Description of the biOmatiC Automation Concept

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1 Foreword

The biOmatic system described in the following includes several internal circuits that represent the actual heart of the system. The graphical elements described in the following can be adapted as desired to meet the special requirements of the customer. Special input screens for system configurations or operating the PLC I/O level, too, can be set up at the customer's request.

The document is a rough description of the system and is not customised to any specific system configuration. This is why every input field is not described in this manual. Moreover, this manual contains explanations on parts of the system that are not necessarily available in every variant or configuration of the system.

2 Safety Instructions

- Please read this manual before operating the system.
- The automation system has been configured for operating biOmatic. All other installations and modifications of the software environment require the (written) consent of ORmatiC GmbH. In particular, this concerns software updates (anti-virus protection and Operating System patches).
- The system should be used only for the purpose for which it is foreseen. Any claims for liability are rendered null and void in case of violation of the condition stated above.
- Special caution must be exercised when using removable storage media of any kind (CD/DVD, USB stick and external hard disks). Connect these to the system only by trustworthy persons and after testing them with an established and proven anti-virus protection software.
- The biOmatic system pertaining to this manual should be operated by qualified personnel only. Qualified personnel includes those who, based on their education and experience, are capable of identifying risks and preventing likely hazards in working with and handling the system.

3 General Technical Information

- All documentation supplied with the biOmatic system must be observed and followed accurately by the operator.
- If the PLC and the PC get disconnected simultaneously from the mains supply, either on account of a fault or specifically for the purpose of maintenance work, all system parameters in biOmatic must be checked exactly, since they get reset to default values.
- The hardware of the biOmatic system must be installed in a temperature-controlled room in which the ambient temperature does not exceed 40°C.
- The data on the hard disk must be backed up regularly in order to prevent loss of data.

4 General

The visualisation, reporting and alarm generation **biOmatic** system of ORmatiC GmbH integrates the requirements regarding:

- System operation
- Reports and reporting system
- Alarm generation and maintenance scheduling

into one concept. Together with the ORmatiC service, **infOmatic**[1], ORmatiC offers one package that meets all the requirements of the new EEGs regarding the obligation of verification in a safe, simple and quick manner.

biOmatiC has not only been developed for NaWaRo bio-gas systems (BGS), but it is also deployed in an extended form in co-fermentation plants. In co-fermentation plants, the system is generally used with a Client-Server architecture or in a redundant configuration.

Special parameters and operational backgrounds have been explained in section 6.6 of this document.

4.1 Important aspect during start-up

Since the **biOmatic** solution of ORmatiC GmbH runs on a virtual machine for the sake of service (Information about this is given, e.g. at http://de.wikipedia.org/wiki/Virtuelle_Maschine), there are always two Windows systems that start. The first Windows system is the so-called host (the Windows user interface is grey) and after a short time, the actual application starts up automatically. This application runs on a virtual machine and the background is illustrated by way of an example in Figure 4-1. The name of the system, In general, is displayed in the middle.

Figure 4-1 Example of the background in a virtual machine in **biOmatic**

It is necessary that certain systems run safely in the background so that **biOmatic** runs safely. Hence, it is necessary that the visualisation system iFix within **biOmatic** starts with a delay time of at least 120 sec. This is why the virtual machine starts up and pauses for at least 120 sec. in

1 infOmatic is still under construction, scheduled commencement is Q3 2012

the Windows environment illustrated in Figure 4-1 before iFix starts. Please do not try to start iFix once again.

4.2 *The overall automation structure*

The hierarchy of the entire automation technology for a BGS Including **biOmatic** and its options is illustrated in Figure 4-2. In small bio-gas systems (small BGS), a central PC with the functions of visualisation, data storage and reporting is coupled via a bus to an industrial PLC. In co-fermentation systems or industrially operated BGS, **biOmatic** can be upgraded with clients and web clients as and when required, and it can also be configured as a redundant system.

For the sake of customer security in the future, **biOmatic** consists of special bio-gas system objects that have been created on the basis of the Scada system Proficy iFix of General Electric Inc. (GE Fanuc) and the database Proficy Historian, also of General Electric Inc. In other words, **biOmatic** is a bio-gas system object library that has been based by ORmatiC on standard software.

This concept gives you the assurance that the **biOmatic** applications will even run on hardware platforms in future with the appropriate Operating System. Even today, you can connect up to 300 different PLC systems via the most diverse buses to **biOmatic**.

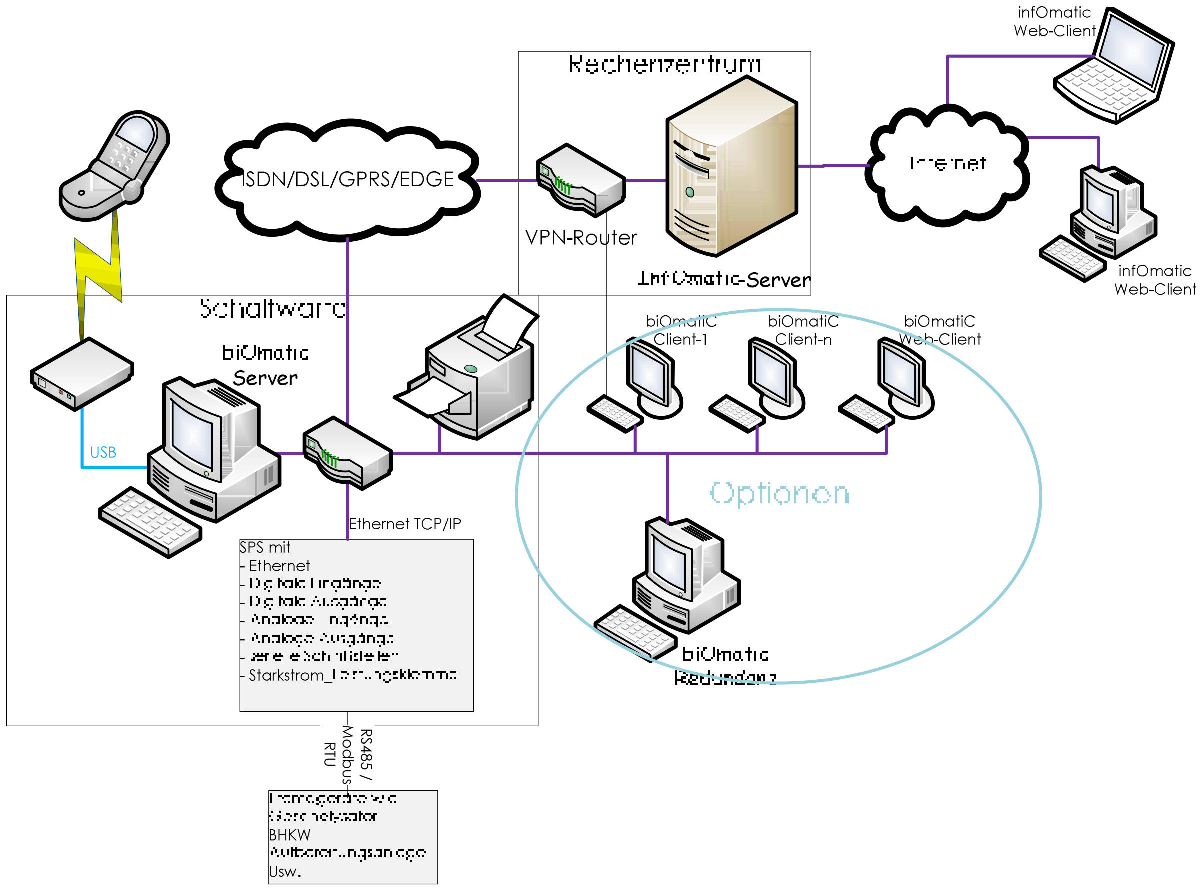


Figure 4-2 Structure of the automation technology

4.3 The *biOmatic* structure

The biOmatic system consists of 9 system-modules:

- The user interface of biOmatic
  - Operating the BGS and indicating all statuses and alarms as well as messages (not only process alarms but even derived alarms such as limit value of the slurry component or the mixer running times)
  - Determining forecasts for the next 30 days for the bio-gas and methane production (under preparation)
  - Displaying web server user interfaces of units having a separate controller (e.g. Diane of GE Jenbacher)
  - Simple recipe or formulation preparation and management
  - Display of on-line quick trends
  - Raw materials logbook and entry of raw materials supplied
  - Operational logbook including entry of actions in the BGS (maintenance, etc.)
  - Input of the biological analytical values (provided that they are not centralised in infOmatic)
- The process interface of biOmatic already provides over 300 interface drivers as of today so that the database (PDB) of the user interface accesses the PLC system used in a reliable manner.
- The historical database of biOmatic ensures that all data (process values, input values, alarms and indications) cannot be corrupted.
- The reporting system of biOmatic
  - Display of current and historical alarms
  - Display of current and historical process values in trends
  - Display of reports prepared in advance in a tabular form for any desired time periods (export and printout) on a daily or weekly basis
  - Compilation of raw material lists
  - Operational management evaluations
- The message system of biOmatic contains a complete and consolidated alarm generation tool with acknowledgement, user administration, escalation strategy, SMS or voice service.
- Transmission of the historical data to a central database
  - for complex evaluation via infOmatic using the web functionality
  - Data backup (redundant data management)
  - Preparation of reports according to the EEC Directive for environmental assessment
- Complex user administration, or optionally using the user administration of Windows
- Optionally, you may activate user data storage that saves all settings of the system for a specific period on the PC in csv files.
- Settings for changing the language may be integrated as an option

All these modules are installed and configured on a DELL PC or on a Worthmann PC. The visualisation system runs in the so-called runtime mode in which no modifications to the engineering system are possible. You may, of course, modify set-point values, limit values, switching states in accordance with the agreements made and confirm error or fault messages.

The visualisation system is illustrated schematically in Figure 4-3. You may select two types of sub-diagrams from the main screen (centre).

- Functional diagrams that are selected via buttons and contain supplementary functions for the process

- Operational diagrams that are displayed directly from the user interface and display the relevant part of the system in greater detail

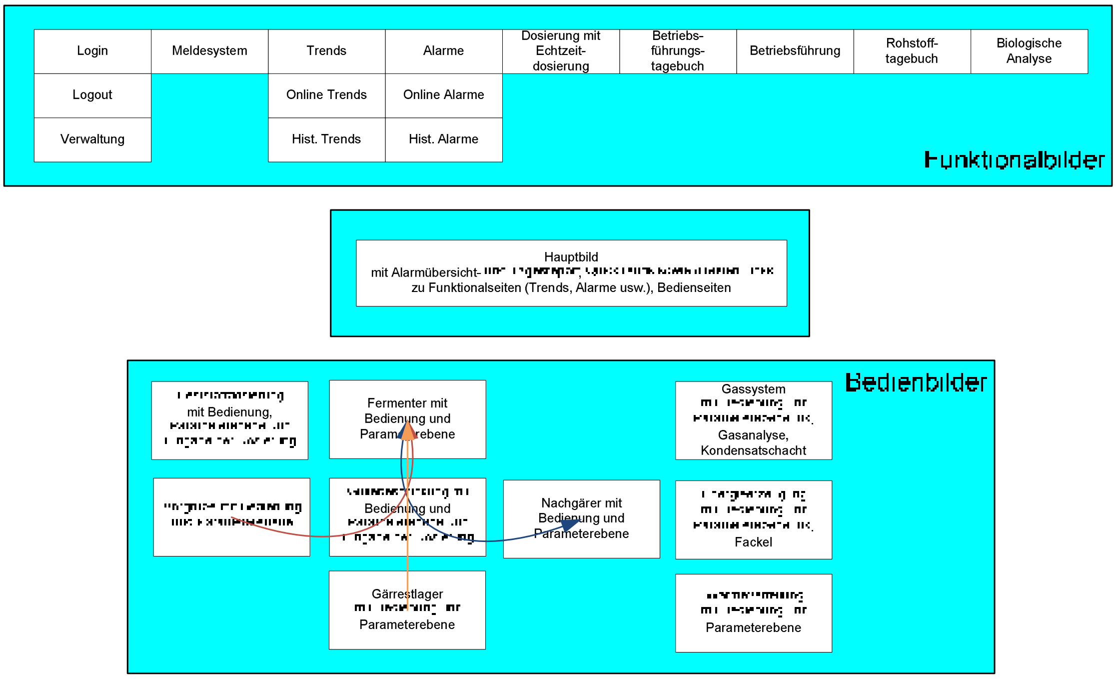


Figure 4-3 Structure of **biOmatic** (Supervisory level)

The operational diagrams linked by arrows in Figure 4-3 can be monitored completely as a unit in the operating mode (see Login hierarchies in Section 4.4) (see Figure 6-5)

4.4 Operational concept of *biOmatic*

The operational concept follows four basic philosophies

1. Regardless of where you are in the operating sequence or navigation, there is always the maximum possible amount of the overall system that can be seen! The size of the operating or functional diagrams opened is adapted to the respective display.
2. The filling routes can also be monitored completely in the operational display! (see section 6.5)
3. Each operator must be logged in with his name in order to be able to carry out control operations in the course of administration of the rights and privileges. Logging in is indispensable for manual inputs of values pertaining to raw materials and analytical values or for control operations.
4. The configuration of the parameters is located directly at the operator control level and the parameters belong respectively to the respective control elements of the associated control diagram!

The entire system is password-protected. There are 4 hierarchies in the runtime mode that can be associated with as many users as desired:

1. Observer (Start mode) - The observer can only view the main screen and not operate or control anything
2. Operator - The operator can control actuators and change the values of power of the frequency converters in all operator diagrams. He can also view the functional diagrams such as alarms and trends. He cannot access the parameter configuration levels

   Default setting:
   Name: Test2
   Password: Test2
3. Expert - The expert can switch to the parameter setting levels and modify process-related settings in them

   Default setting:
   Name: Test3
   Password: Test3
4. Supervisor - The supervisor can also configure system settings such as controller parameters, indication system settings and user administration. He can also switch to the Windows user interface using Alt Tab.

   Default setting:
   Name: Test4
   Password: Test4

4.5 *The single redundancy concept of biOmatic*

biOmatic is available in different types of redundancy and client-server architecture. In the process, it is generally a purely licence model of the vendor of the software module iFix.

ORmatiC has conceived and designed a very special solution for the price-sensitive bio-gas market that combines the benefits of the client - server architecture and the redundancy to a fraction of the licence costs.

In this concept, there is one control computer and a second computer. Both computers are connected via Ethernet with the PLC and with one another. In the process, the choice of the data protocol is insignificant.

Both the control computer and the second computer have identical configurations.

You can perform all the functions described under section 4.3 with the help of the control computer, regardless of whether the second computer is connected to the system or not. In the case of the dual computer system, it is somewhat different, and a part of the functional diagrams (Reports, raw materials entry, control operations and biological analysis) can only be executed on the second computer when this is connected to the control computer. Attention: If you try to use a functional diagram when the control computer is disconnected, the PC will remain at a standstill for about 2 minutes on account of the attempt to make a request over the network.

When starting up the PC, the parameters are always compared with those saved in its own internal database. It makes sense, of course, that the PC that has been started up after a long period of shut-down (if you have modified any parameters via the PC that had not failed) compares the parameters with those last known. For this purpose, you can use the button "Load parameters from the other PC" and manually compare the parameters as illustrated in Figure 4-4.

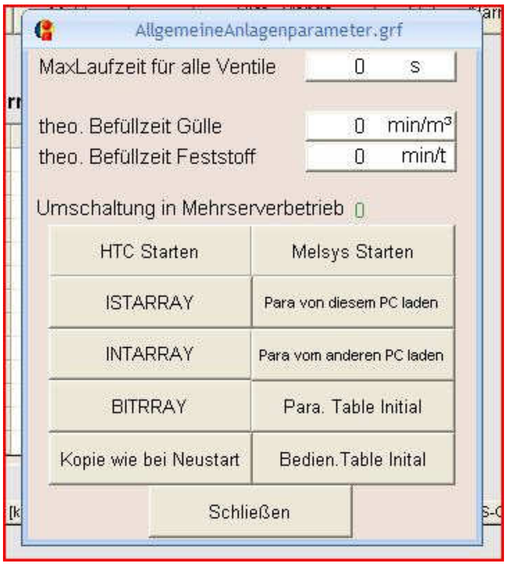


Figure 4-4 General System Parameter Setting diagram for a redundant system

The system diagram in Figure 4-4 can be started using the *biOmatic* logo in the visualisation system. In a redundant system, even the historical data is copied for display in the historical trend and recipes. You can transfer these manually using the button "Copy as in the case of restart".

Attention: The other buttons are basically meant to be operated only by ORmatiC.

4.6 *Meaning of the display*

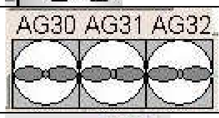
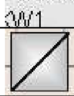
4.6.1 Important message

While starting up or when calling up certain sub-diagrams, the message window may appear as illustrated in Figure 4-5. Please simply confirm this with OK.

Figure 4-5 Message window

4.6.2 Display of the elements

The elements listed in Table 4-1 change their colour according to their states.

Name	Display	States	Remarks
Valve		Open – green, closed – white, intermediate position – green/white flashing, fault - red	
Mixer		No display of a single state	Display of the control point as a % value
Screw pump		On – green, Off in automatic mode – white, Off in manual mode – blue, Off in maintenance – magenta, fault - red	
Process pump		Same as the screw pump	
Water pump and dual pump	 	On – green, Off in automatic mode – white, Off in manual mode – blue, fault - red	There is no state for maintenance
Chopper		Same as the screw pump	
Mixers		Same as the screw pump	
Refrigerated bench		Same as the water pump	
Blower		On – green, fault - red	There is no manual or maintenance status since the blower must operate continuously
Compressor		No status display, fault - red	
Heat exchanger		Traversed by substrate – Green, otherwise grey	
Measuring point		OK – transparent (in containers) OK – white (other classifications) , fault - red	

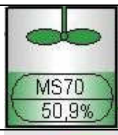
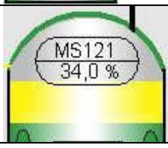
Fill level of liquid		Empty - grey – empty, fill height - coloured – Fill height, OK – green, red - limit value	If analogue measured values are available, these are displayed
Fill level of gas		Empty - grey – empty, fill height - coloured – Fill height, OK – yellow, red - limit value	If analogue measured values are available, these are displayed

Table 4-1 Display of the elements

All substrate lines are grey when they are in non-traversed condition. When they are traversed, they are green. Gas lines are always yellow. Hot water lines are red - hot side or blue- cold side.

New alarms flash until they are confirmed, after which they are displayed in steady red colour. This happens in both the alarm window and in the respective elements. For example, in case of an alarm for the fill level, the filling in the container flashes, for alarms pertaining to measured values the measuring point flashes or in case of actuator alarms, the actuator becomes red in colour.

4.6.3 Designation of the elements

All elements in the visualisation system are associated with an MS or R&I number (Measuring point or pipeline & instrumentation number). These numbers should be assigned only once in a given system and thus, they are unique designators.

These designations are specified by the planner or designer in the project development stage and this is done for all subsystems. This uniqueness is the reason that we have specified these designators in the visualisation system.

As far as the MS numbers are concerned, the alphabets MS, AG and PS have no deeper meaning other than measuring point, unit and pneumatic slider respectively.

It is different in the case of the R&I numbers, and these are generally in line with the European standard EN 62424, which is explained at length at http://de.wikipedia.org/wiki/R%26I-Flie%C3%9Fschema. In short, you may say that the first alphabet stands for the physical parameter measured (p-pressure, T-temperature, L-level..) and the subsequent alphabets indicate what is done with this measurement parameter.

4.6.4 Explanation of the control elements

4.6.4.1 Basic control regulations

In the automatic and manual modes of operation, interlocks are incorporated for process pumps and valves. As a result of doing so, it is prevented that a process pump is operated in manual mode without the associated flow of media through the open valve having been released or enabled. Valves, in turn, cannot be operated if a pump in the associated process circuit is switched on. In maintenance mode, the individual mixers and process pumps may be operated without any monitoring. The valves may also be operated locally without monitoring.

If an open valve leaves the end position, the associated process pump is automatically shut down in an instant.

Every local intervention may lead to damage and hence, it must be done with utmost care!

4.6.4.2 Input window

Inputs are made via an input window in which the input is checked for logical correctness. This means that when numerical values need to be input, the input window does not accept any alphanumeric values. Moreover, only such input values are accepted that lie within the range of values in accordance with the specifications of the process technician.

Figure 4-6 Input window

4.6.4.3 Entering texts

The values are entered directly in grids or boxes in the recipe management, raw material entry, analysis value entry and in the operational management systems respectively. To do this, you need to click on the appropriate box and enter the values.

4.6.4.4 The valve operation

Each hydraulic control valve can be operated in both the manual and automatic modes of operation. This is illustrated with the help of the following displays. The button for open / close operation is visible, and can thus be operated only in the manual mode.

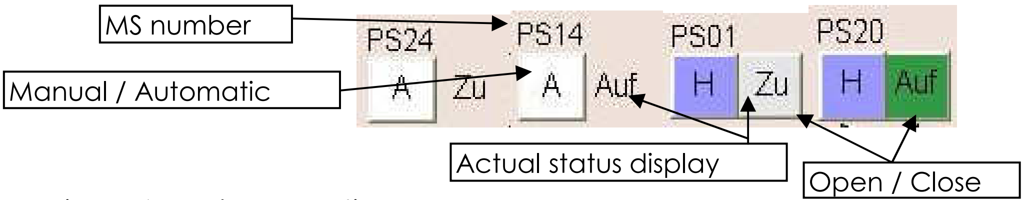


Figure 4-7 Valve operation

4.6.4.5 Operating the controller

If plants or systems have complex controller circuits, they are display specially in accordance with Figure 4-8 in the engineering system. The controller circuit has multiple operational levels:

1. Operator – He can switch the controller to manual or automatic mode and specify a control parameter in manual mode.
2. Expert – He can specify a new set-point value for the controller
3. Supervisor – He can modify the controller parameters.

The supervisor can call up an on-line trend to set the controller circuit (see section 7.10.4).

A controller circuit with the actual value, set-point value, control parameters and manual / automatic mode switch-over is displayed in the following.

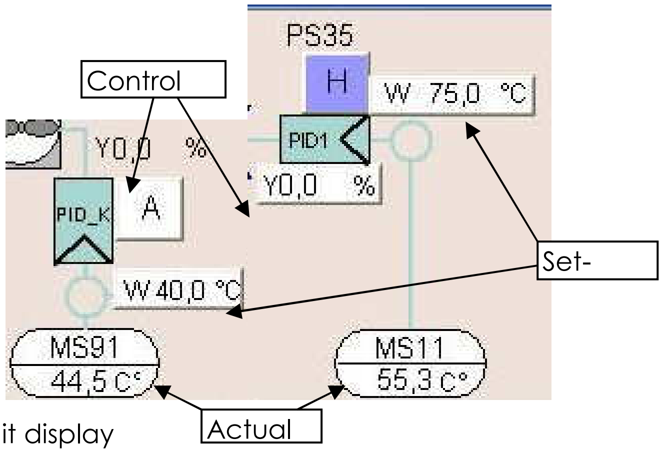


Figure 4-8 Controller circuit display

The set-point value can be specified both in the manual and automatic modes of operation. The control parameter can be specified only in manual mode, since this is set by the controller in automatic mode.

For simple controllers, as they are generally used in NaWaRo systems, only the parameters in accordance with Figure 4-9 can be entered. This can be done only by a supervisor.

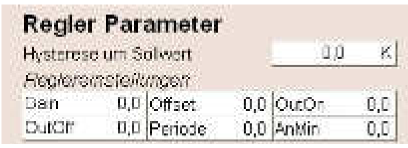


Figure 4-9 Controller parameters for NaWaRo systems

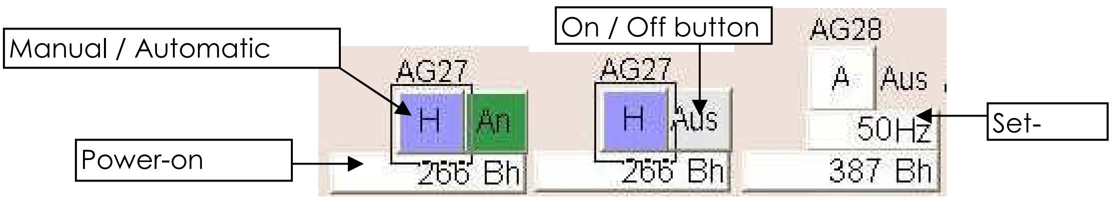
4.6.4.6 Actuator operation

4.6.4.6.1 Standard Operation

The actuators in standard operation may be operated in the manual or automatic mode of operation.

The actuators with frequency converters may be operated in manual mode only via the controller displayed. To do this, the controller must be put in manual mode and a control parameter for the frequency converter must be specified via the control parameter Y.

Changeover to manual / automatic mode of operation is done with the help of a manual / automatic button.



4.6.4.6.2 Extended operating concept

The actuators, primarily the mixers and process pumps may have 3 working states that interlock one another mutually:

1. Automatic mode [A] – The devices are operated by the automatic mode program in the PLC
2. Manual mode [H] – The devices are operated from the visualisation system by manual intervention
3. Maintenance mode [S] – The devices are operated locally by the local switch that is located in the repair switch housing.

In the extended operation concept of the actuators, there are basically two control panels, one without and one with entry of set-point values in manual mode of operation. The various possible displays of control elements is illustrated in the following. Only one of the 3 buttons can be active at any given point in time (Manual/Automatic/Maintenance). The actuators can be operated only in manual mode with the help of the On / Off mode. In contrast to the controllers, the set-point value for the speed can be specified in both the manual and automatic modes of operation. Only one local operation is possible in maintenance mode.

In addition, the power-on hours is displayed in each control element. In case of a fault in the actuator, the operation is always in service.

4.6.5 Explanation of the colours

Colour	RGB code	Meaning
White	255-255-255	Actuator is off in automatic mode or valve is closed (no colour change for mixers)
Green	51-153-71	Actuator is on or valve is open, and the media lines are filled
Light grey	189-189-189	Containers and heat exchangers do not contain any medium
Red	196-4-33	Alarm
Yellow	254-242-18	Gas system
Blue	153-151-255	Actuator off in manual mode
Magenta	254-129-248	Actuator off in maintenance mode
Grey	127-127-127	Medium line is empty (not traversed)
Light blue	167-214-209	Signal lines of the controller (Structural illustration)
Red	255-0-0	Hot side of the heating system traversed
Light red	210-182-172	Hot side of the heating system not traversed
Blue	0-0-255	Cold side of the heating system traversed
Light blue	184-188-199	Cold side of the heating system not traversed
Pink	237-225-218	Pop-up background
Orange	239-159-71	General information about certain statuses

Table 4-2 Description of the colours used

4.6.6 Frequently used parameter terms

Min. value	Value that triggers a certain action if it is undershot
Max. value	Value that triggers a certain action if it is overshot
Min. alarm	Value that in addition to triggering the min. value action also triggers an alarm when it is undershot
Max. alarm	Value that in addition to triggering the max. value action also triggers an alarm when it is overshot
On time	Value for which a mixer is on
Off time	Value for which a mixer is off
Limit value	Value that results in a message when it is exceeded
Max. current	Value that results in a message and sometimes also in an action when it is exceeded
Target frequency	Set-point value for actuators operated by the frequency converter when there is no controller operation
Set-point value	Set-point value for control operations that are related to this measurement parameter
Hysteresis	Value around a switching point for which there is no change in the status. This can also be a set-point value
Kp	Gain parameter of a PID controller
Tn	Reset time parameter of a PID controller
Tv	Derivative time parameter of a PID controller
Reset	Using the reset button, the respective operating times of the actuators can be reset to zero.

5 Main Screen

The main screen and the following operator diagrams are only examples and are adapted accurately to your system configuration.

The main screen is always visible on the PC and cannot be closed or shut off. This screen is displayed immediately after starting the PC. The observer is logged in by default as the user.

No operations can be performed in the main screen. The entire process can be monitored. You can go to the control and functional diagrams from this screen. You can reach the control diagrams by clicking on the section whose details you would like to browse. To do this, the user must be logged in as an operator or higher.

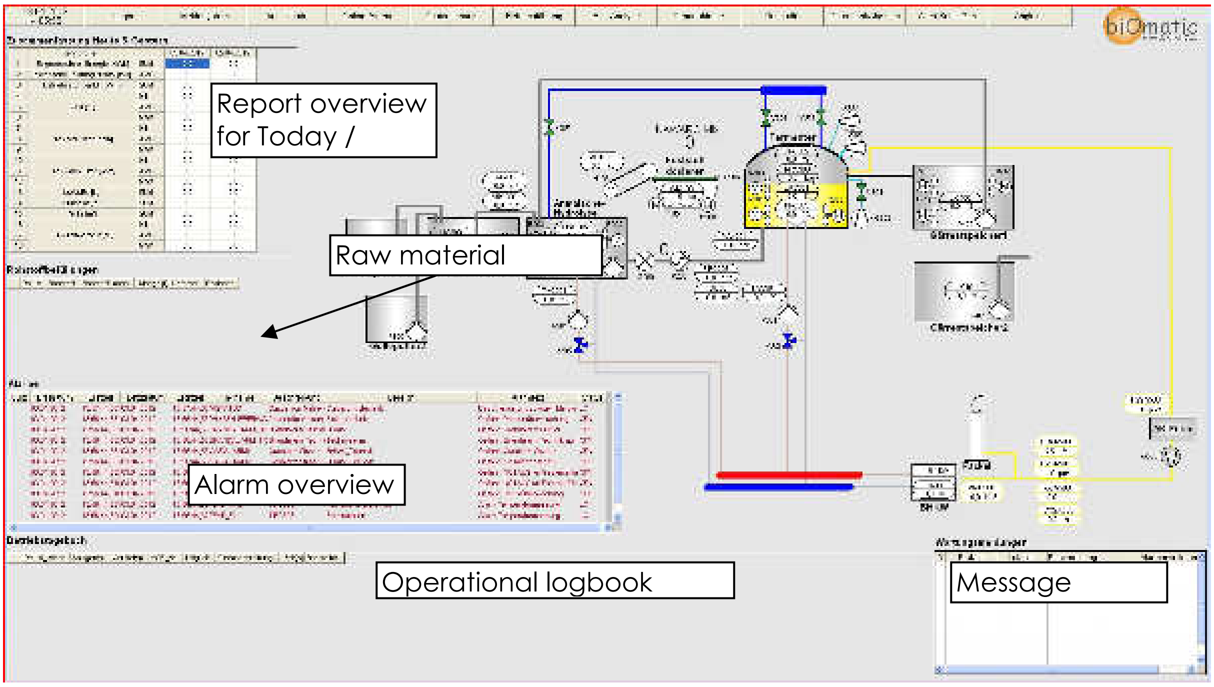


Figure 5-1 Main screen

The buttons for the functional diagrams are located at the top of the main screen. Exceptions are the two buttons that have only one function:

- Logout under Login – The Login level of observer is activated and
- Close all – All open control diagrams are closed,

The alarm and information windows are displayed on the left side. The entire BGS with all important process values is displayed on the right side.

All control and functional diagrams are displayed as pop-up screens above the main screen. The pop-up windows cover only that part of the main screen that is necessary for the respective display.

6 Control diagrams

Up to 3 password levels may be activated in the control diagrams.

In the first level, you may only operate individual actuators or specify target values of frequency for mixers and pumps. Moreover, the power-on hours are displayed for all actuators in this level. You reach the second level by pressing the Parameter button. To do this, the user must be logged in as an expert or higher.

In the second level, the parameter level, all process-related specifications can be made for the actuators and sensors that are available at the operator level. These are:

- Limit values (min., max.)
- Set-point values (Fill level, temperature, flow rates, etc.)

Moreover, the power-on hour's counter for the actuators may be reset manually and a maintenance cycle may be entered.

In the parameter level, the control diagrams with control functionalities have yet another input level. This is visible only for the user rights of a supervisor or higher. Using these, you can set the control parameters.

Any number (no upper limit) of control diagrams may be open simultaneously. This is why the loading of the fermenter (see Figure 6-5) can also be displayed continuously in the operating mode.

6.1 *The dosing of solids (with automatic raw material storage)*

In the diagram, Dosing Solids (see Figure 6-1), all actuators may be operated. In this diagram, you can also choose the raw material that is filled if dosing is to be done. This automatic raw material storage is not available in every system, since it does not conform to the customer's requirement. This feature can be retrofitted whenever desired by the customer. The 3 function group buttons are used to connect complete functional units to the process of dosing solids.

The no. of the last step of filling is also placed directly above the dosing unit in some systems.

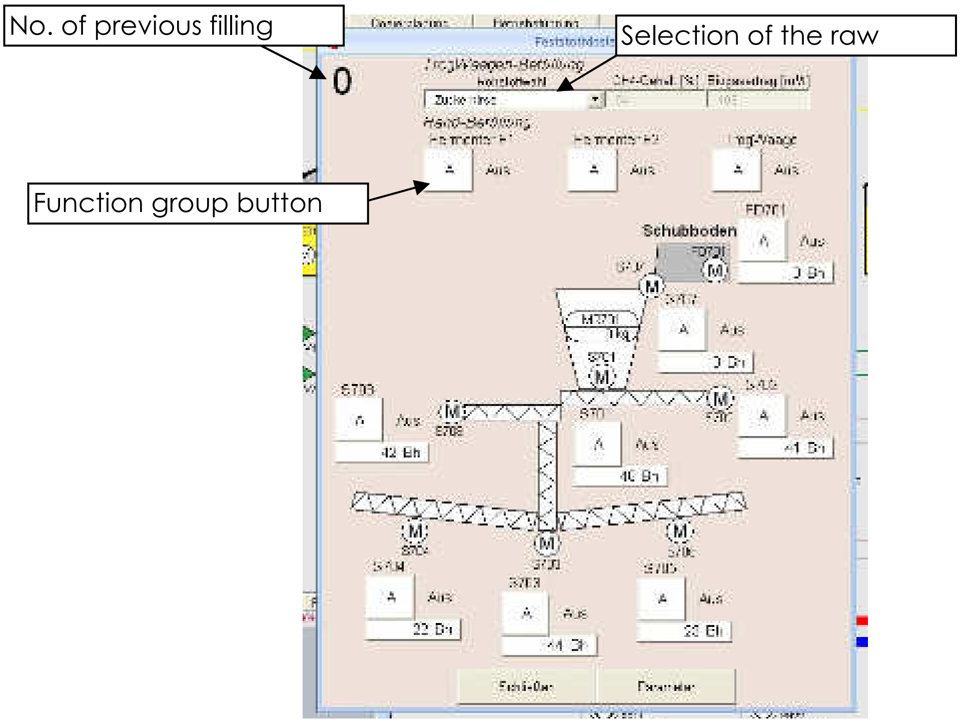


Figure 6-1 User interface of the dosing unit for solids

6.2 *Liquid flow route*

Just as in the case of dosing of solids, in the case of the liquid route, each actuator can be operated. The pump, however, can be switched on only when there is a complete flow route over which the medium can flow.

The last filling step is displayed only in systems with a time-based recipe. In systems that organise pumping across the containers depending on the level, there is no display of the filling cycles.

The no. of the last step of filling is also placed directly above the dosing unit in some systems.

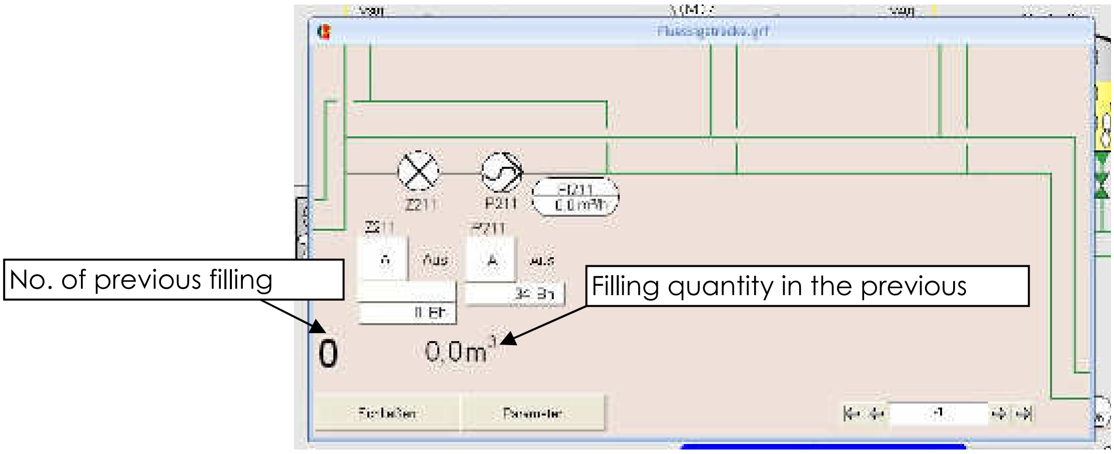


Figure 6-2 User interface for liquid flow route

6.3 *Example of the operator level (Dosing solids)*

This display illustrates the operator level of the individual system parts. You reach this display by "clicking" on the desired section of the system, in this case, on the section for dosing solids.

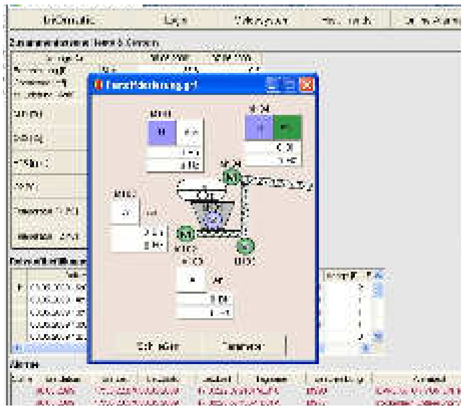


Figure 6-3 Display of the operator level

The section of the plant selected can be controlled or operated completely in this control diagram.

6.4 *Example of the parameter level (Dosing solids)*

You reach the parameter level by clicking the "Parameter" button at the operator level. In order to do this, the user must be logged in as an expert or higher.

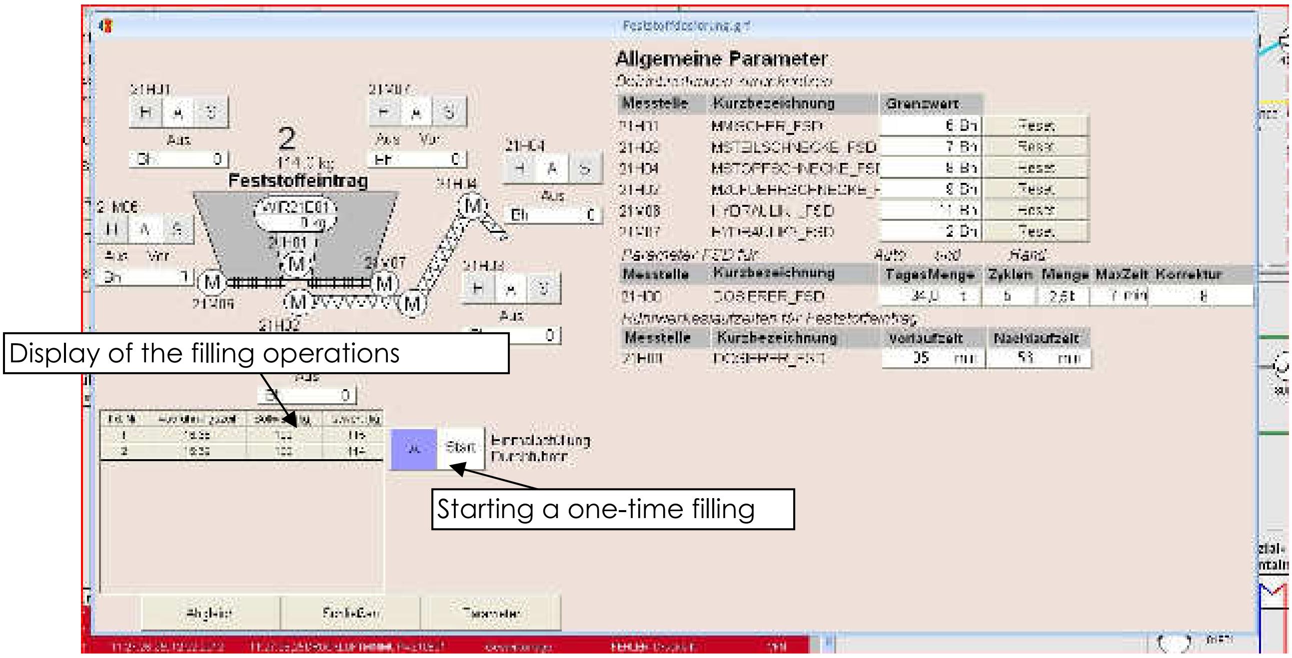


Figure 6-4 Display of the parameter level

In this control diagram, you may set all parameters for the plant section selected. A special parameter input screen is not provided in the concept of **biOmatic**, but it can easily be incorporated if desired by the customer.

In the diagram displayed, special parameters for the FSD are listed, which is not there in plants or systems with recipe management, section 7.6. The parameters have the following meaning:

- Daily quantity – Quantity per day
- Cycles - Filling cycles per day
- Quantity - Quantity for manual filling operation
- MaxTime - Maximum time that a filling cycle should need, otherwise the filling operation is cancelled
- Correction - This is a factor lying between 0…9 and is a measure for the speed with which shortfall quantities during dosing are replenished.

In systems that have a separate controller for the entry of solid, it may also happen that only the first 2-4 variables are available. This depends on the intelligence of the controller.

6.5 Example of continuous display in the operating mode (Fermenter-1 to Fermenter-2)

As described in section 4.4, one characteristic feature of the **biOmatic** structure is the continuity of the process-related routes even at the control level.

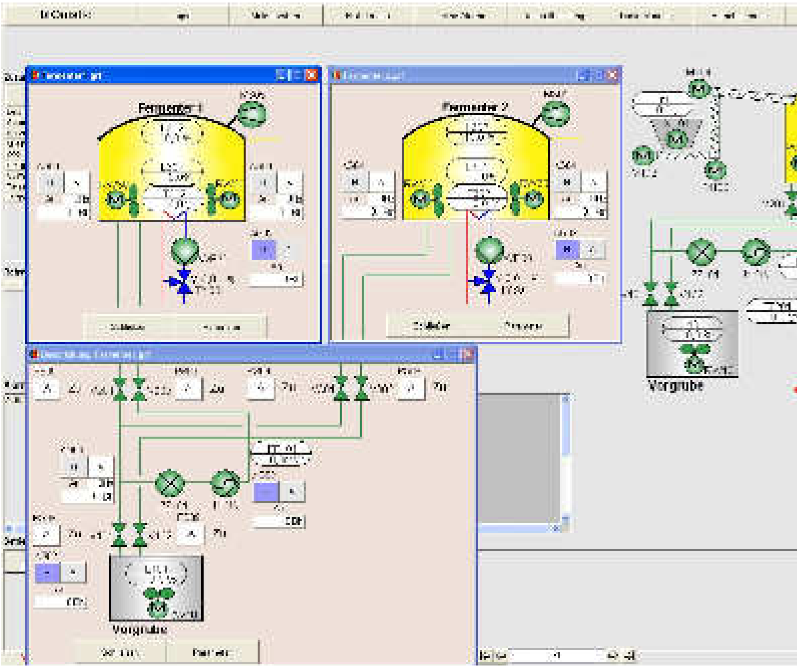


Figure 6-5 Display of the process-related continuity even at the control level

In Figure 6-5 it can be seen that even at the control level, the user can track the flow route of the medium.

6.6 *Customer-specific (Customised) Diagrams*

6.6.1 Controlling the mash hydrolysis (AHS)

This plant section is available only in very special plants. The following diagram illustrates the parameter level of the AHS diagram.

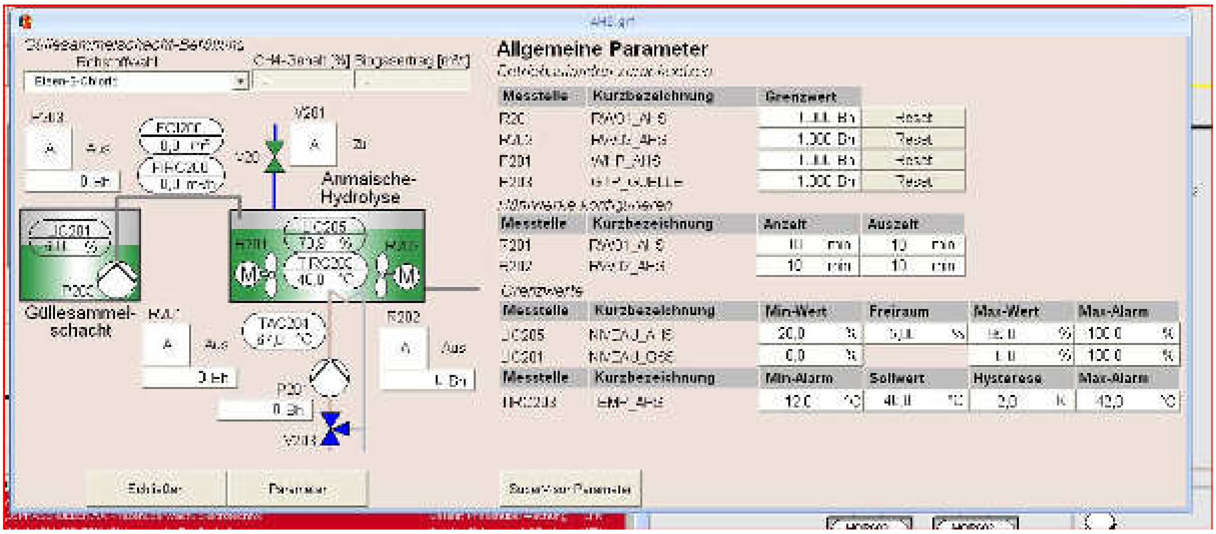


Figure 6-6 Display of the parameter level of the AHS

What needs to be explained here particularly is the parameter "Free space", since this is used only at this one place. The free space in an AHS controller is the space below the maximum value of the fill level, in which no additional recirculating filling takes place. This means that when filling according to the recipe as given in section 7.6 is completed within the free space, no refilling takes place with recirculation. The filling in accordance with the recipe is carried out up to the maximum value. If this recipe filling gets completed below the free space, refilling takes place with recirculation up to the free space.

The recirculated material is refilled only if the pump in the fermentation residue depot is put in automatic mode of operation. This is why the specification of the recirculated material in the recipe has been omitted in the systems since mid 2011.

6.6.2 Controlling the desulphurisation

Some plants have desulphurisation using input of oxygen in the containers. Some plant operators work here with fixed quantities of oxygen input. In this case, it is not necessary to specify any parameter in the visualisation system. The oxygen content is controlled in the case of certain plant manufacturers.

Depending on whether the plant has gas analysis behind each container or only in front of the active carbon filter, the following parameters displayed are available only in the respective container diagrams or in the CHP (Combined Heat and Power plant) diagram.

The oxygen content is controlled in accordance with a minimum and maximum value based on the principle of the limit value switch. This means that when the minimum value is overshot, the blower comes on or the oxygen inlet valve (if the dosing is controlled with the help of valves) is opened and closed when the maximum value is exceeded.

In certain types of plants there is still another parameter, a minimum value for the H_2S content in front of the active carbon filter. The oxygen control system is active only if this value is exceeded. But when the oxygen content is below the minimum value of the oxygen content, this parameter is not active and the desulphurisation process runs.

If the plants have analytical measurements before and after the active carbon filter, you can define a limit value for the H_2S behind the active carbon filter that indicates in the message window that the active carbon filter needs to be replaced.

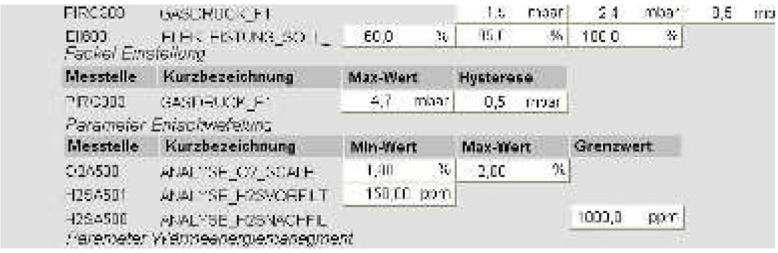


Figure 6-7 Desulphurisation parameters

6.6.3 Characteristic features in plants of bue_Anlagentechnik

Each bio-gas plant manufacturer has his own minor characteristic features, which get reflected even in the operation and control. The plants of bue_Anlagentechnik make always work with mash hydrolysis (AHS). Apart from the characteristic features resulting from this when operating the plant (this can be referred to in the process-related description of the plant operator), there are also characteristic features associated with the operation of the automation system of the plant:

1. You can interrupt the entry of solids in automatic mode of operation only if you turn the key switch for releasing the filling of the solid materials
2. Attention: Automatic mode has total precedence; in other words, if actuators are put in manual mode, they are automatically switched to automatic mode of operation on starting the recipe step. This is why it is absolutely important that for maintenance work, the actuators are disconnected from the mains supply.

7 Functional diagrams

7.1 Overview

Picture name	Password level necessary	Print function included
Operational logbook	Operator	Yes
Input material supply overview	Operator	Yes
Biological analysis values	Operator	Yes
Report generation	Operator	Yes
Dosing schedule	Operator	Yes
Forecast (under preparation)	Operator	Yes
Login	Observer	No
Administration	Supervisor	No
Message system	Supervisor	Yes
Historical trend	Operator	Yes
On-line trend	Operator	Yes
Historical alarm	Operator	Yes
On-line alarm	Operator	Yes

Table 7-1 Functional diagrams overview

In the functional diagrams including the operational logbook, input materials supply overview and biological analysis values, there are always retrieval mechanisms available for the values saved. The inputs are made by selecting parameters and inputs of specific process values, in order to be able also to make an evaluation, for example, of

- maintenance times on the CHP plant or
- share of manure in the BGS on 08.11.2007 or
- trend of the TS content in the fermenter in the year 2007

etc. If the data is entered consistently, commercial observations on the bio-gas plant(s) can be made with **biOmatic**, but only really with the report generation system based on it, namely **infOmatic**, by pressing a button.

Since all values are saved in a non-corruptible database, the user is always asked to confirm, prior to storage, whether the inputs are correct. Despite all this, correction values may also be entered with the help of the input screen. These correction values, of course, are shown separately in the reports via infOmatic.

The information from the functional diagrams, namely the operational logbook, input materials supply overview and biological analytical values and reporting are an important prerequisite for the compilation of qualified biological guidance.

7.2 Operational logbook

All activities or operations in accordance with a "Reason Tree" may be saved in this functional diagram. As a result, detailed evaluations can be conducted according to the most diverse criteria such as plant section, component or with respect to maintenance or troubleshooting activity. This is an important prerequisite for an operational and overall consideration of the bio-gas plant, the preparation of better maintenance cycles or the adaptation of the plant technology.

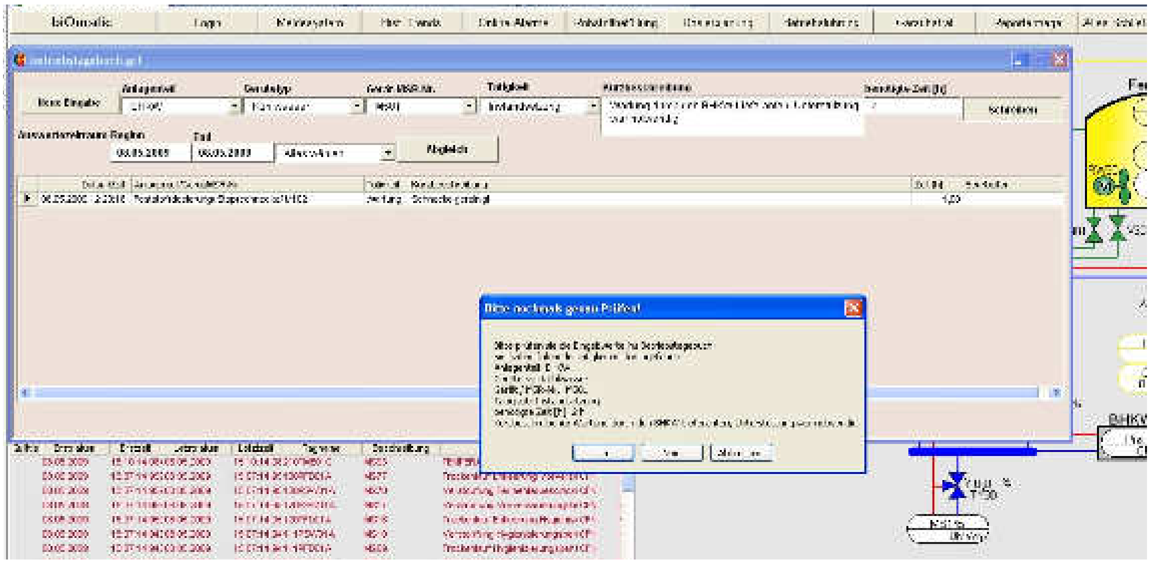


Figure 7-1 Display of the entry of activities or operations carried out on the BGS

7.3 Entry of input material supplies and compilation of raw material overviews

Based on our experience, we have divided the entry of the input (raw) materials in the bio-gas plant process in two steps:

1. The delivery of the raw materials
2. The incorporation of the raw materials into the biological process

The reason for doing so lies in the constantly recurrent difference between raw materials weighed externally and the quantities that are determined with the help of the process measurement technology at the dosing systems. The reasons for these deviations are varied and do not need to be highlighted any further at this juncture. What can certainly be said at this stage is that this difference cannot be eliminated.

This is why we provide the operator the option of deciding on his own the method according to which he evaluates the bio-gas plant process, the quantities of raw materials supplied or the quantities of raw materials consumed in dosing.

Hence, we first save the quantities of raw materials supplied (by weighing and manual input) and then the dosing quantities of solids and liquids are recorded with the help of process measurement technology.

The monitoring and exact quantity of raw material supplies accepted enables us to forecast the gas yields for the dwell period of the fermenter. (see section 7.7)

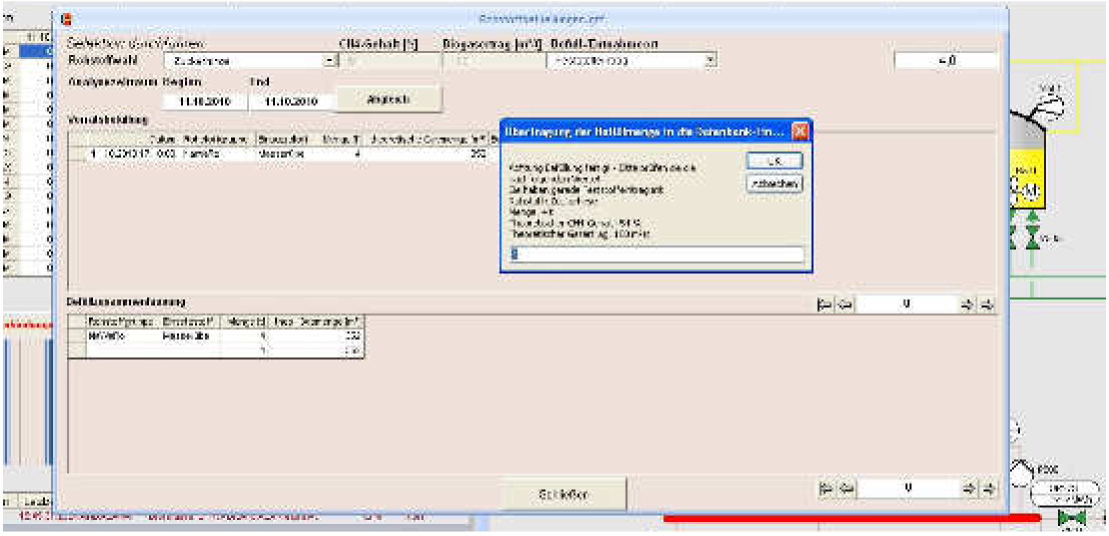


Figure 7-2 Display of the entry of input material supplies

In certain plants, the quantity of raw materials supplied is saved automatically. The raw material that is being filled can be preset in the plant diagram for dosing of solid materials. See

7.4 *Input / Analysis of parameters for biological tests*

The plant operator can enter the analytical values in this functional diagram so that these can be retrieved like all plant-related data directly on the BGS. When using the **infOmatic** service, this page would be omitted completely since the biological test laboratories would enter the laboratory results directly in the database of **infOmatic**.

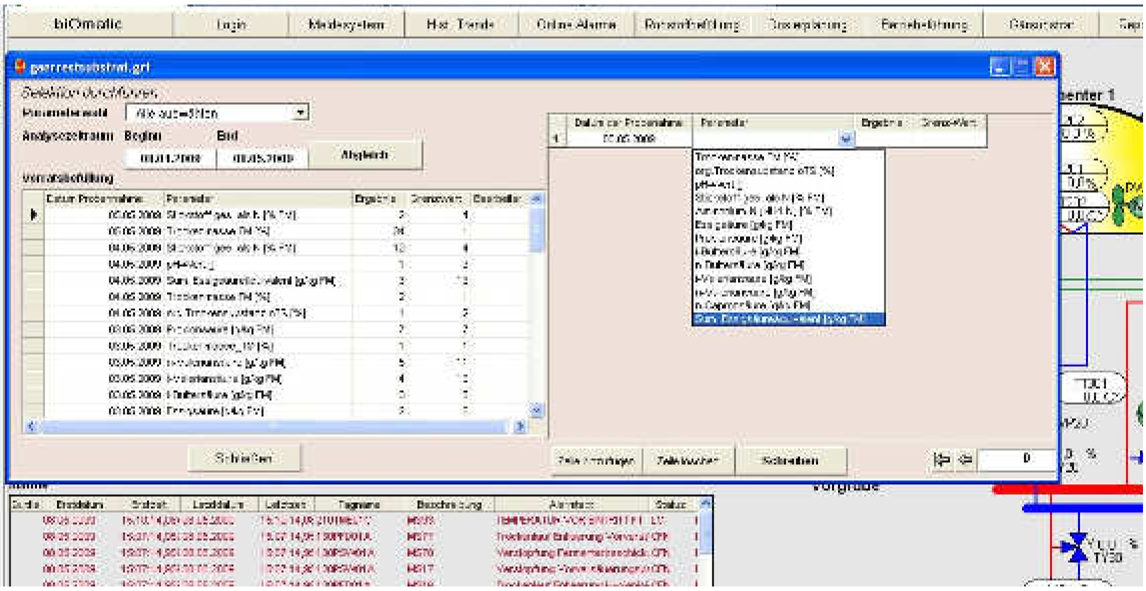


Figure 7-3 Display of the entry of biological analytical values

7.5 Report generation

With **biOmatic**, you are in a position to browse important parameters of your BGS for any point in time since it has been in operation as daily, monthly, quarterly or yearly values for a time period of 54 days, months, quarters or years. The parameters calculated can be exported as a csv file or saved in pdf format (it is necessary to install a pdf printer for this purpose). Optionally, selected parameters can also be displayed in charts. The parameters evaluated here are calculated from process or input values that are saved in a historical database so that they cannot be corrupted.

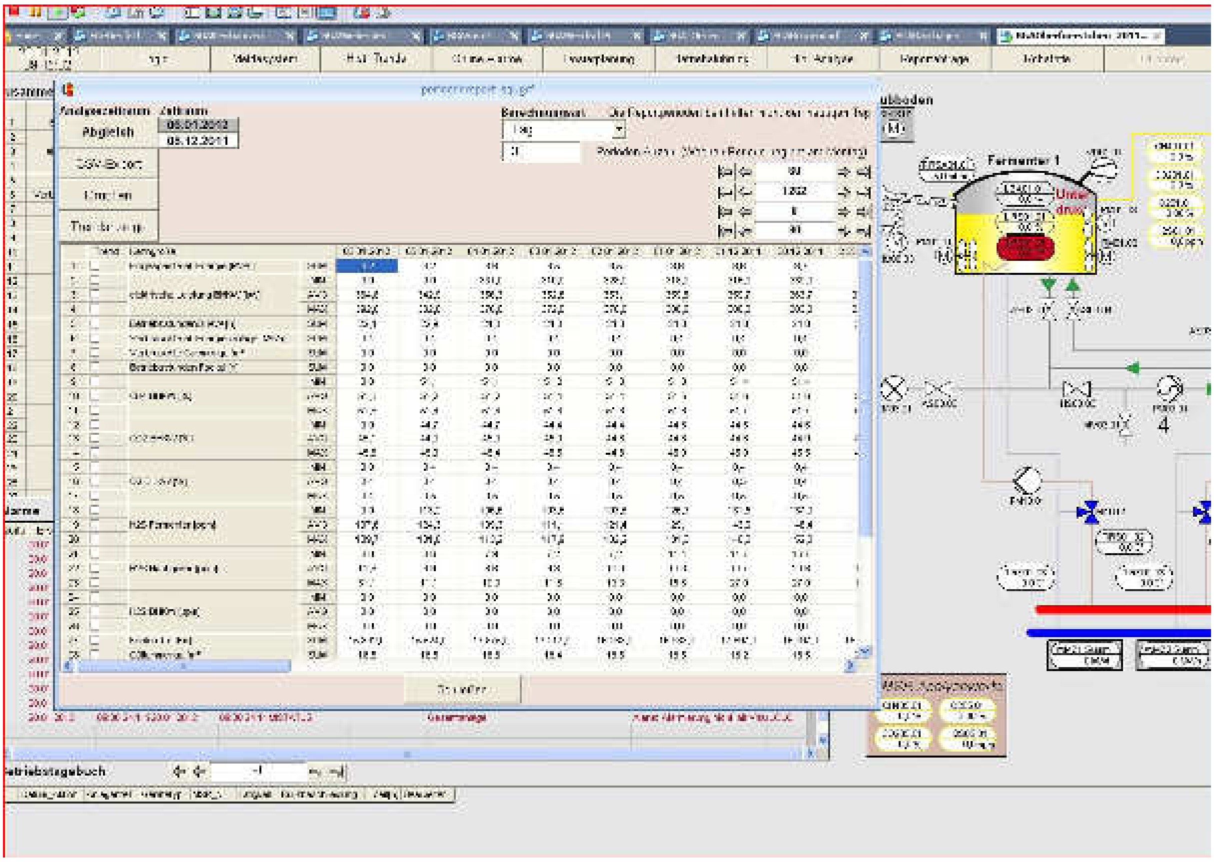


Figure 7-4 Display of the reporting tool

The csv file is exported to the folder C:\Program Files\GE Fanuc\KLEIN_BGA\REP or to the desktop depending on the customer's requirement at the time of creating the project.

Up to 6 curves can be displayed in a trend curves screen for the report values.

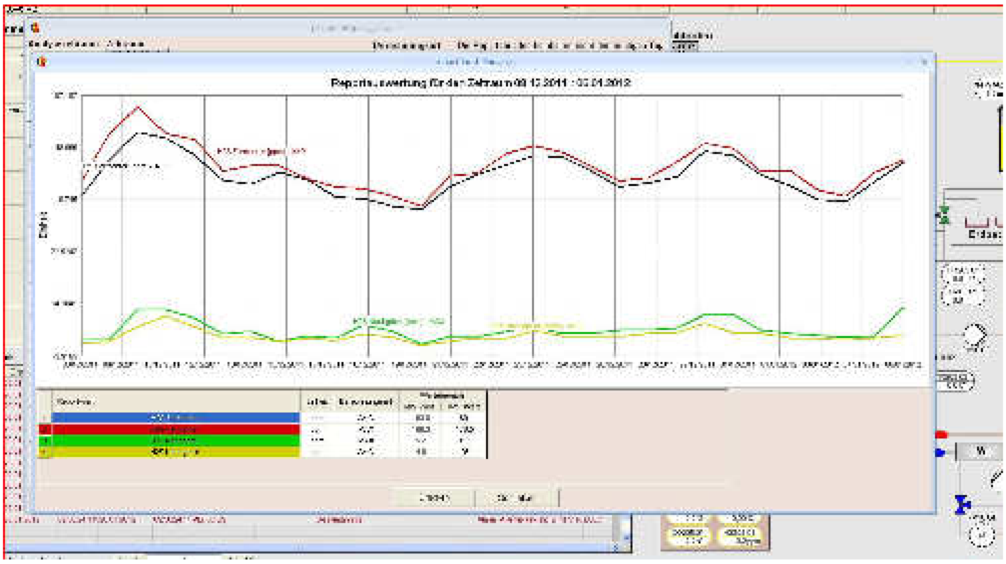


Figure 7-5 Trend curve display of the report values

7.6 Creation and administration of recipes for dosing solids and liquids

This module is not available in all systems since in certain plants the customer desires to have a simple mechanism for specifying the recipe using the two values:

- Quantity per day
- Number of feeds per day

. These settings are then made directly in the diagram for dosing solid materials.

The **biOmatic** recipe administration system is based on the requirements of the pharmaceuticals industry. In the bio-gas segment, the recipe is also designated as daily dosing or daily feed.

The **biOmatic** recipe administration system can create and manage complex recipes consisting of solid material dosing from different silos or bunkers and dosing of liquids from different containers (stored and loaded). Even pumping liquid between containers can be automated with the help of the recipe administration system. The recipe administration system checks the recipes for time-related plausibility prior to storage.

In conjunction with the forecast module of gas and methane yields (see section 7.7), **biOmatic** could indicate at the planning stage whether limit values determined theoretically such as the share of manure are undershot, TS values in the fermenter are overshot or bio-gas production is overshot or undershot. (However, this is still under preparation)

The handling of recipe input is simple and clear since only lines are available that also represent one step of the recipe.

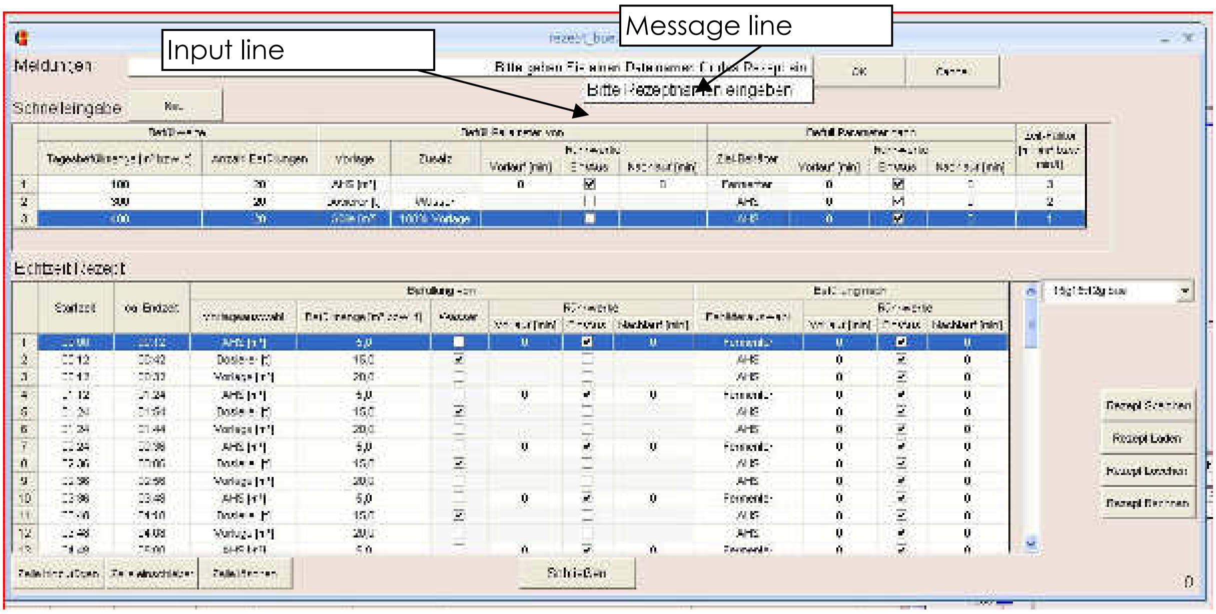


Figure 7-6 Display of the input user interface of the recipe administration system

You can use the quick entry facility to create a complex recipe by entering few parameters.

With "New", the quick entry facility is reset to its original condition.

With "Calculate Recipe", the quick entry is implemented to a recipe for utilisation on the PLC.

Recipes can be saved with "Save Recipe".

Recipes can be loaded with "Load Recipe".

Recipes can be deleted "Delete Recipe".

With "Utilise Recipe", recipes can be loaded on the PLC. ATTENTION - Only recipes that have been saved can be loaded on the PLC.

In the real-time recipe grid, you can create and edit generated, loaded or even completely new recipes. You can add, insert or delete lines.

Please note that after entering the name in the input window, Enter must be pressed for confirmation and then the OK button too.

The recipes are saved in the

C:\Program Files\GE Fanuc\KLEIN_BGA\PIC\RCM

folder

7.7 Forecast for the gas and methane yields for the mean dwell time in the fermenter (under preparation)

On account of the detailed record of the input (raw) material supplies (see section 7.3), we can determine relative accurately which raw material needs to be mixed with which energy-related parameters in the process. From the material-specific and plant-specific parameters, we can forecast the production quantity of gas and methane as well as the parameters that can be derived from them such as the bio-gas power or electrical power for the next 30-40 days. Even the TS and oTS content in the fermenter could be forecast with the **biOmatic** solution. In this manner, assistance can be provided to plant operators for planning the dosing activities, in order, for example, to mix specifically high energy input materials temporarily to the process, so that the CHP plant can always be operated at maximum power.

These values are also displayed in tabular form or as a chart in the gas system part of the plant section.

7.8 Login - Functions

7.8.1 Login

On starting the Login routine, the Login window of iFix opens. The user name and password must be entered here.

Figure 7-7 Login window

By holding the mouse on the Login button (see section 7.8.2) the Logout and Administration buttons become visible (see section 7.8.3).

7.8.2 Logout

By pressing this button the current Login level is set to that of the operator level.

7.8.3 Administration

When starting the administration, the administration window of iFix opens (see Figure 7-8). By pressing the user profile button, the Figure 7-9 opens, in which a new user can be created. By assigning a user group, the necessary rights are assigned automatically to the new user created. This is why all that is needed to be specified when creating a user is only a complete name, login name, the password and the group membership.

You can choose 4 different user groups; for this see section 4.4. Please do not make any modifications to the other settings and do not create any new user groups without being trained on iFix.

Please note that you could block yourself completely out of the system by making incorrect security settings!

Figure 7-8 Login configuration

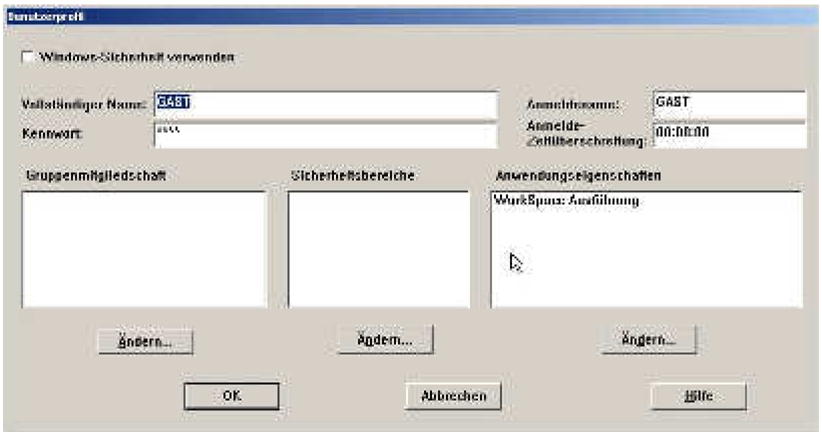


Figure 7-9 Creating a user profile

7.9 Message system

When starting the message system, the user interface of Melsys opens and other alarms can be activated for forwarding the alarms. Moreover, other telephone numbers can be integrated for alarm generation, alarm groups or even alarm schedules. For more information on the configuration of the message system please refer to the on-line help of Melsys.

7.10 Trend displays

There are three types of displays for trend curves:

- Historical trends, in which saved values from the historical data storage of iFix are displayed.
- On-line trends that access the current process variables directly but begin with the display when the data point is called up. An exception to this is formed by the data points of type *_ETR.
- Controller trends are on-line trends that are permanently associated with the controller parameters, set-point value (W), actual value (X) and control parameter (Y) as a diagram group.

Each trend supports a zoom feature and a ruler function. With the ruler function, you can display any value in the diagram as a number.

All trends can be printed out on the default printer using the Print button whenever desired.

7.10.1 Historical trends

Measured values that have been saved can be displayed in the historical trends for any period of time. In order to select the display range, you have to choose the start date (via a calendar function, see Figure 7-11) and set the start time and the display horizon. You can scroll forwards or backwards using the arrow keys below the trend.

Other display values can be selected on-line using the diagram group editor (Figure 7-13). The diagram groups editor is opened by double clicking on the trend.

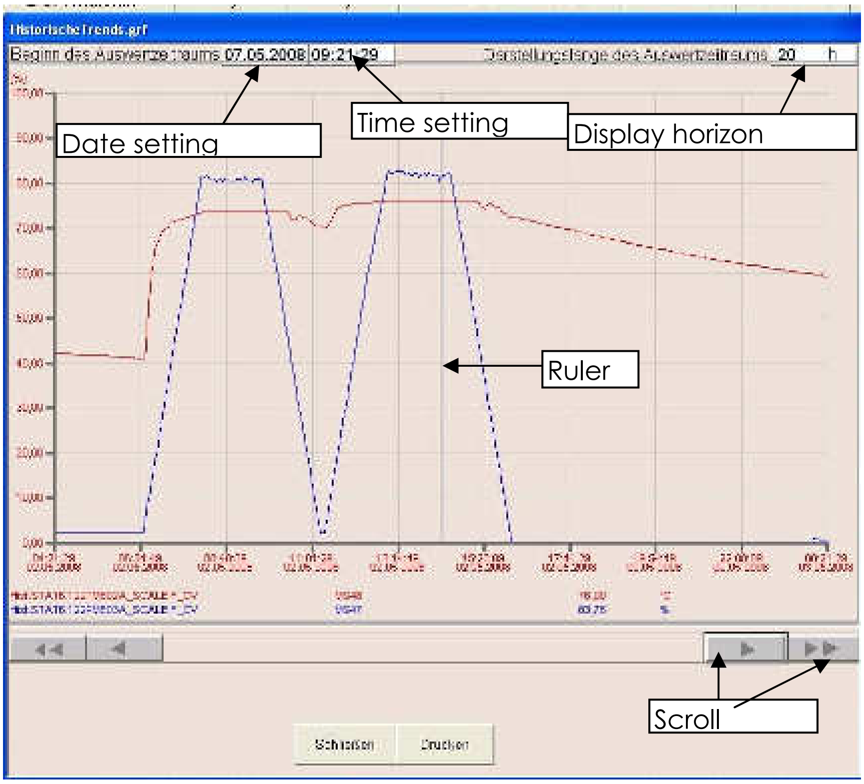


Figure 7-10 Historical trend

Figure 7-11 Calendar function

7.10.2 On-line trends

In an on-line trend, no other settings can be made other than the choice of the diagram group.

Other display values can be selected on-line using the diagram group editor (Figure 7-13). The diagram groups editor is opened by double clicking on the trend.

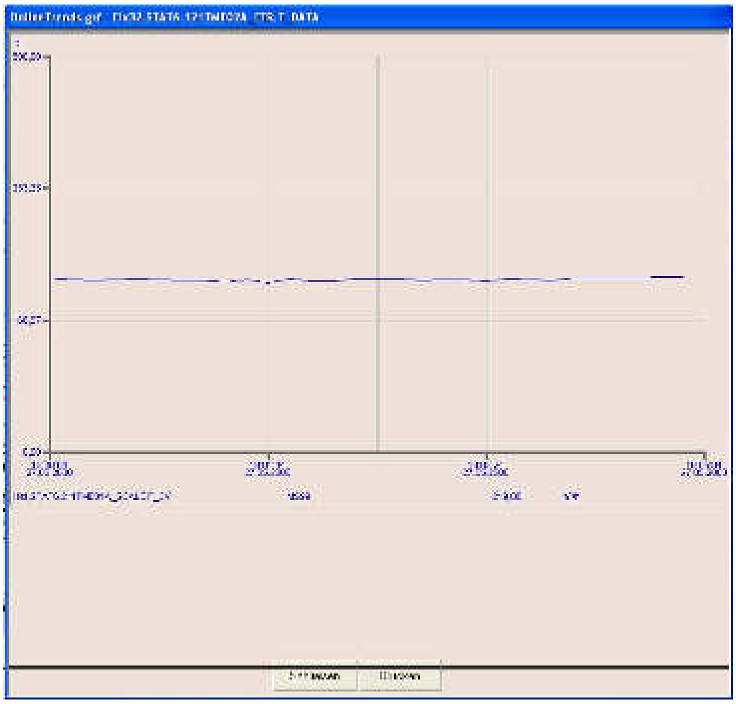


Figure 7-12 On-line trend

7.10.3 Defining new diagram groups

Despite a brief explanation for creating new diagram groups and the assignment of data points to curves, you are referred to the on-line help at this juncture since it contains significantly detailed explanations.

The diagram groups editor opens when a historical trend is called up and even by double clicking on the trend. You can select and display diagram groups in this that have been prepared in advance. You can also create other folders in this.

You can select this by clicking on a program group (in the same manner as that of the Windows functionality). Thereafter, you can:

1. apply this on the trend by clicking on the "Apply" button
2. edit this diagram group by clicking on the "Edit curve" button
3. With the "New" button, you can generate a new diagram group

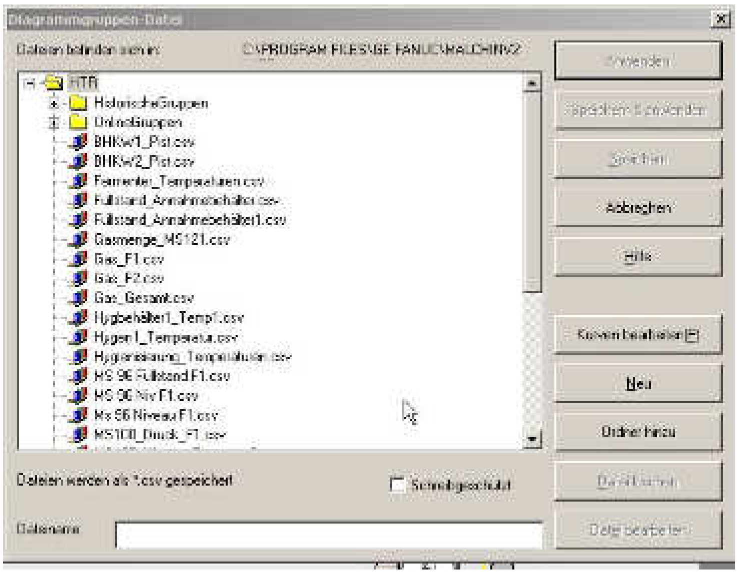


Figure 7-13 Diagram groups editor

By executing 2. and 3., the configurator opens as illustrated in Figure 7-14. Special settings may be configured for each curve in this application. By clicking the button that is designated as "Creating a new curve" in Figure 7-14, another curve can be activated. By pressing the "..." button, the curve selected is assigned to a data point.

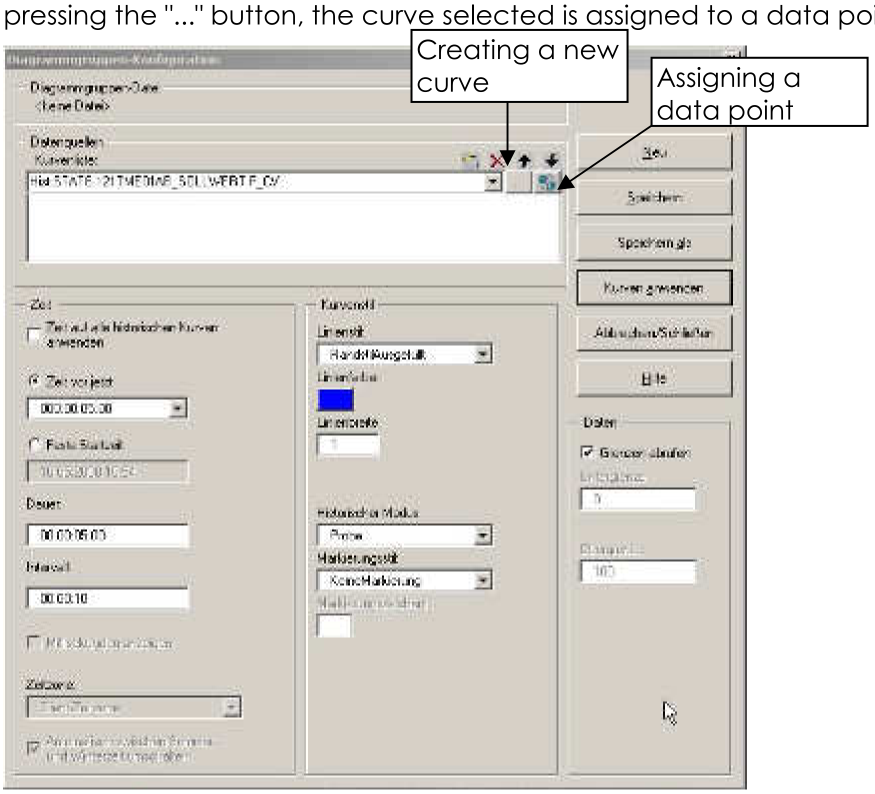


Figure 7-14 Diagram groups configurator

After creating a new curve, Figure 7-15 opens, in which different data points are selected for on-line trends and historical trends. In order to assign historical data points to historical curves, the historical tab must be selected (see section 7.10.3.1). For the assignment of data points to on-line curves, the FIX Data base must be selected (see section 7.10.3.2).

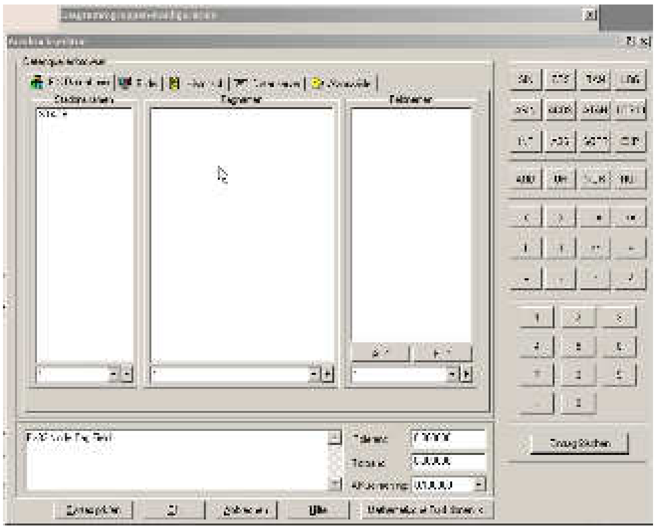


Figure 7-15 Data point assignment

7.10.3.1 User groups for historical trends

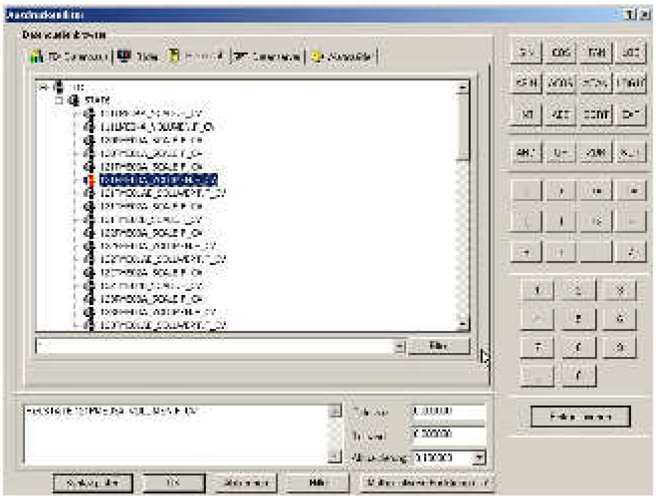


Figure 7-16 Selecting a data point for a historical trend

7.10.3.2 User groups for on-line trends

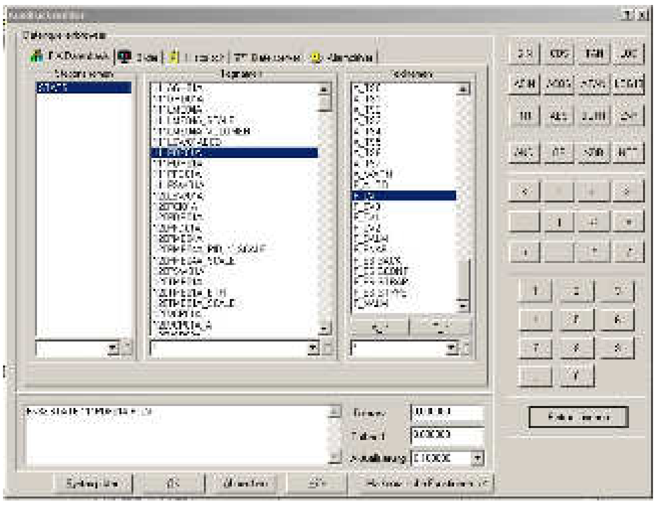


Figure 7-17 Selecting a data point for an on-line trend

7.10.4 Controller trend display (for complex control operations)

For all controllers, the user group "Supervisor" can call up an on-line trend with the critical controller parameters, set-point value (W), actual value (X) and control parameter (Y) to optimise the controller parameters.

No other settings are possible with these trends.

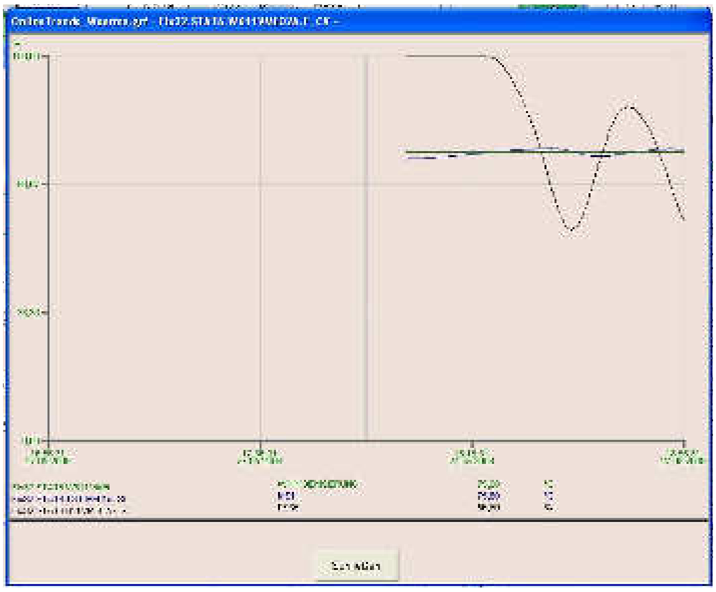


Figure 7-18 Display of the controller trend

7.11 Alarm displays

7.11.1 General

Both the historical and the on-line alarms can be printed out whenever desired by using the print button on the default printer. The state (historical alarm) or the status (on-line alarm) is output in both alarm displays. The names for these are specific to iFix and cannot be modified. (Please note the differences to other control systems)

- LOLO - Min. alarm generally triggered by an additional process switch
- LO - Min. alarm generally triggered by a software limit
- OK - Fault or error is confirmed or resolved
- HI - Max. alarm generally triggered by a software limit
- HIHI - Max. alarm generally triggered by an additional process switch
- CFN - An alarm contact has been made
- COMM- Error that occurs if communication (in this case the Ethernet link) is interrupted

7.11.2 Historical alarms

The beginning and the end of the evaluation time can be selected via the calendar feature (see Figure 7-11) in the historical alarms.

The display is updated by pressing the adjustment button.

Apart from the P&ID no., the MS no. and the alarm text, the status of the alarms is also displayed in the alarms table. Moreover, you can see in the time columns when the error occurred, when it was confirmed and when it was resolved or when it normalised.

The control feature at the bottom left indicates whether the historical alarm monitoring:

- is still under processing - "Link being set up"
- has completed successfully - Number value > -1
- has not found anything - -1
- has no link to the database - "Link error"

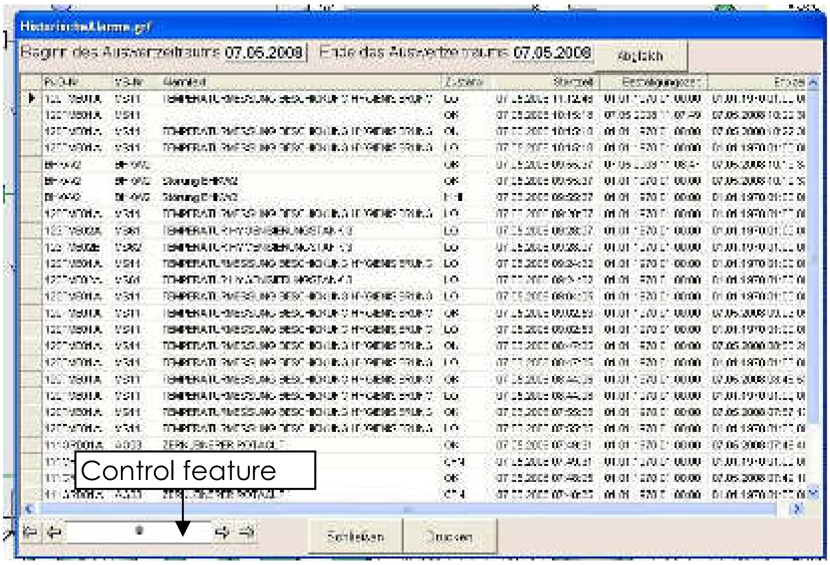


Figure 7-19 Historical alarms

7.11.3 On-line alarms

7.11.3.1 General

In On-line Alarms, the on-line alarms are displayed in one screen and the on-line messages in a second screen. The following functions can be executed on the on-line alarms by clicking the right mouse button (see Figure 7-20):

- confirming one or more alarms
- deleting one or more alarms
- sorting the alarms
- filtering alarms

Please refer to the on-line help feature to get detailed explanation of how you can execute various steps.

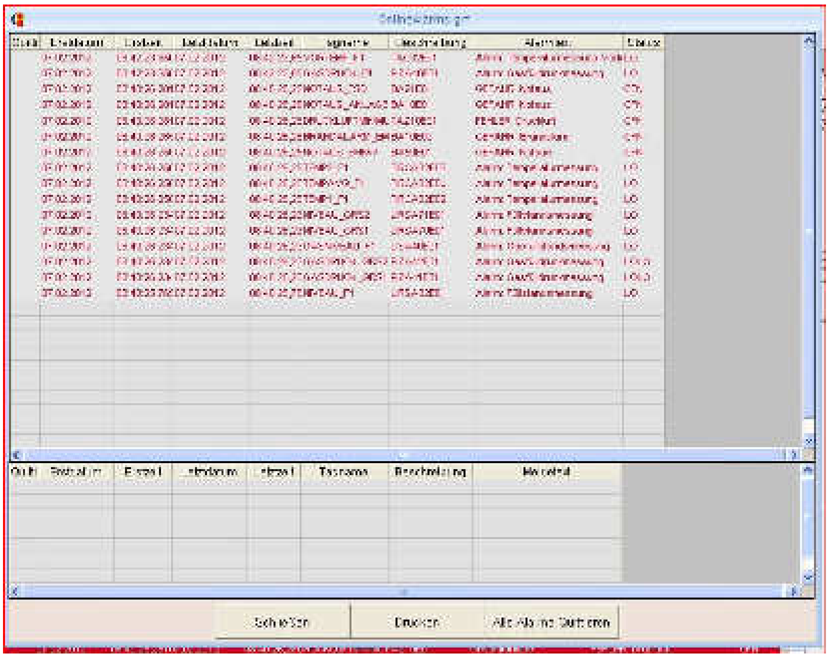


Figure 7-20 On-line alarms display with selection

All current and unconfirmed alarms are displayed in the On-line Alarms. Alarms that are confirmed or have normalised are no longer displayed.

8 Remote maintenance

A remote maintenance program such as pcAnyWhere or UltraVNC is installed for remote maintenance on each virtual machine and on the host. These tools must always be active so that you can login to them on the computer. Hence, please always make sure that when pcAnyWhere is installed, the symbol illustrated in Figure 8-1 is displayed.

Figure 8-1 pcAnyWhere is ready

If the symbol is displayed as that illustrated in Figure 8-2, it means that someone has logged in to the system.

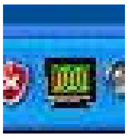


Figure 8-2 pcAnyWhere is active

If none of the two symbols is visible, please start the host (Ormatic) using the pcAnyWhere tool. See Figure 8-3 and the help provided within the pcAnyWhere tool.

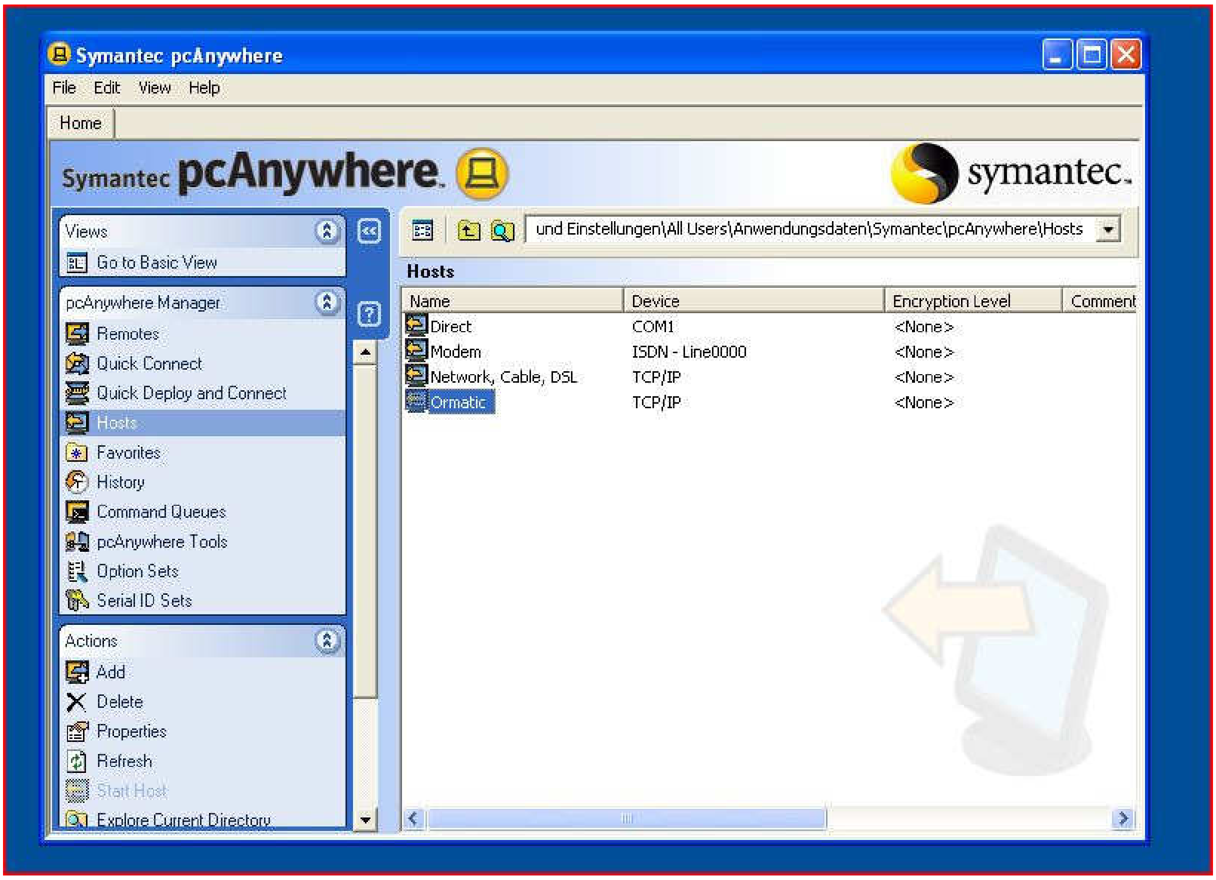


Figure 8-3 pcAnyWhere tool, host equipment

9 Shutting the system down

Since biOmatic is a system in a virtual machine, two Windows systems must always be shut down before the PC goes off. The system is shut down exactly in the same way as that for any Windows system via "Start" and "Shut down computer". When you have shut down this first system (see Figure 4-1), you have another Windows system in front of you, which has a grey background.

If you would like to make a complete backup in accordance with section 10.2, the actions just described must be carried out.

In order to shut down the PC completely, the same actions must be carried out in the so-called host as those done in the virtual machine.

10 Data backup

10.1 Regular data backup

The historical process data and alarms should be backed up regularly.

The process data is available as files with names ending in YYMMDDxx.H24 in the folder

C:\Program Files\GE Fanuc\Klein_BGA\HTRDATA\STAT6

The alarm data is saved twice, once as text files in the form YYMMDD.ALM in the folder C:\Program Files\GE Fanuc\Klein_BGA\ALM and a second time in the historian database under C:\Program Files\GE Fanuc\Proficy Historian\Archives\

The data backup can be made in the simplest case by copying the files on the second hard disk of the PC.

10.2 Complete backups

The entire virtual machine should be copied every now and then! There are two ways of doing this:

1. Complete backup after the virtual machine has been shut down. This has the advantage that the copying procedure is completed faster and the Windows system is restarted once
2. Complete backup while the system is running. This has the advantage that no data gets lost.

10.2.1 Backing up the virtual machine that has been shut down

In order to do this, please close iFix (the other software modules forming part of **biOmatic** need not be closed) by clicking on the red cross at the top of the screen in the picture (see Figure 10-1). Next, close Windows. After Windows of the virtual machine has been shut down, the host, another Windows system with a grey background becomes visible.

Figure 10-1 Start screen of biOmatic

From this host, you can use the file manager to backup the entire virtual machine with the actual visualisation system and all saved process data, alarms and events in the drive D:\VM.

10.2.2 Backup during on-going operation

The virtual machine can also be backed up while the system is in operation. However, to do this, you must have certain basic knowledge of Windows.

The virtual machine must be minimized with [CTRL]+[ALT] [ENTER]. You may now backup the entire virtual machine on the host using the File Manager on the drive D:VM. When you have completed this, you may once again maximise the virtual machine to the entire screen using the key combination [CTRL] + [Alt] [ENTER].

10.3 Setting the time

The time on the host PC must be set twice a year. This is necessary as a result of the deviation of the internal clock of the PC from the real time.

The procedure to end the visualisation system and the virtual PC is identical to that described in section 9.2.

Alternatively, the time may also be set on the host without shutting the VM down. In order to do this, please press the key combination "CTRL"+ "ALT" so that the VM gets minimised. After setting the time, the VM is maximised once again to the full screen.

The clock is then opened on the host PC and set accordingly. This time that is set then synchronises the virtual PC. In this manner, the time specified in the batch reports, historical alarms and trends remains realistic

11 Troubleshooting

11.1 Software crash

If the software crashes, first try to restart the "Workspace". The workspace is the actual visualisation system without the process database. In order to do this, please press the appropriate button Figure 11-1 on the desktop. If this does not work, please restart the computer. If this is not successful, please send an e-mail to info@ormatic.de or call up via telephone directly. The current telephone no. is available at www.ormatic.de.

Figure 11-1 Button to restart the "Workspace"

11.2 Computer defective

If the computer is defective, a VMWare player must be installed on the new computer. You can download this free of charge at http://www.vmware.com/de/products/desktop_virtualization/player/overview.html

. After installing the VM player, simply copy the previous backup of the virtual machine of the plant visualisation system to the computer. In order to ensure that the alarm generation system also works properly, a CAPI server that is supplied along with the system must be installed on the PC.

Next, the correct IP addresses need to be set up in accordance with the data sheet supplied along with the system. After the software dongle has been plugged in the PC and then the virtual machine may be restarted.

When the virtual machine is running, all historical data in the relevant folders can be copied.

- Copy the historical trend data YYMMDD00.H24 to the folder, C:\Program Files\GE Fanuc\Klein_BGA\HTRDATA\STAT6
- Copy the backed up trend groups to the folder, C:\Program Files\GE Fanuc\Klein_BGA\HTR
- Historical alarms may be imported via the program Historian – Administrator. See the on-line Help of Historian for this purpose

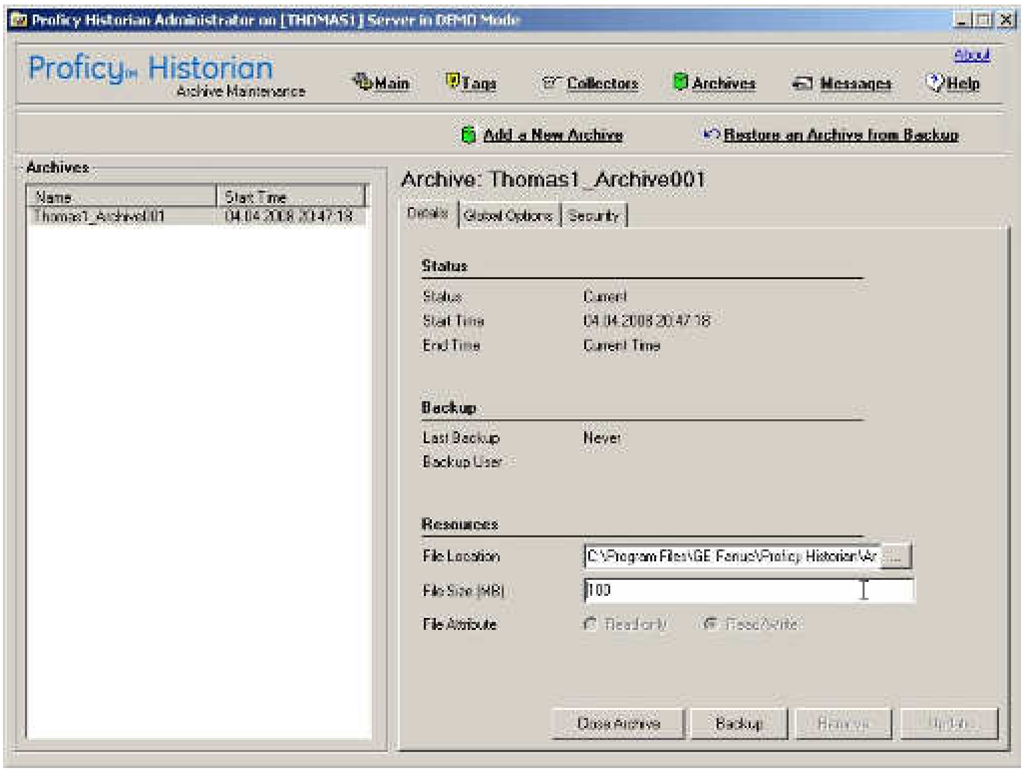


Figure 11-2 Restoring historical alarms

Please observe and follow the sequence.

11.3 Defect in the dongle

In case of defect in the dongle, a replacement may be obtained directly from GEFanuc at www.gefanuc.com or from ORmatiC at www.ORmatiC.de.

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