

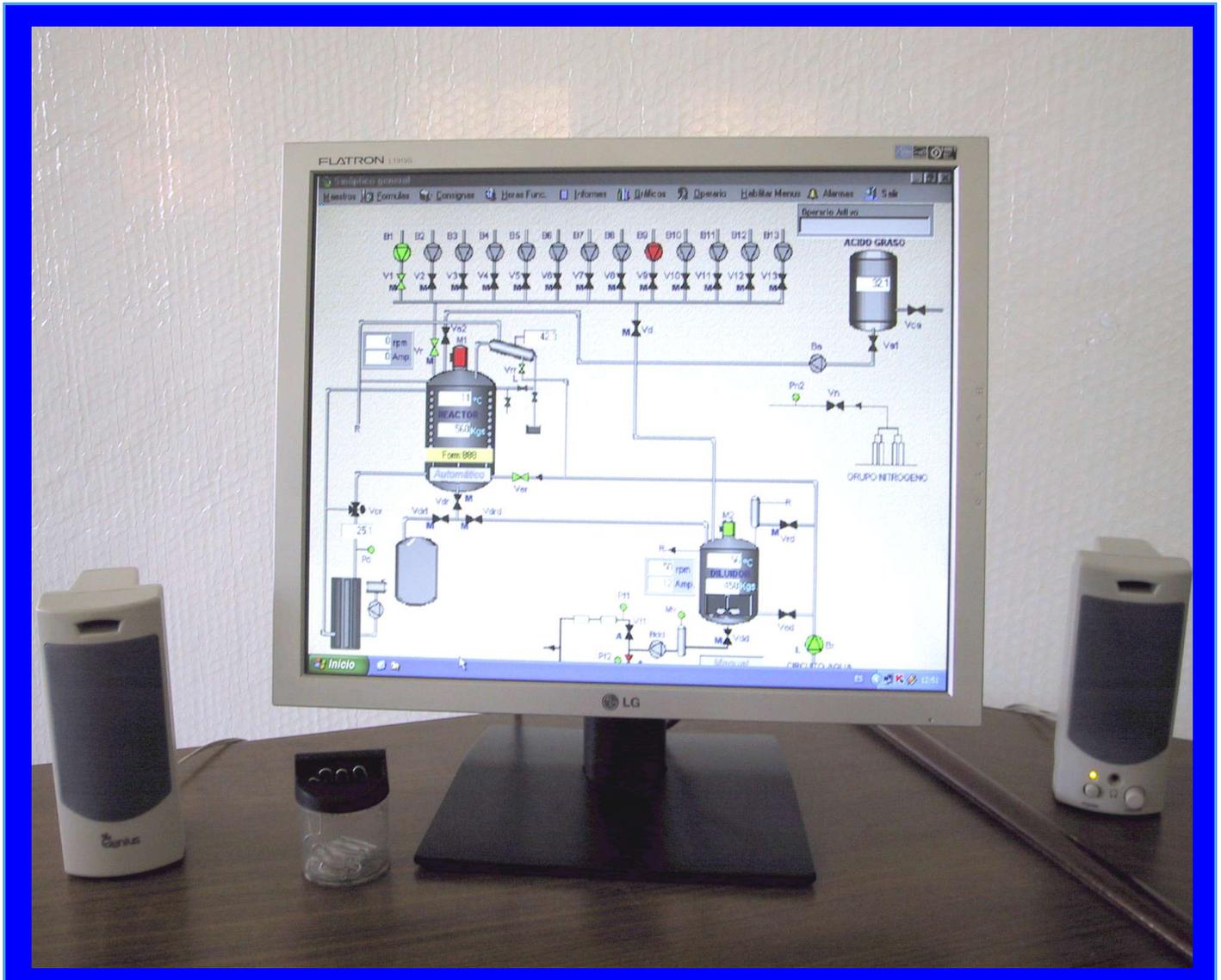
Manufacturing Plant for Production of Resins



NTD designs and builds installations of resins. We make and install reactors, dissolvers, solvent installations, thermal oils, nitrogen, circulation systems, filtration, storing, etc.

The operation can be manual, semi-automatic or automatic. This sample is described below:

- Plant with computerized control system, production, formulation and dosing.
Installations with EExd protection (flame-proof).



Control system supplied by NTD is a database developed in Windows environment with the following features:

- § General screen. It shows a diagram of all different processes of the plant. It gives a dynamic view of all control devices.
- § Possibility of action over components (motor, pumps, valves, etc..)
- § Setting-up of masters: products, lines, workers, etc..
- § Starting and monitoring processes (M.O.)
- § Alarm management and setting.
- § User management (workers).
- § Reporting: formulas, consumption of products, alarms, etc.

This system eases an absolute control over processes, not only operational, but also over production..

Link with other management systems (AS-400, BAAN, SAP, etc.) is also possible.

Easy use. Only basic knowledge of computers is required to work with the program.

SUPERVISION AND CONTROL SYSTEM FOR MANUFACTURING PLANT FOR PRODUCTION OF ISOCYANATES

MANUAL OF OPERATION

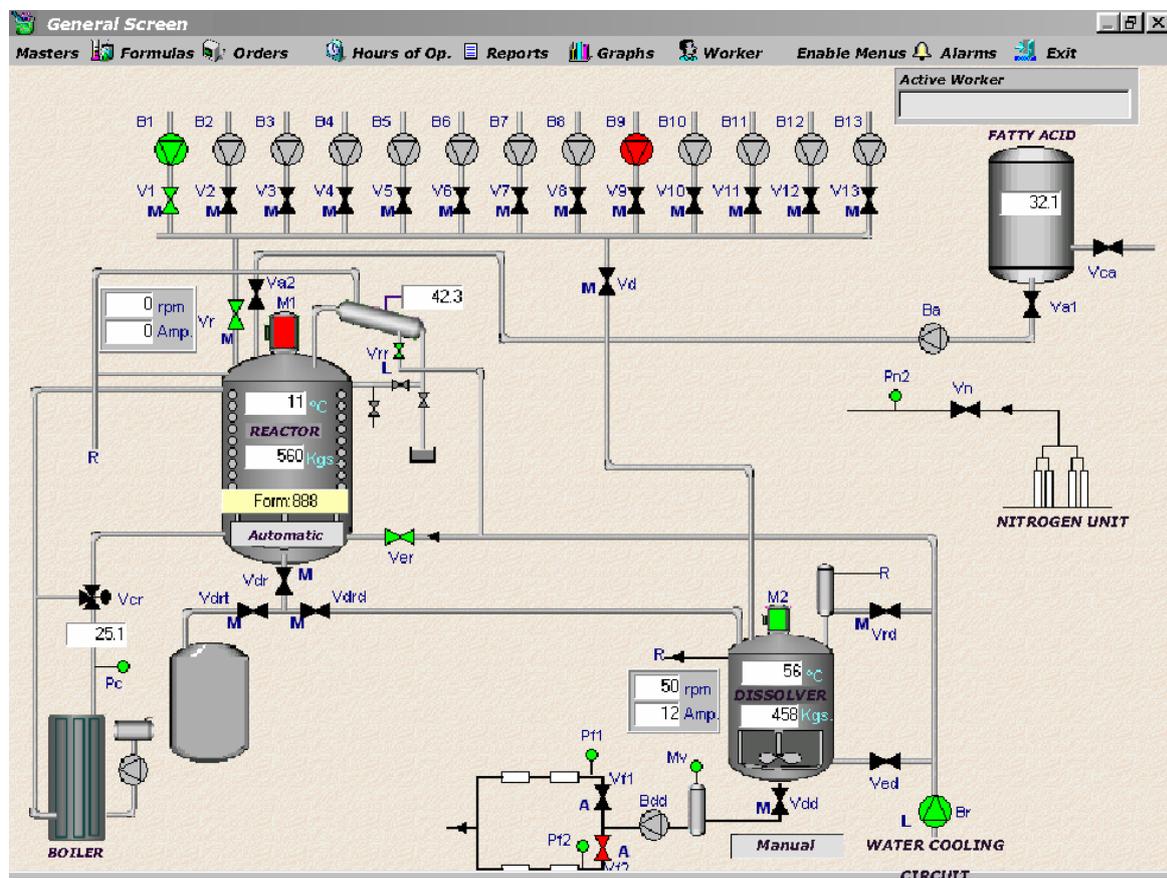
Screenplays containing options that are described in following pages, constitutes integrated Control and Supervision Program.

The Program is developed in WindowsNT environment; therefore, the appropriate icon must be clicked on desktop to execute the program.

Name of icon in this guide is “NTD”.

Mouse double click on the icon executes the program, coming out the general screen. This is the centre of operations and the access to detailed screens and Menu options, which links with the operations.

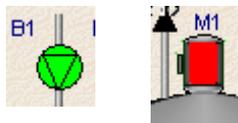
GENERAL SCREEN



As you can see on pictures below, there is a general view of all components of installation. State of control elements are classified with different colours.

Pumps, motors

Green: In process
Grey: Stop
Red: Thermal difference



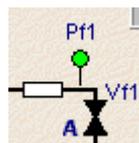
Valves:

Verde: opened
Black: closed
Red: Irregularity: after request of open, the valve remains closed



Pressure switch

Green: It is not activated
Red: It reaches the value settled.

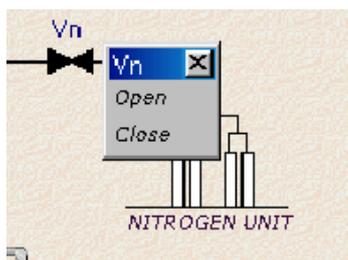


System analogue variables (temperature, rpm, amperes, weight) appear in digital values on the body of respective components, reactor, dissolver, fatty acid and heater.

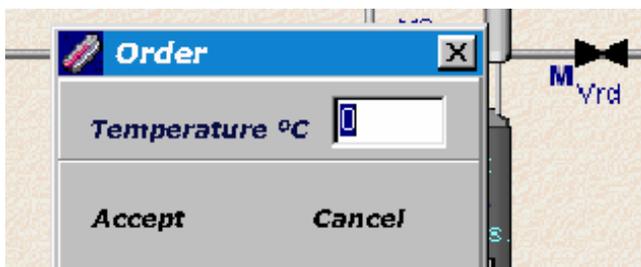
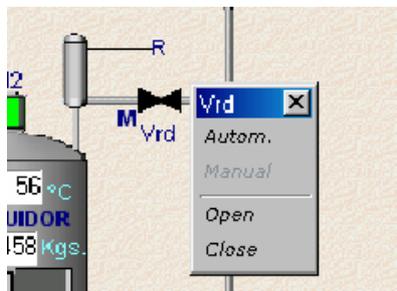
In addition, letter indicates on control components their operation mode:

- A – Automatic
- M – Manual
- L – Local

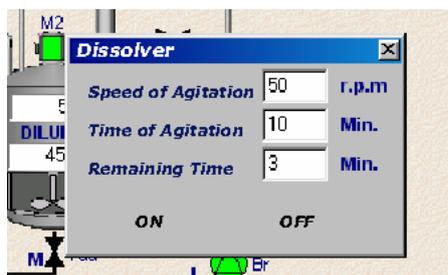
To command valves, click on them from computer to open a window with options: open, close.



Click on Cooling Electrovalves on reactor condensers (Vrr) and Dissolver (VRD) to open a window and select operational mode. Select Manual to open and close the valve. In Automatic mode, you can set working orders.



Motor-Agitator



Click on motor and enter on a pop-up window speed and time of agitation. It shows the remaining minutes to finish the process. If user wants to keep the agitator working (non-stop), “0” must be written on time field.

NOTE: To change speed and time of agitation, press enter to register new data.

On body of reactor and Dissolver, a legend indicates the mode (automatic/manual) and the formula in process. E.g. Formula 888. Legend coloured in yellow means the formula is in process; grey means formula stopped.

Apart from showing state and actions of different components, on the upper side of general screen, there is a general menu, which gives access to different options of the program. They are described below.

MENU

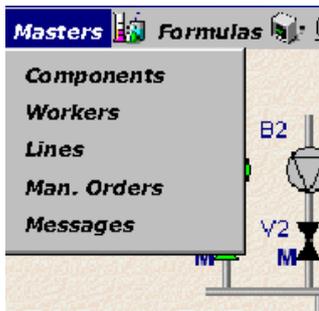
The program has three access levels with their respective passwords. Number 3 means maximum priority and 1 minimum priority.

Level 3 – It gives access to all options so you can set lowest level users.

Level 2 – Gives access to options defined.

Level 1 – Gives access to system operative options. You can not access to other menu options.

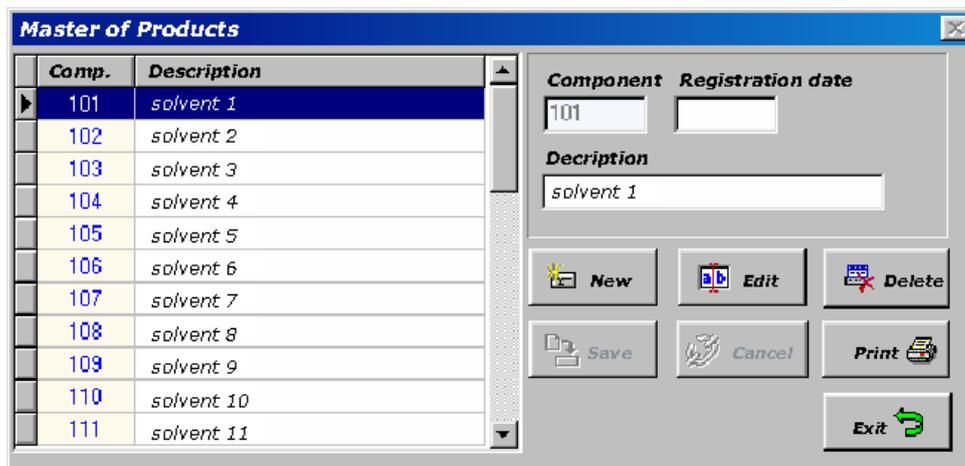
Masters



This option menu contains masters: Components, Workers, Lines, Messages, Orders.

Components

Set up products used in the processes in this master, either raw material or finished products.



Data fields are Component, Description, and Registration date.

Action buttons in all masters have the same meaning:

New. Create new register

Edit. Allow to modify registered data

Delete. Eliminate a register

Save. Record new data

Cancel. Modifications are not saved.

Print. Print data from master.

Exit. Close the window and return to general diagram

Workers

Set workers in this master assigning them Code, Name, Security Level and Password.

Code	Name
1	WORKER 1
3	worker 3
4	Worker 4
5	pepe

Code: 3
Name: worker 3
Level of Security: 3
Password: 3

New Edit Delete
Save Cancel Exit

Lines

Assign products to automatic lines. In this master, you can also enter inertia data in kg. used to close the valve in order to compensate pipe inertia.

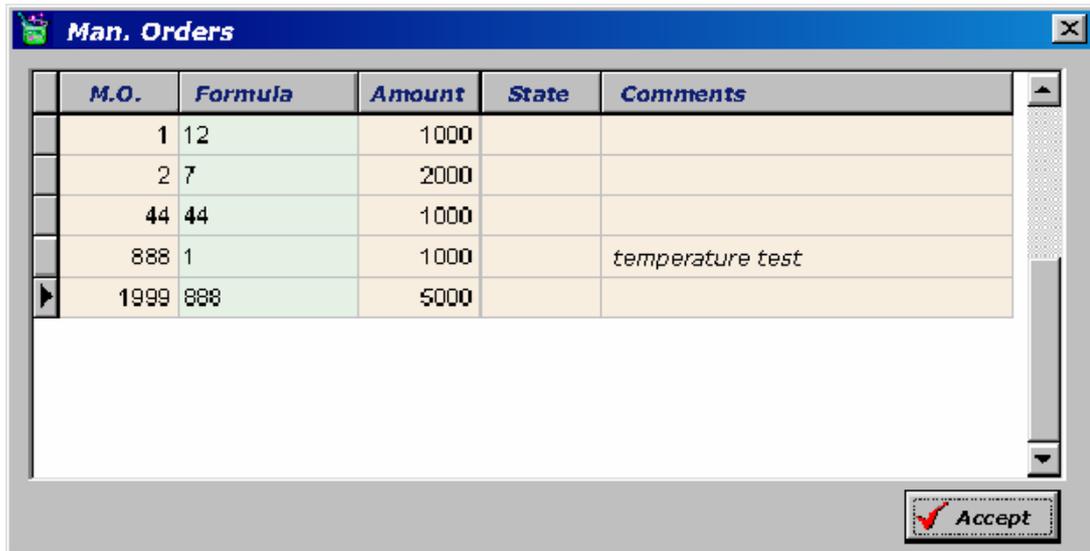
Lines	Product	Inertia
Ba	fatty acid	14
L1	solvent 1	1
L10	solvent 10	10
L11	solvent 11	11
L12	solvent 12	12
L13	solvent 13	13
L2	solvent 2	2
L3	solvent 3	3
L4	solvent 4	4
L5	solvent 5	5
L6	solvent 6	6

Line: Ba Product: 114 Inertia: 14
Product Description: fatty acid

Edit Save Cancel
Exit

Orders

Click on this menu option to open manufacturing orders tab. You can create or assign new orders.



M.O.	Formula	Amount	State	Comments
1	12	1000		
2	7	2000		
44	44	1000		
888	1	1000		<i>temperature test</i>
1999	888	5000		

Go to the last line and enter No. of M.O (Manufacturing Order), formula and amount. There is a field to add comments.

Messages

Set any possible messages that will pop up during automatic execution of formulas.

Code	Message
10	VERIFY VISCOSITY
20	OPEN MANUAL VALVES

Alarm indicator

Alarms

When an alarm goes off during the process, a window comes out (alarm indicator) showing in red, date/time of the alarm.

Alarms		
22/02/99 20:19:16	Electrovalve malfunction Vf2	22/02/99 20:19:18

Left double click opens the alarm indicator tab with a button to register alarms. You can access to the indicator from this option menu.

Alarm Indicator			
Alarm	Start	End	Registered
Thermal Irregularity B-9	22/02/99 20:18:58		
Electrovalve malfunction Vf2	22/02/99 20:19:16	22/02/99 20:19:18	

Group

Register All Close

When alarm is registered and is still active, you will get a green indication. If the alarm is no longer active and nobody has registered it, the indication is yellow.

Likewise, if an alarm is registered and after that, it loses the “alarm condition”, the alarm is deleted automatically from the window and registered in Alarm history.

Master of Formulas

Here, you can set up formulas for different manufacturing processes.

Seq.	Reac	Process	Product	Batch	Messages		Orders			Sequence		
					Mes.1	Mes.2	% Kgs	rpm °C/min	Temp. °C	Min.Ag. Min.M	Next Seq.	Execute Seq.
5	1	1 SOLVENT	108 solvent 8	123			48				10	
10	1	9 HEAT / COOL							80	20	20	110
20	1	1 SOLVENT	106 solvent 6				10				30	
30	1	1 SOLVENT	101 solvent 1	1234			5				40	
40	1	3 FATTY ACID	114 fatty acid				0.8				50	
50	1	2 AGITATE				2		50		10	60	
60	1	3 FATTY ACID	114 fatty acid				7				70	
70	1	2 AGITATE	101 solvent 1					60			80	
80	1	4 ADD SOLID	21 SOLID 1		7	4					90	
90	1	4 ADD SOLID	32 SOLID 4								110	
110	2	1 SOLVENT	105 solvent 5					60		30	115	
120	2	1 SOLVENT	113 solvent 13		9	10	4.2				130	
130	2	4 ADD SOLID	32 SOLID 4				5				140	
140	1	6 UNLOAD REACTOR					100				150	
150	1	1 SOLVENT	102 solvent 2	88			20					

On the lower side of the screen, there are buttons to **Create** new formulas, **Edit** formulas, **Delete**, **Delete line**, **Print** and **Save as**. You can create a new formula making changes on an existing one, changing the name and clicking on **Save as**.

Head of tab consists of Code, Description and Destination reactor (reactor, dissolver)

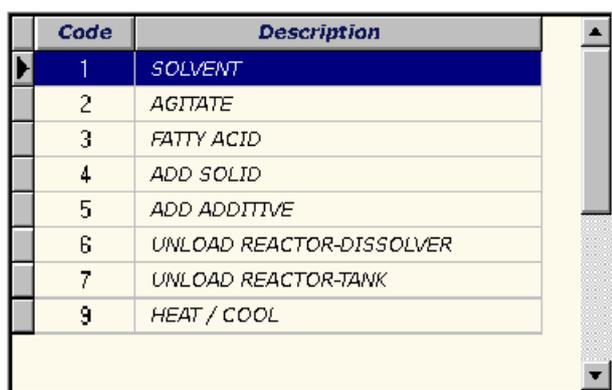
Set the formula entering parameters of action and sequence of execution.

Enter data as follows:

Sequence No: Better, enter from 10 to 10 to enable the addition of steps between sequences.

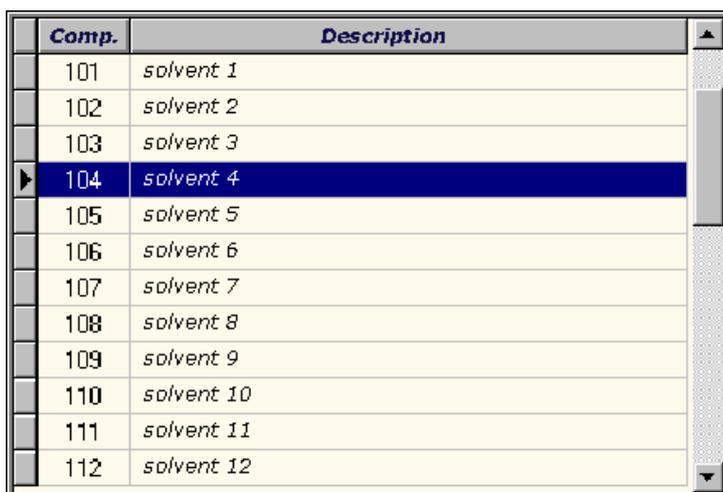
Reactor: Select the component where the process will be performed.

Process: Go to this field and press Enter. An info window drops down a list with all possible actions. Go to the wanted option and press Enter to select it.



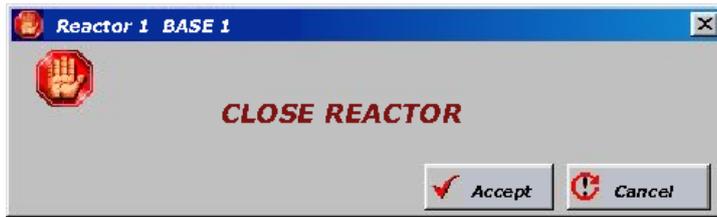
Code	Description
1	SOLVENT
2	AGITATE
3	FATTY ACID
4	ADD SOLID
5	ADD ADDITIVE
6	UNLOAD REACTOR-DISSOLVER
7	UNLOAD REACTOR-TANK
9	HEAT / COOL

Product. Double click on this field or press Enter. An info window appears with a list of products. Go to the product required and press Enter for selection.



Comp.	Description
101	solvent 1
102	solvent 2
103	solvent 3
104	solvent 4
105	solvent 5
106	solvent 6
107	solvent 7
108	solvent 8
109	solvent 9
110	solvent 10
111	solvent 11
112	solvent 12

Message 1. This message appears before starting an action. Press Enter to open master of messages and select the messages. Pop-up message has the following features:



Click “Accept” to perform the action.

Message 2. This message pops up when an action is finished. Click on Accept to execute next action.

%Kg. Kg percentage of product to be dosed.

Rpm., °C/min. This parameter shows agitation speed on agitator and speed of change in temperature on heating/cooling actions.

Min Agit, Min Maint. – Set time of actions in minutes related to agitation and temperature maintenance.

Temperature. Temperature value required for heating and cooling actions.

Next Sequence. Execution of next action will proceed after finishing current one.

Execute sequence. Write sequence number in this field to execute it at the same time as sequence in process.

Orders

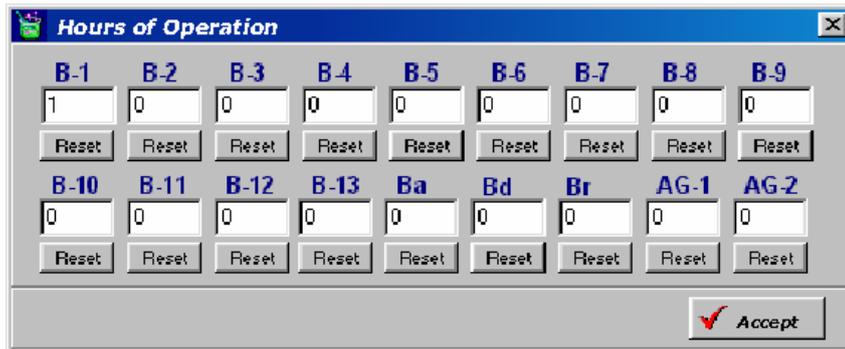
Set security orders to control kg of product in agitators. This way, disk agitator is not damaged as it is always submerged.

Security Temperatures		Reactor	Time Fat. Acid	Boiler	Reactor Steam	Dissolver Steam
Max		220	125	250	200	200
Min		0	0	0	0	0

Security Agitators (kgs)	
Reactor	Dissolver
2000	3000

Hours of operation

Click on this menu option to enter in a new window, data of hours of operation and control elements (pumps and motor). You can reset separately each element. This is a helpful option in maintenance of components.



The 'Hours of Operation' window displays a grid of 18 control elements, each with a numerical value and a 'Reset' button. The elements are arranged in two rows of nine. The first row contains B-1 through B-9, and the second row contains B-10 through B-13, Ba, Bd, Br, AG-1, and AG-2. The values for B-1 through B-9 are 1, 0, 0, 0, 0, 0, 0, 0, and 0 respectively. The values for B-10 through B-13, Ba, Bd, Br, AG-1, and AG-2 are 0, 0, 0, 0, 0, 0, 0, 0, and 0 respectively. An 'Accept' button is located at the bottom right of the window.

Element	Value	Reset
B-1	1	Reset
B-2	0	Reset
B-3	0	Reset
B-4	0	Reset
B-5	0	Reset
B-6	0	Reset
B-7	0	Reset
B-8	0	Reset
B-9	0	Reset
B-10	0	Reset
B-11	0	Reset
B-12	0	Reset
B-13	0	Reset
Ba	0	Reset
Bd	0	Reset
Br	0	Reset
AG-1	0	Reset
AG-2	0	Reset

Graphics

Click on this options to access to graphic screen, which shows different temperatures of processes. Request graphics within dates.

Select one or more variables for the same graphics clicking on them.

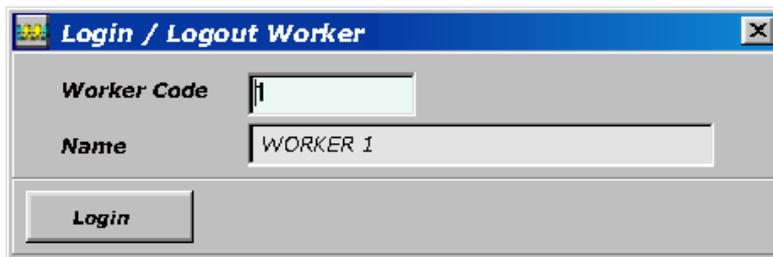


You can print the graphics or zoom the area desired. Perform a drag and drop operation to zoom in the area wanted. Click on remove zoom or perform drag and drop operation backwards to restore normal size.

Go over the graphic to see data/time and temperature values. Values appear on cursor upper-right corner as you place it on one point over the graphic.

Worker

Click on this option to enter the worker code that works on the process. This data is important as data processed is assigned to one worker.



The screenshot shows a dialog box titled "Login / Logout Worker". It contains two input fields: "Worker Code" with a cursor in the first position, and "Name" with the text "WORKER 1" entered. Below the fields is a "Login" button.

Enable Menu

You can enable or disable menu options entering the appropriate passwords

Reports

Click here to access to Alarm report. The rest of data related to production are internally processed for AS-400 system.

Order the report within dates.



The screenshot shows a dialog box titled "Alarm Report". It has two date selection fields: "From" with the date "08/01/99" and "To" with the date "15/01/99". Below these fields are two buttons: "Accept" with a red checkmark icon and "Cancel" with a red circular arrow icon.

Data included in the report are alarm occurred, date/time of start, End date/time, date/time of registration, duration and worker.

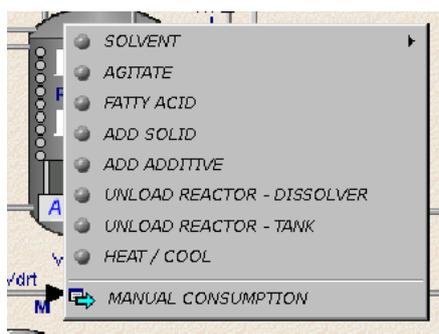
Manufacturing Plant of Resins		Alarm Log From 08/01/99 To 15/01/99		
General stop activated	08/01/99 15:46	08/01/99 15:46	08/01/99 15:46	00:00:17
Reactor stop activated	08/01/99 15:46	08/01/99 15:46	08/01/99 15:46	00:00:17
Dissolver stop activated	08/01/99 15:46	08/01/99 15:46	08/01/99 15:46	00:00:17
Lack of starting conditions in reactor	11/01/99 11:30	11/01/99 11:32	11/01/99 11:30	00:01:26
Lack of starting conditions in reactor	11/01/99 11:32	11/01/99 12:34	11/01/99 12:14	01:02:03
Lack of starting conditions in reactor	11/01/99 12:14	11/01/99 12:34	11/01/99 12:14	00:20:37
Reactor stop activated	11/01/99 12:43	11/01/99 12:44	11/01/99 12:48	00:01:00
Reactor stop activated	11/01/99 12:46	11/01/99 12:47	11/01/99 12:48	00:01:03
Reactor stop activated	11/01/99 12:47	11/01/99 12:48	11/01/99 12:48	00:00:24

Page 1 of 1

Exit

Click Exit to leave the application. Before, a dialogue box pops up to ask confirmation.

WAY OF OPERATION



The system has been developed to execute control actions individually or linked with execution sequences, according to settled formulas. Below there is a descriptions of actions you can perform related to Reactor and Dissolver. The selector on electrical panel must be in “automatic position”.

To make an action, right click on appropriate reactor opens a window with different options. Click on action desired to open a new pop-up window to enter conditions of action.

Action

Add Kgs. 500

Dosed Kgs. 0

State of Action
Pendent

Product / Batch
103 solvent 3

Inertia 3

Continue Cycle Stop Cycle

End Action

For example, clicking on “Add solvent”, opens a window where amount of product and product data (component, batch, inertia) can be selected. State of action is also indicated: done, in process, interrupted. Likewise, other actions can be selected: Continue process, Stop process, End action.

In actions menu there is another option: *Manual consumption*. Click on this option to open a tab and enter product and kg. This option is helpful to enter data of products consumed in the process and also to control product consumption.

Manual Consumption

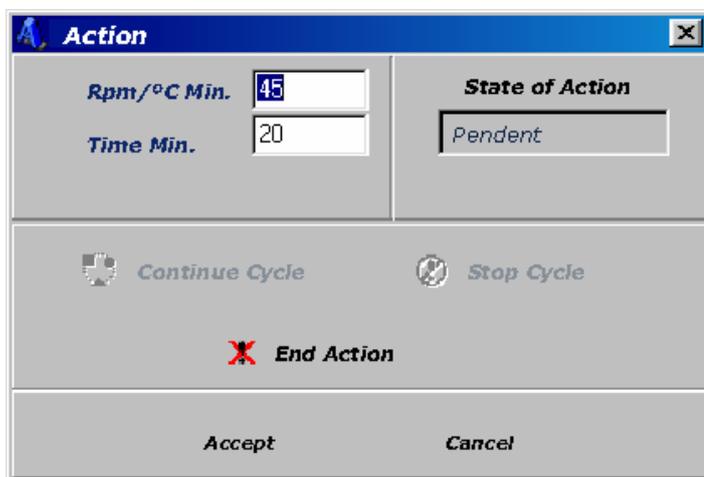
Component 21 Batch SOLID 1

Dosed Kgs. Source ALM Destin REA

Accept Cancel

Other windows come out to select actions orders: Agitate, Heat/Cool.

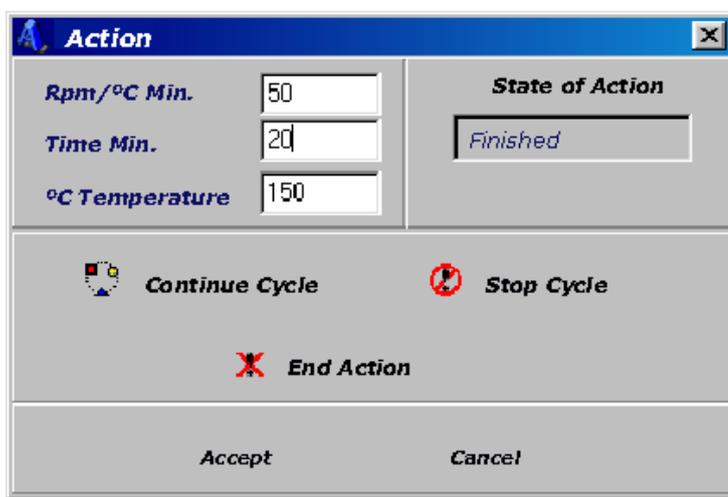
Agitation action



Rpm/°C Min. <input type="text" value="45"/>	State of Action <input type="text" value="Pendent"/>
Time Min. <input type="text" value="20"/>	
 Continue Cycle  Stop Cycle	
 End Action	
Accept Cancel	

Set time of agitation and agitation order in rpm. If you want unlimited agitation period, write “0” in the appropriate field.

Heating/Cooling action



Rpm/°C Min. <input type="text" value="50"/>	State of Action <input type="text" value="Finished"/>
Time Min. <input type="text" value="20"/>	
°C Temperature <input type="text" value="150"/>	
 Continue Cycle  Stop Cycle	
 End Action	
Accept Cancel	

Set cooling and heating speed in °C/minute, required temperature and time of maintenance (minutes) of temperature. If you want a quick heating, set a high value (maximum is **6000.0**). Likewise if you want an undefined time of maintenance, select maximum time which is **999.9** minutes.

NOTE: For quick cooling processes, write on °C/min field maximum value 999 and write on Min. Time field estimated time for reaching temperature required.

An alarm (AL2) is set in Eurotherm controller Mod 903 to disable cool release (-100%) by means of a relay, when heating processes are executing. AL2 is the value settled for the alarm. The value entered for AL2 is the differential value according to temperature ordered. Here, the value given is 20°C, which means cooling circuit will start when ordered temperature is 20°C lower than real temperature. If this happens, intermittent AL2 is activated on controller and valve is coloured in green.

FORMULATION

Set formulas automatically following the process described below:

Left mouse click on reactor opens formulation window.

The screenshot shows the 'Formulation' window with the following details:

- M.O.: 1999, Batch: [empty], Program. Amount: 5000
- Formula: 888, formula test
- Com.: [empty]
- State: In Process, Kgs. Comp.: 1995
- Active Worker: WORKER 1

Seq.	Reac	Process	Sour	Dest	Product	Batch	Amount Kgs.	rpm °C/Min	Temp. (°C)	Min.Ag Min.M	Real Amount	State
10	1	SOLVENT	L1	REA 101	solvent 1		2,000.0				0	Finished
20	1	SOLVENT	L2	REA 102	solvent 2		2,000.0				1,995.0	Finished
30	1	ADD ADDITIVE	REA	REA 102	solvent 2		500.0					Pendent
31	1	ADD ADDITIVE	REA	REA 21	SOLID 1		500.0					Pendent
35	1	AGITATE	REA	REA				50		20		Pendent
40	2	SOLVENT	L3	DIL 103	solvent 3		1,000.0					Pendent
50	2	ADD ADDITIVE	DIL	DIL 35	ADDITIVE 3		150.0					Pendent
60	2	UNLOAD DISSOLVER	DIL	TAN 37	ADDITIVE 5		5,000.0					Pendent
100	1	HEAT / COOL	REA	REA				999.9	250	1		Pendent

Buttons at the bottom: Continue Cycle, Modify Step, Stop Formula, Release Reactor, Enter M.O., Stop Cycle, End Step, End Formula, Start Formula, Samples, Exit.

This window shows detailed information about process and many actions can be executed.

When no formula is registered, formulation window appears empty. Therefore, the first action is *Enter M.O.* clicking on the appropriate button.

M.O.	Batch	Amount
888		1000

Formula

1	RESIN 1
---	---------

Comments

temperature test

Accept Cancel

After clicking, the window above comes out. Go to MO field and press enter or double click to access to Master of Manufacturing Order. Select the manufacturing order and upload indicating Batch No. and pressing Enter. In this moment, the tab is filled with formula data and a calculation in Kg for each product.

You can access from the same tab to reactor and auxiliary tank formulation. Click on appropriate figure on the upper side of the screen.

On top of the tab, there are other fields:

State. Shows state of formula: stop or executing

Kg. Indicates the amount in kg of dosage product.

Time. Indicates the remaining time in agitation processes.

At the right end of every line, there is a description of states:

Pending. Not executed yet

In process. Executing

Interrupted. The step is interrupted

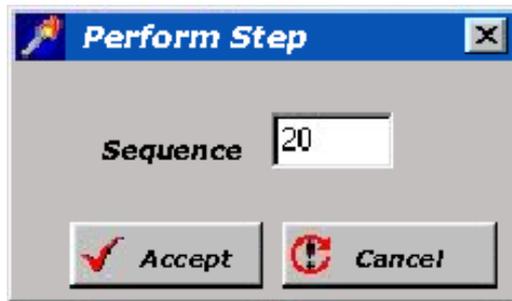
Finished. The step is already done

Likewise, at the lower side of the tab there are different buttons for different actions:

Step Modification. Modify a step, select the step and then click button "Order modification". A display comes out to change data.

End. Finish a step in process.

Continue. Continue the formula after an interruption (voluntary interruption or due to safety conditions)



Stop. Interrupt the process.

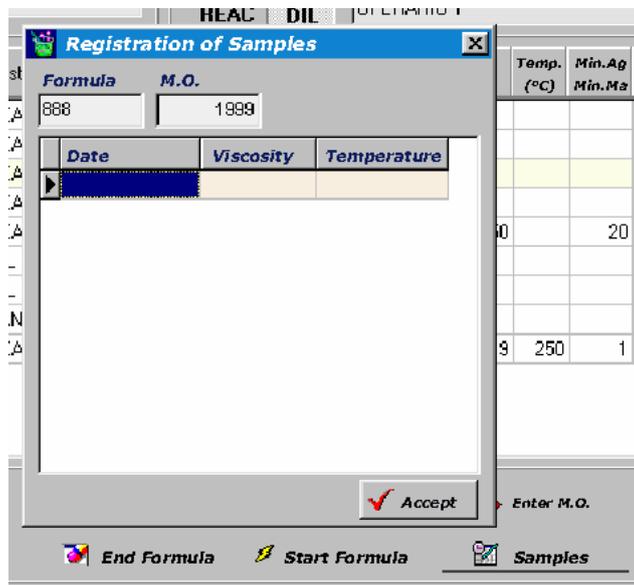
Stop Formula. Interrupt the formula. Finish step in process and do not start the following step.

Start Formula. This option starts the execution of a formula from beginning or after another step if the process was stopped.

End Formula. This option ends formula in process. Clicking this button, data disappear from the screen and is registered in database of process history.

Release reactor. Use this option when formula in reactor and dissolver is in process, process in reactor is finished and you want to start another in it.

Samples. Click on this option to enter in the pop-up tab data as temperature and viscosity of product in formula in process.



Exit. Close the window

When a reactor has a formula unloaded, a description appears on the lower side of the screen. In addition, it shows planned Kg and Real Kg of product which is being dosed.

During the process, some messages or alarms may pop up.

If an action has a message assigned, you may be prompted with it. To continue the process press Accept.



Alarms can also come out. Some of them inform and others stop or act over the process.

When an alarm goes off visual and acoustic signal are activated. You can stop them either pressing reset at electrical panel or clicking on "register" button on computer.

When a formula is in execution and the process stops –it stops when reaches a step when worker must perform an action (unload product)-, the step is marked like "In process". It will not continue until worker gives the order. Actions to add products manually are divided in two types:

- ADD SOLIDS
- ADD ADDITIVES

Next to reactor there is an electrical panel with a green pilot light and a push button

When process reaches a manual step, pilot light is switched on to indicate a worker must perform the unloading of product. If the product is solid the light is steady, if it is an additive, is intermittent. As it is done, the worker must indicate it to the system. To do it, press push-button or finish the process from computer.

The criterion to register dosed kg is:

- **ADD SOLID.** Kg recorded are those the scale registers by difference of weight
- **ADD ADDITIVE.** “Planned” kg are registered by default. This data can be changed in “step modification” option in formulation tab.

If formula is performing a heating/cooling action, if you push the button it will finish the action and will start with the next one. **ATTENTION:** You must do that only if you want to finish heating process in order to start cooling process.

To make an action (heating, dosing) during an automatic formula, the formula must be stopped. Right click opens a window with different options; when formula is in process, you cannot click on any options. However, you can choose any option when formula is stopped.

You can only act over agitation process in automatic formulations. You can stop or start an agitation process clicking on motor (on computer screen or from push button located placed next to reactor or/and dissolver).



Detail of manufacturing plant



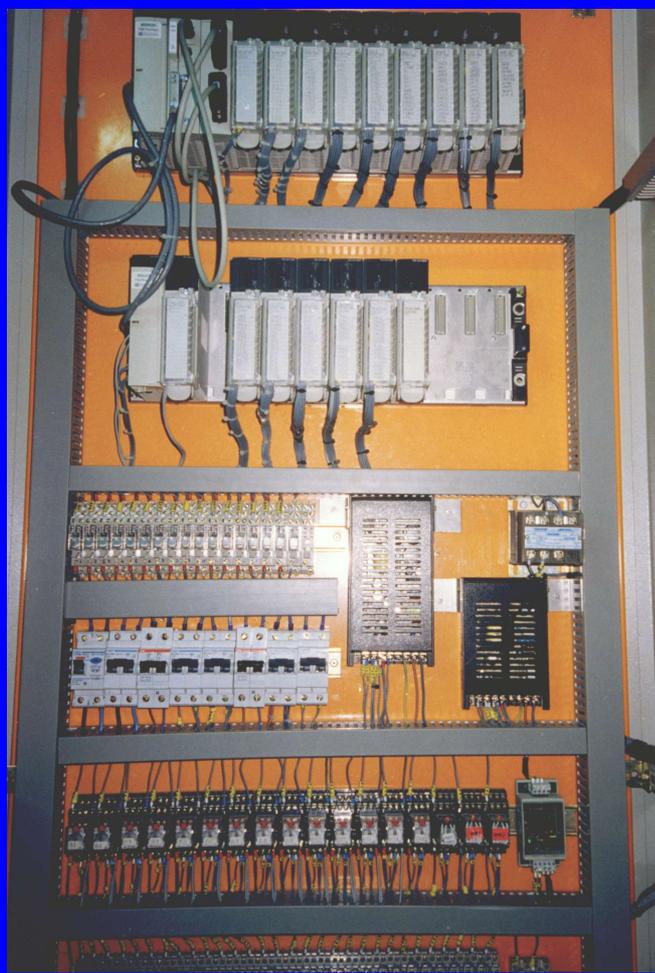
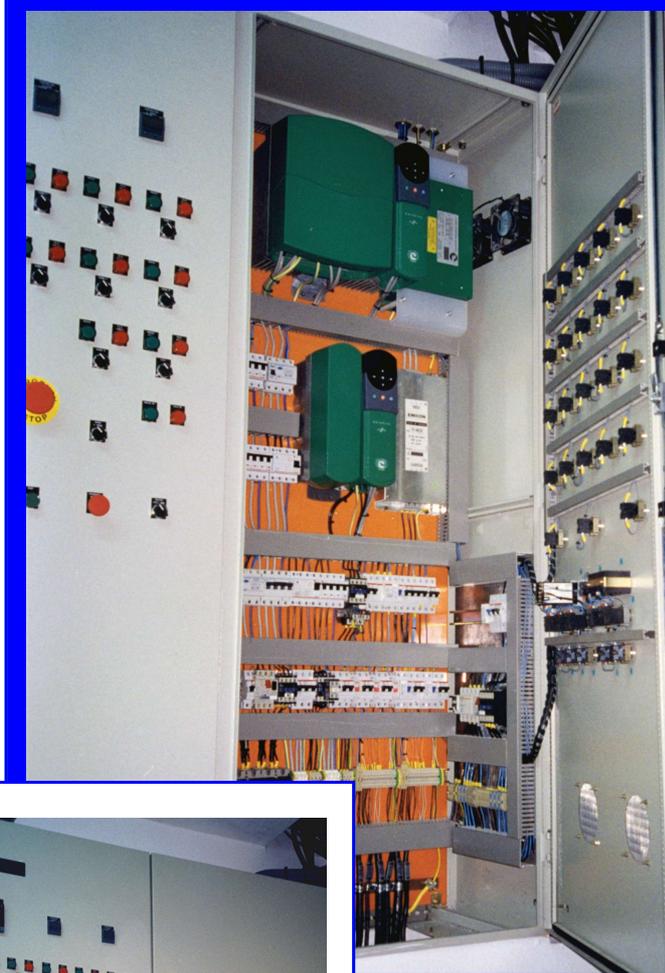
Detail of manufacturing plant



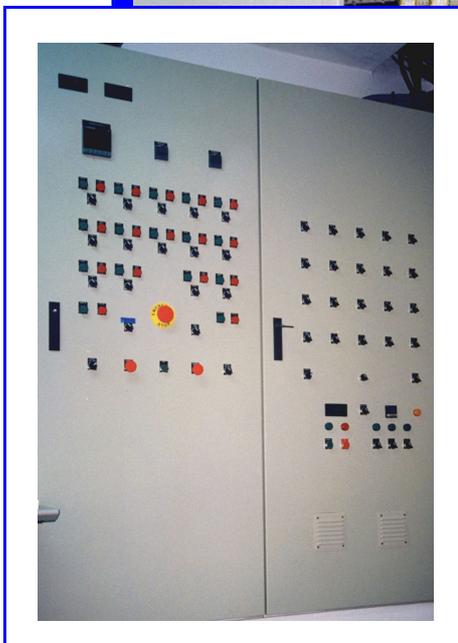
Detail of dissolver and temperature regulation



Automatic filtering equipment



Detail of electrical panel and PLC



Detail of electrical installations