71	103	MR	1	3
LOC-0310	Not used	71	103	MR	1	3
LOC-0311	Not used	71	103	MR	1	3
LOC-0312	Not used	71	103	MR	1	3
LOC-0313	Not used	71	103	MR	1	3
LOC-0314	Not used	71	103	MR	1	3
LOC-0315	Not used	71	103	MR	1	3
LOC-0316	Not used	71	103	MR	1	3
LOC-0317	Not used	71	103	MR	1	3
LOC-0318	Not used	71	103	MR	1	3
LOC-0319	Not used	71	103	MR	1	3
LOC-0320	Not used	71	103	MR	1	3
LOC-0321	Not used	71	103	MR	1	3
LOC-0322	Not used	71	103	MR	1	3
LOC-0323	Not used	71	103	MR	1	3
LOC-0324	Not used	71	103	MR	1	3
LOC-0325	Not used	71	103	MR	1	3
LOC-0326	Not used	71	103	MR	1	3
LOC-0327	Not used	71	103	MR	1	3
LOC-0328	Not used	71	103	MR	1	3
LOC-0329	Not used	71	103	MR	1	3
LOC-0330	Not used	71	103	MR	1	3
LOC-0331	Not used	71	103	MR	1	3
LOC-0332	Not used	71	103	MR	1	3
LOC-0333	Not used	71	103	MR	1	3
LOC-0334	Not used	71	103	MR	1	3
LOC-0335	Not used	71	103	MR	1	3
LOC-0336	Not used	71	103	MR	1	3
LOC-0337	Not used	71	103	MR	1	3

LOC-0338	Not used	71	103	MR	1	3
LOC-0339	Not used	71	103	MR	1	3
LOC-0340	Not used	71	103	MR	1	3
LOC-0341	BIAS	71	103	MR	1	3
LOC-0342	1-BIAS	71	103	MR	1	3
LOC-0343	Not used	71	103	MR	1	3
LOC-0344	Not used	71	103	MR	1	3
LOC-0345	Not used	71	103	MR	1	3
LOC-0346	Not used	71	103	MR	1	3
LOC-0347	Not used	71	103	MR	1	3
LOC-0348	Not used	71	103	MR	1	3
LOC-0349	Not used	71	103	MR	1	3
LOC-0350	Not used	71	103	MR	1	3
LOC-0351	Not used	71	103	MR	1	3
LOC-0352	Not used	71	103	MR	1	3
LOC-0353	Not used	71	103	MR	1	3
LOC-0354	Not used	71	103	MR	1	3
LOC-0355	Not used	71	103	MR	1	3
LOC-0356	Not used	71	103	MR	1	3
LOC-0357	Not used	71	103	MR	1	3
LOC-0358	Not used	71	103	MR	1	3
LOC-0359	Not used	71	103	MR	1	3
LOC-0360	Not used	71	103	MR	1	3
LOC-0361	Not used	71	103	MR	1	3
LOC-0362	Not used	71	103	MR	1	3
LOC-0363	Not used	71	103	MR	1	3
LOC-0364	Not used	71	103	MR	1	3
LOC-0365	Not used	71	103	MR	1	3
LOC-0366	Not used	71	103	MR	1	3
LOC-0367	Not used	71	103	MR	1	3
LOC-0368	Not used	71	103	MR	1	3
LOC-0369	Not used	71	103	MR	1	3
LOC-0370	Not used	71	103	MR	1	3

LOC-0371	Not used	71	103	MR	1	3
LOC-0372	Not used	71	103	MR	1	3
LOC-0409	Not used	71	104	MR	1	4
LOC-0410	Not used	71	104	MR	1	4
LOC-0411	Not used	71	104	MR	1	4
LOC-0412	Not used	71	104	MR	1	4
LOC-0413	Not used	71	104	MR	1	4
LOC-0414	Not used	71	104	MR	1	4
LOC-0415	Not used	71	104	MR	1	4
LOC-0416	Not used	71	104	MR	1	4
LOC-0417	Not used	71	104	MR	1	4
LOC-0418	Not used	71	104	MR	1	4
LOC-0419	Not used	71	104	MR	1	4
LOC-0420	Not used	71	104	MR	1	4
LOC-0421	Not used	71	104	MR	1	4
LOC-0422	Not used	71	104	MR	1	4
LOC-0423	Not used	71	104	MR	1	4
LOC-0424	Not used	71	104	MR	1	4
LOC-0425	Not used	71	104	MR	1	4
LOC-0426	Not used	71	104	MR	1	4
LOC-0427	Not used	71	104	MR	1	4
LOC-0428	Not used	71	104	MR	1	4
LOC-0429	Not used	71	104	MR	1	4
LOC-0430	Not used	71	104	MR	1	4
LOC-0431	Not used	71	104	MR	1	4
LOC-0432	Not used	71	104	MR	1	4
LOC-0433	Not used	71	104	MR	1	4
LOC-0434	Not used	71	104	MR	1	4
LOC-0435	Not used	71	104	MR	1	4
LOC-0436	Not used	71	104	MR	1	4
LOC-0437	Not used	71	104	MR	1	4
LOC-0438	Not used	71	104	MR	1	4
LOC-0439	Not used	71	104	MR	1	4

LOC-0440	Not used	71	104	MR	1	4
LOC-0441	Not used	71	104	MR	1	4
LOC-0442	Not used	71	104	MR	1	4
LOC-0443	Not used	71	104	MR	1	4
LOC-0444	Not used	71	104	MR	1	4
LOC-0445	Not used	71	104	MR	1	4
LOC-0446	Not used	71	104	MR	1	4
LOC-0447	Not used	71	104	MR	1	4
LOC-0448	Not used	71	104	MR	1	4
LOC-0449	Not used	71	104	MR	1	4
LOC-0450	Not used	71	104	MR	1	4
LOC-0451	Not used	71	104	MR	1	4
LOC-0452	Not used	71	104	MR	1	4
LOC-0453	Not used	71	104	MR	1	4
LOC-0454	Not used	71	104	MR	1	4
LOC-0455	Not used	71	104	MR	1	4
LOC-0456	Not used	71	104	MR	1	4
LOC-0457	Not used	71	104	MR	1	4
LOC-0458	Not used	71	104	MR	1	4
LOC-0459	Not used	71	104	MR	1	4
LOC-0460	Not used	71	104	MR	1	4
LOC-0461	Not used	71	104	MR	1	4
LOC-0462	Not used	71	104	MR	1	4
LOC-0463	Not used	71	104	MR	1	4
LOC-0464	Not used	71	104	MR	1	4
LOC-0465	Not used	71	104	MR	1	4
LOC-0466	Not used	71	104	MR	1	4
LOC-0467	Not used	71	104	MR	1	4
LOC-0468	Not used	71	104	MR	1	4
LOC-0469	Not used	71	104	MR	1	4
LOC-0470	Not used	71	104	MR	1	4
LOC-0471	Not used	71	104	MR	1	4
LOC-0472	Not used	71	104	MR	1	4

LOOP0301	No active control loop	41	103	MR	1	3
LOOP0302	No active control loop	41	103	MR	1	3
LOOP0303	DO	41	103	MR	1	3
LOOP0304	pH	41	103	MR	1	3
LOOP0305	No active control loop	41	103	MR	1	3
LOOP0306	No active control loop	41	103	MR	1	3
LOOP0307	Temperature	41	103	MR	1	3
LOOP0308	Pressure	41	103	MR	1	3
LOOP0401	No active control loop	41	104	MR	1	4
LOOP0402	No active control loop	41	104	MR	1	4
LOOP0403	No active control loop	41	104	MR	1	4
LOOP0404	Ammonium	41	104	MR	1	4
LOOP0405	No active control loop	41	104	MR	1	4
LOOP0406	No active control loop	41	104	MR	1	4
LOOP0407	Nitrate	41	104	MR	1	4
LOOP0408	No active control loop	41	104	MR	1	4
VD--0341	Not used	61	103	MR	1	3
VD--0342	Not used	61	103	MR	1	3
VD--0343	Not used	61	103	MR	1	3
VD--0344	Not used	61	103	MR	1	3
VD--0345	Not used	61	103	MR	1	3
VD--0346	Not used	61	103	MR	1	3
VD--0347	Not used	61	103	MR	1	3
VD--0348	Not used	61	103	MR	1	3
VD--0349	Overpressure valve	61	103	MR	1	3
VD--0350	Not used	61	103	MR	1	3
VD--0351	Not used	61	103	MR	1	3
VD--0352	Not used	61	103	MR	1	3
VD--0353	Not used	61	103	MR	1	3
VD--0354	Not used	61	103	MR	1	3
VD--0355	Not used	61	103	MR	1	3
VD--0356	Not used	61	103	MR	1	3

VD--0441	Not used	61	104	MR	1	4
VD--0442	Not used	61	104	MR	1	4
VD--0443	Not used	61	104	MR	1	4
VD--0444	Not used	61	104	MR	1	4
VD--0445	Not used	61	104	MR	1	4
VD--0446	Not used	61	104	MR	1	4
VD--0447	Not used	61	104	MR	1	4
VD--0448	Not used	61	104	MR	1	4
VD--0449	Not used	61	104	MR	1	4
VD--0450	Not used	61	104	MR	1	4
VD--0451	Not used	61	104	MR	1	4
VD--0452	Not used	61	104	MR	1	4
VD--0453	Not used	61	104	MR	1	4
VD--0454	Not used	61	104	MR	1	4
VD--0455	Not used	61	104	MR	1	4
VD--0456	Not used	61	104	MR	1	4

In Figures 5 and 6 the display of the different control loops and locations can be seen, As an example of the screens that have been implemented both system and user stations.

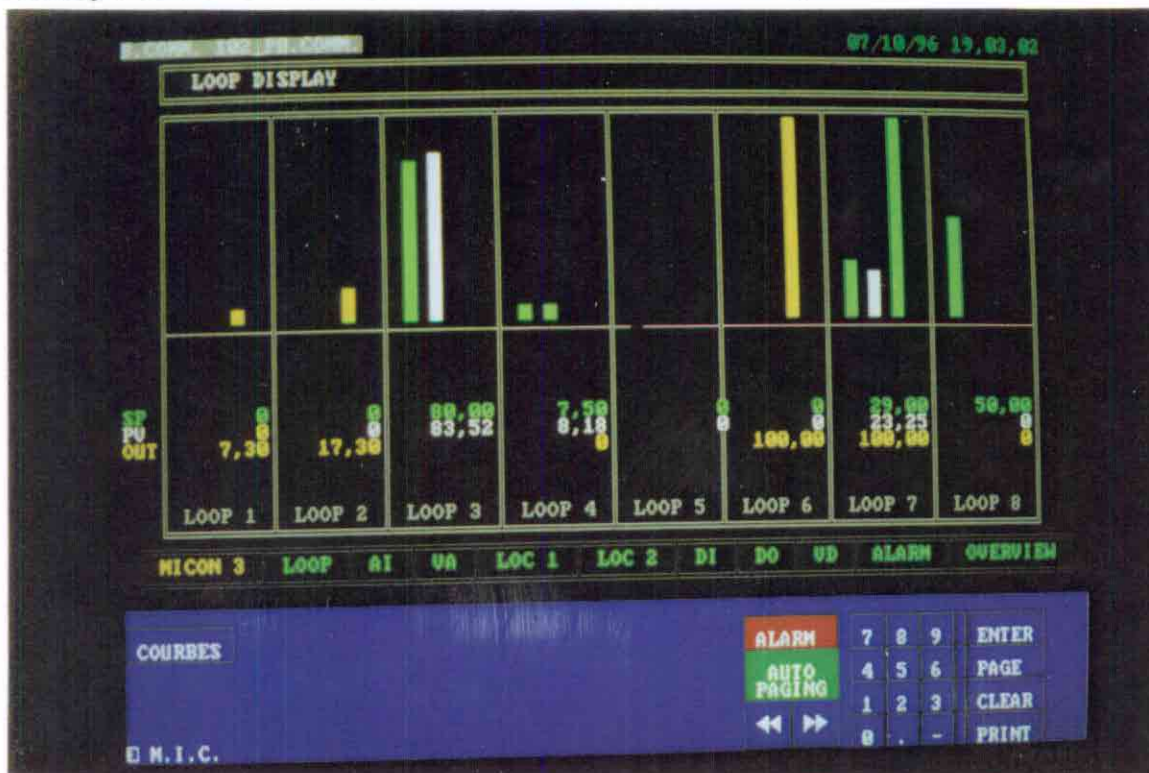


Figure 5. Display of the control loops for Nitrifying compartment.

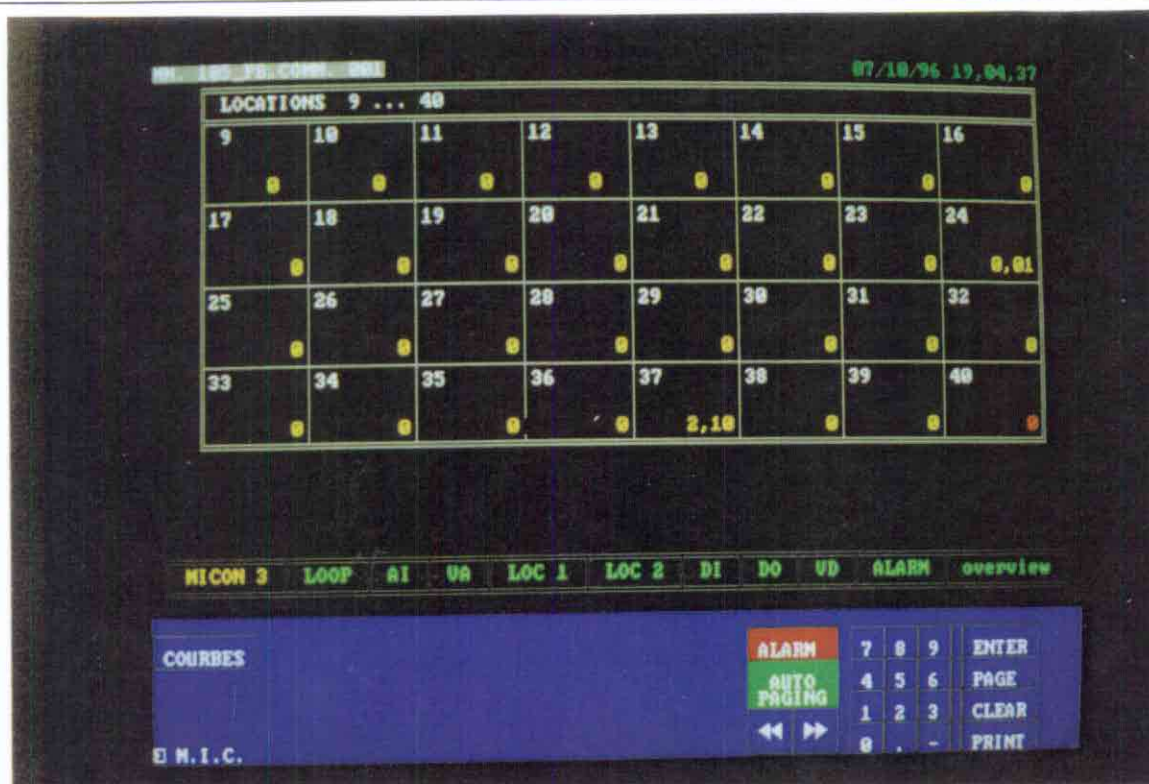


Figure 6. Display of locations for Nitrifying compartment.

2. NITRIFYING GROUPS FOR CURVES AND DATA TREATMENT

Archiving Applications Configuration

The values of surveyed variables may be archived on disk for later analyses reports production or curve drawing. The report generation software uses two databases, HISTO which contain raw samples of configured variables and, HISTO2 for calculated records. It also uses the data coming from the mail box.

To configure the databases the first step is to define the station which receive the configuration. The configuration may be different for each station. Afterwards is necessary to define the structure of each database as follows:

- Duration of record is the time period that is wanted to save on disk, data are gathered and stored in a FIFO file.

- Storage unit
- Number of scanning frequencies (5 maximum) from 1 second to 60 seconds for the first data base HISTO. For the second one HISTO2 data are scanned every minute, averaged and stored once every hour.

The system calculates the available disk space and enquire the operator to confirm or not his choices.

The first database, definition of the variables is first done by specifying their sampling rates, and afterwards gathering them in groups to allow exploitation. An archive group contains up to ten variables among those defined. A group is characterised by the group name, time scale, display mode of data and data order and characteristics.

The second database definition of variables to be treated is defined with his name, description, and type of treatment to be done. The report generation software allows also the creation and printing of report issued with real time data, in this case we shall define groups containing up to ten variables.

Graphical display of archived and current data values

The MDC100 software has two other main functions: curves and data processing. The graphic representation of the data on a colour screen is useful to follow the behaviour of the process. The user may choose and modify the following items: the displayed group (ten variables maximum), the displayed variables, the visualisation scale, the time scale and so on. The software has also the capability of data printing from the two databases.

For the first database HISTO, the data can be extracted by printing a table of process values, or transferring then to an ASCII file for later exploitation or graphic printing. The second data base HISTO2 allows periodic report edition and counters check.

Up on setting up the Nitrifying compartment, and configuration of its controller new variables become available, the values of those variables that can be stored in groups,

Nitrifying (Group6) and Nitrifying II (Group7), are listed below, corresponding to the first database.

B.D. 1 N° GROUPE : 6

nom du groupe : NITRIFYING

date : 150996 heure : 1400

code échelle : 3 option : 1

mode : 0 ny : 1

repère	ver	libellé	sp	cl	seuil bas	seuil haut	unité	minimum	maximum
AI--0301	1	DO top	60	1	0.000	100.000	%	0.000	100.000
AI--0303	1	DO bottom	60	2	0.000	100.000	%	0.000	100.000
SPC-0303	1	DO set point	60	3	0.000	100.000	%	0.000	100.000
AI--0304	1	pH top	60	4	0.000	14.000		0.000	14.000
AI--0302	1	pH Fixed Bed	60	5	0.000	14.000		0.000	14.000
SPC-0304	1	pH set point	60	6	0.000	14.000		0.000	14.000
AI--0309	1	TemperatureT	60	7	0.000	140.000	C	0.000	140.000
AI--0310	1	TemperatureB	60	8	0.000	140.000	C	0.000	140.000
SPC-0307	1	Temperatures	60	9	0.000	140.000	C	0.000	140.000
AI--0311	1	Pressure top	60	10	0.000	1000.000	mb	0.000	1000.000

B.D. 1 N° GROUPE : 7

nom du groupe : NITRIFYING II

date : 051096 heure : 1930

code échelle : 3 option : 1

mode : 0 ny : 1

repère	ver	libellé	sp	cl	seuil bas	seuil haut	unité	minimum	maximum
AI--0401	1	NH4 conc.	60	1	0.000	50.000	mg/L	0.000	50.000
SPC-0404	1	NH4 setp	60	2	0.000	50.000	mg/L	0.000	50.000
AI--0402	1	NO3 conc.	60	3	0.000	110.00	mg/L	0.000	110.000
AI--0409	1	P TECH	60	4	-1.000	1.000	bar	-1.000	1.000
SPC-0308	1	Pressure top	60	5	0.000	100.00	mbar	0.000	100.00
AO--0305	1	O2 mass cont	60	6	0.000	0.500	l/min	0.000	0.500
AI--0405	1	N2 mass cont	60	7	0.000	20.00	l/min	0.000	20.00
AI--0406	1	CO2 mass con	60	8	0.000	0.500	l/min	0.000	0.500

Data, graphic pages and plots obtained in real-time, at system and user stations, for Nitrifying compartment are presented in Figures 7 and 8.

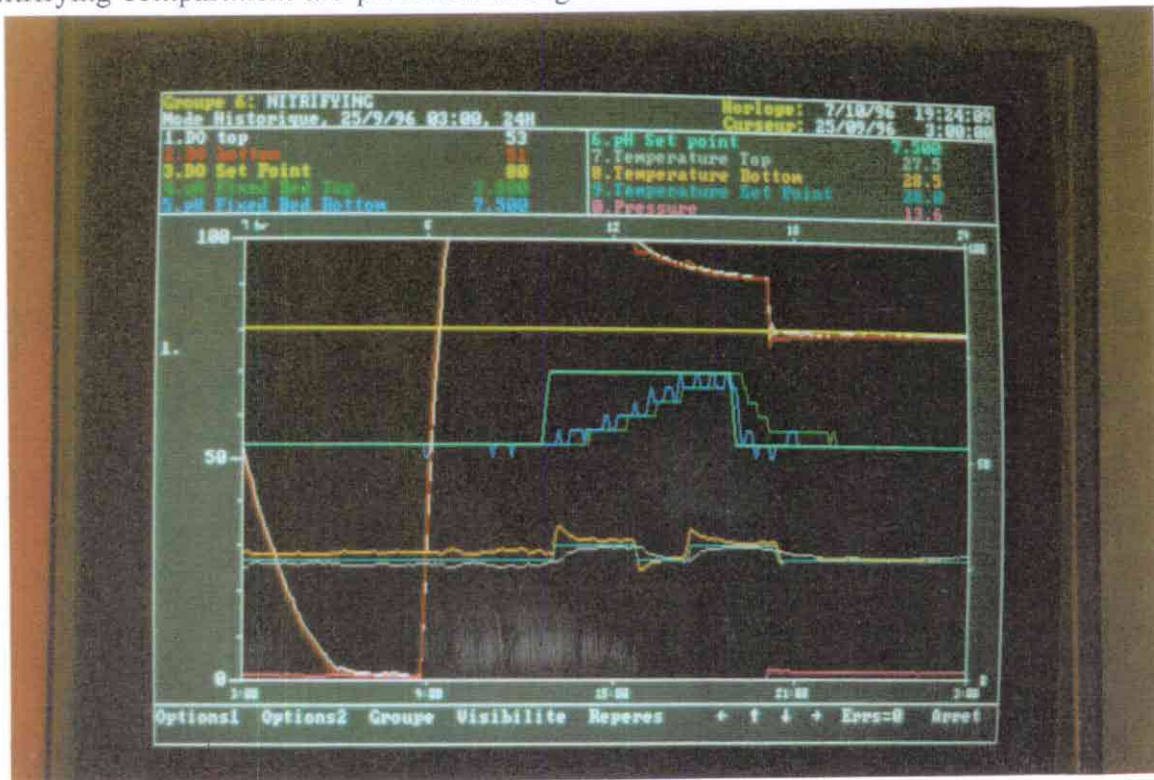


Figure 7. Graphic and data corresponding to Group6 NITRIFYING.

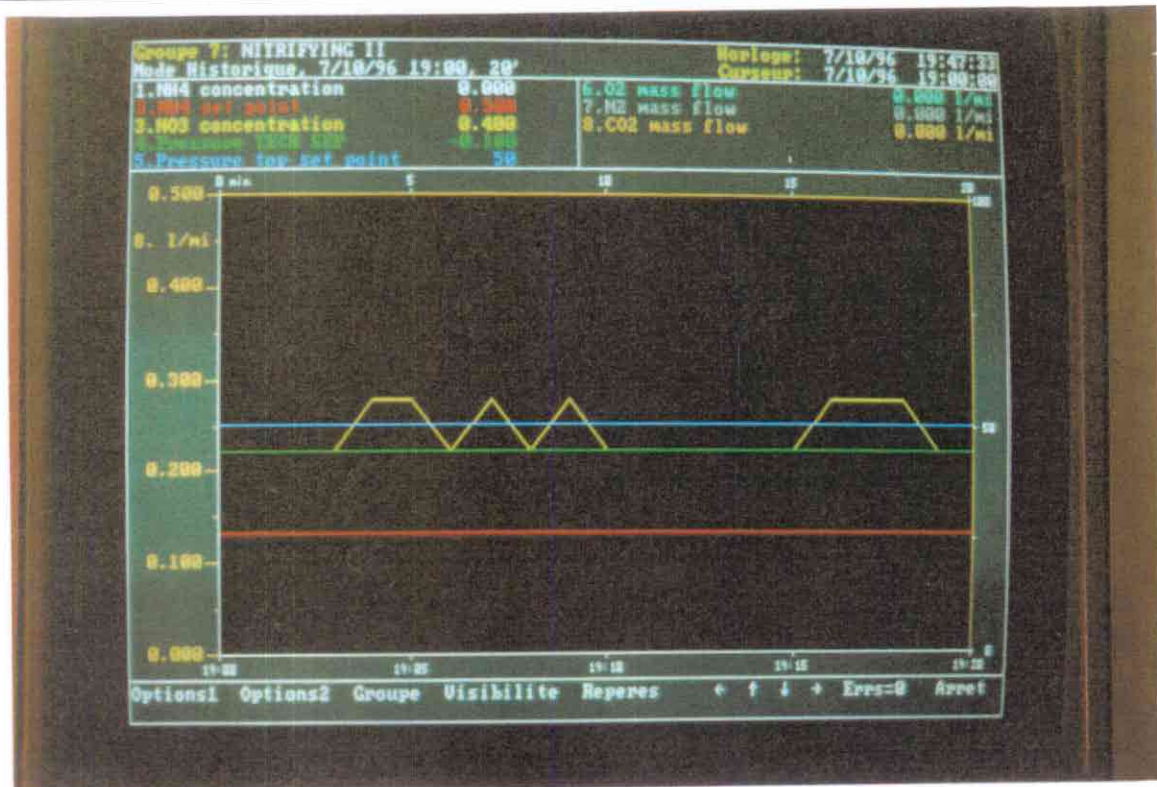


Figure 8. Graphic and data corresponding to Group7 NITRIFYING II.

3. GPS group.

The GPS communicates with the control/command station connected to the process, using a set of predefined procedures (GPS programming interface) to read or write data related to the controlled process. It may access two types of data, TAG (read only) and COMMAND (read and write). The permission to access/modify data is configured by the system configuration software. Data are gathered by 40 items in a group, of which only one may be active at a time. This station is intended to support user specific software such as a control model and allows a global view of many processes.

As a tool for system configuration, the software provides the possibility of the constitution of groups of variables, which will be managed by the programming interface. Only the variables defined during the configuration sessions can be included in the groups. A group contains a maximum of 40 variables (tags and commands).

As a first file version (NITR.GPS), the GPS group of the Nitrifying Compartment is composed for only several variables, in order to be able to obtain, store and display different test data:

LOOP-0303	DO (%)
LOOP-0304	pH
LOOP-0307	Temperature (°C)
LOOP-0308	Pressure (mbar)
LOOP-0404	Ammonium concentration (mg/L)
LOOP-0407	Nitrate concentration (mg/L)

Locations (LOC) could be also added, whenever necessary, for control purposes, for instance, when using a control model in future applications.

On-line data and graphics obtained for this compartment are shown in Figures 9 and 10.

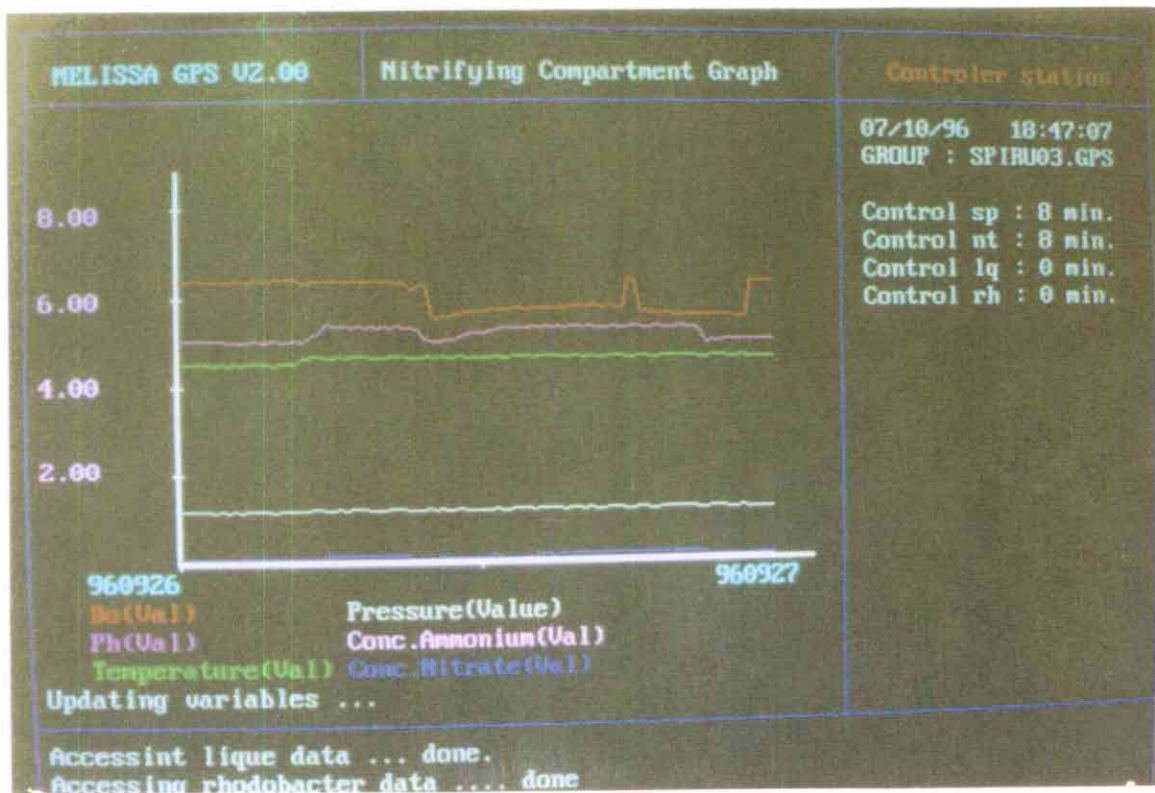


Figure 9. Nitrifying compartment graph at GPS station.

MELISSA GPS U2.00	Nitrifying compartment		Controler station
			07/10/96 18:42:26 GROUP : SPIRU03.GPS
			Control sp : 12 min. Control nt : 12 min. Control lq : 0 min. Control rh : 0 min.
	Value	SetPoint	
DO (%)	83.6	80.0	
pH	8.2	7.5	
Temp. (°C)	23.2	29.0	
Pressure (bar)	23.2	29.0	
NH3+ (mg/l)	0.0	0.5	
NO3- (mg/l)	0.4	0.0	

Figure 10. Nitrifying compartment data.

REFERENCES

PONS, P.L., ALBIOL, J., GODIA, F. (1996). General Purpose Station. Main Program update. TECHNICAL NOTE 25.5. ESTEC CONTRACT 11549/95/NL/FG.

PEREZ, J., MONTESINOS J.L., GODIA, F. (1996). Starting of the nitrifying reactor. Steps 1 and 2. TECHNICAL NOTE 25.310. ESTEC CONTRACT 11549/95/NL/FG.