# CAMPANA

MADE IN ITALY

## Nicarb nitriding plant
## Technical Description

# THE NITRIDING PROCESS

The nitriding process executes a surface hardening on ferrous materials which is obtained by means of nitrogen diffusion at a temperature from 450 to 550 °C.

The treatment is kept in ovens which are filled with gases in a suitable proportion to obtain optimum conditions for their dissociation and reaction with metal. Today nitriding processes are obtained in gaseous atmospheres and are the followings:

- **standard gaseous nitriding**: is obtained in atmosphere of anhydrous ammonia mixed with nitrogen directly dissociated on material surface;
- **gaseous nitrocarburising**: is obtained in carburising atmosphere and realizes a diffusion of nitrogen and carbon atoms;
- **oxi-nitrocarburising**: is obtained in carburising atmosphere and reaches the final phase in oxidizing atmosphere.
- **nitro-postOxy** at the end of the process a phase of post-oxy controlled with $N_2O$ introduction, to improve the corrosion resistance.

# NICARB NITRIDING PLANT

Nicarb nitriding plant allows the above mentioned nitriding processes to be **realized in optimum condition**; the main characteristics of this plant are:

- wide flexibility in use
- fully automated process control
- certification in conformance with UNI EN29000 (ISO 9000)
- outstanding repeatability of results
- easy integration in CIM environment
- complete elimination of polluting outflow

The plant is realized as shown in the annexed picture and represents the most advanced today available technical solution for running nitriding processes basing its characteristics on hundreds of installations all over the world.

A **remote handling of the plant** obtained by means of an internet connection provides a complete control of the cycles from our side as well as the easy update of the software, when necessary.

## TREATMENT OVEN

The treatment oven is a pit furnace made up with a sealed cover and electrical heating, specifically designed to obtain the **best temperature and atmosphere uniformity**; various dimensions are available to fit specific productivity needs.

# CONTROL SYSTEM

The control system offers **full regulation capability** and is easily expandable as well as it can be connected to a supervisory system at a higher CIM level. The control system is composed as follow:

- Control system is made up of an OCTOPUS OCS Series 4000 controller which integrates all the needed functions to run a treatment process;
- Gas analysis and distributing is accomplished by means of gas analyzers and proportional valves to obtain an accurate atmosphere regulation;
- Power cabinet supplies power to the heating elements as well as to the installed electromechanical devices.

# CONTROL CABINET

**Cabinet with IP 54 protection grade containing:**

- touch screen color graphic monitor as operator interface
- graphic recorder with data backup
- controller OCTOPUS OCS Series 4000

# POWER CABINET

**Cabinet with IP 54 protection grade containing:**

- disconnecting switch and voltmetric/amperometric meters
- devices for the supply and the regulation of heating power
- relay switches
- safety pyrometer
- electrical meter for consumption
- UPS for PLC and Analyzer backup

# ANALYSIS AND DISTRIBUTION GAS CABINET

The gas input is directly controlled by the value set in the process recipe; any manual adjust is needed.

A vacuum phase preceed the furnace starting purge in order to speed up the process and to minimize the gas consumption.

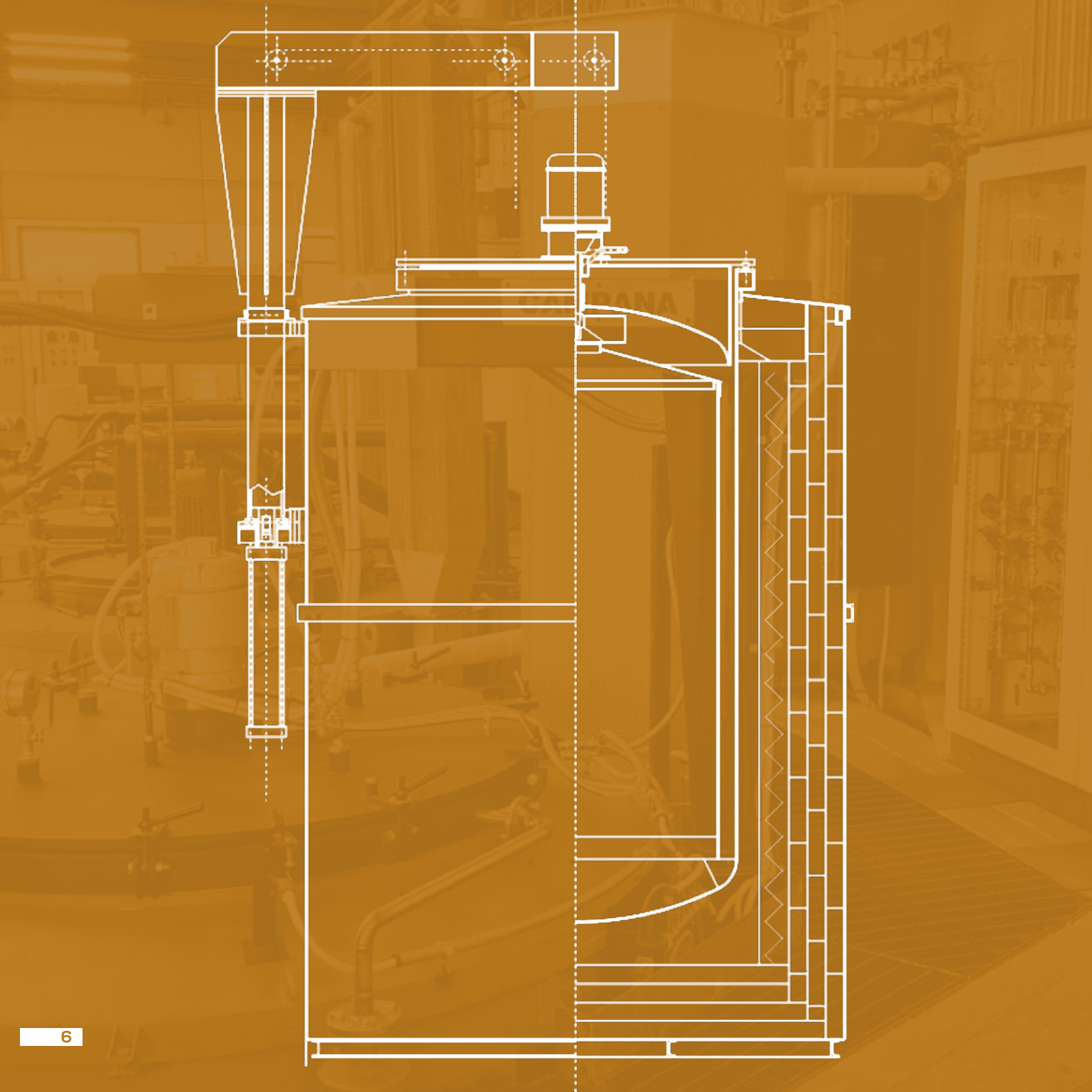
**Cabinet with IP 54 protection grade containing:**

The analysis section contains:

- diaphragm pump for gas thieving
- filters for dust felling;
- flow meters for thieving control
- hydrogen analyzer

The gas distribution section contains:

- pressostat detecting gas
- ball valve
- event valve
- regulating valve
- electromagnetic flow meter with analog interface



# TREATMENT OVEN
## CONSTRUCTIVE FEATURES

**External carpentry** made up of a sturdy cylinder realized with steel plates and sections electrically welded together.

- External coating as follows
- Washing and cleaning of surfaces
- Two antirust coatings
- Finishing with RAL 9006 aluminium coating or other type to define
- Heat insulation by means of low density bricks and light bricks class "23"
- Heating is obtained by resistors in original alloy Kanthal Nikrotal 80 plus. Resistors are sustained by hooks directly placed in the masonry. This solution offers an efficient heat transmission and allows an easy resistor substitution
- Hermetic gas proof muffles for treatment atmospheres circulation; made in refractory alloy AISI 310 S or, as option, INCOLOY DS. Water jacket for weather strip cooling
- The cover is insulated with ceramic fiber and is provided with sealed electric fan. Gas proofing is obtained by a unique static seal which completely avoids gas leakage. Parts which are heat exposed are made out of refractory alloy. The cover is sustained by means of a rotating arm mounted on brass and ball bearings; the cover elevation is obtained by a pneumatic cylinder.

**Forced cooling is obtained by:**

- Centrifugal fan for cooling air inlet
- Air lock at inlet and outlet of cooling system driven by pneumatic cylinders
- Flue for hot air outflow
- Cool air inlet is at the bottom and is uniformly distributed on muffle surface by means of a distributor realized in the masonry. Hot air is kept at the top and outflows through the flue. Air locks mounted at inlet and outlet of cooling system avoids ascending flow produced by a flue effect
- A vacuum pump is provided in order to have an initial vacuum phase that speeds up the nitrogen purge and reduces gas consumption

# NITRIDING PIT FURNACES

| | ICS 60/120 | ICS 60/160 | ICS 80/120 | ICS 80/160 |
|---|---|---|---|---|
| Floor dimensions (cm) | 145x170 | 145x170 | 165x190 | 165x190 |
| Overall height (cm) | 270 | 310 | 270 | 310 |
| Charge dimensions (cm) | 60 x 120 | 60 x 160 | 80 x 120 | 80 x 160 |
| Charge gross weight (2 kg/liter) | 780 | 900 | 1.200 | 1.600 |
| Thermal power installed (kW) | 45 | 55 | 65 | 75 |
| Temperature range (°C) | 0-700 | 0-700 | 0-700 | 0-700 |
| No. of regulated sections | 1 | 2 | 1 | 2 |

# NITRIDING PIT FURNACES

| | ICS150/250 | ICS120/280 | ICS100/200 | ICS150/300 |
|---|---|---|---|---|
| Floor dimensions (cm) | 260x380 | 230x410 | 210 x 300 | 260 x 430 |
| Overall height (cm) | 500 | 530 | 370 | 550 |
| Charge dimensions (cm) | 150 x 250 | 120 x 280 | 100 x 200 | 150 x 300 |
| Charge gross weight (2 kg/liter) | 5.500 | 4.800 | 3.500 | 6.000 |
| Thermal power installed (kW) | 165 | 150 | 100 | 180 |
| Temperature range (°C) | 0-700 | 0-700 | 0-700 | 0-700 |
| No. of regulated sections | 3 | 3 | 2 | 3 |


CAMPANA

# ECONITRO

Complete felling of ammonia and NOx outflow is obtained by means of Econitro device; its characteristics as well as its use are in conformity with ECC.

**Technical features - Type Econitro 5000**

Floor dimensions ► 110 x 90 cm

Overall height ► 160 cm

Max fournace volume ► 15 $m^3$

Catalyst capacity ► 22 liter

Thermal power installed ► 9,4kW

Maximum temperature ► 1.100°C

Ammonia trace ► <50ppm

NOx trace ► unmeasurable

# AMMONIA DISSOCIATOR (OPTION)

The Dissociator produces gases for processes requiring hydrogen by dissociating anhydrous ammonia

$NH_3 <-> 0.5N_2 + 1.5H_2$

The equilibrium of the reaction is a function of pressure and temperature, at atmospheric pressure the percentage of residual ammonia is a function of temperature as in diagram 1.

**Technical features - Type Dissociator 5000**

Atmosphere composition ► 25% N2,75%$H_2$

Flow ► 30 $Nm^3/h$ @ 70°C

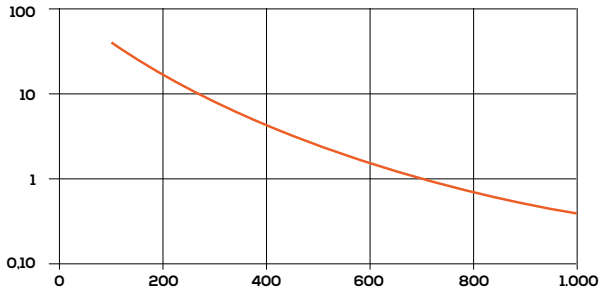
Working temperature ► 850 °C

Ammonia residual flow ► 0,11 kg/h

Installed power ► 20 kW

Ammonia consumption ► 13 kg/h

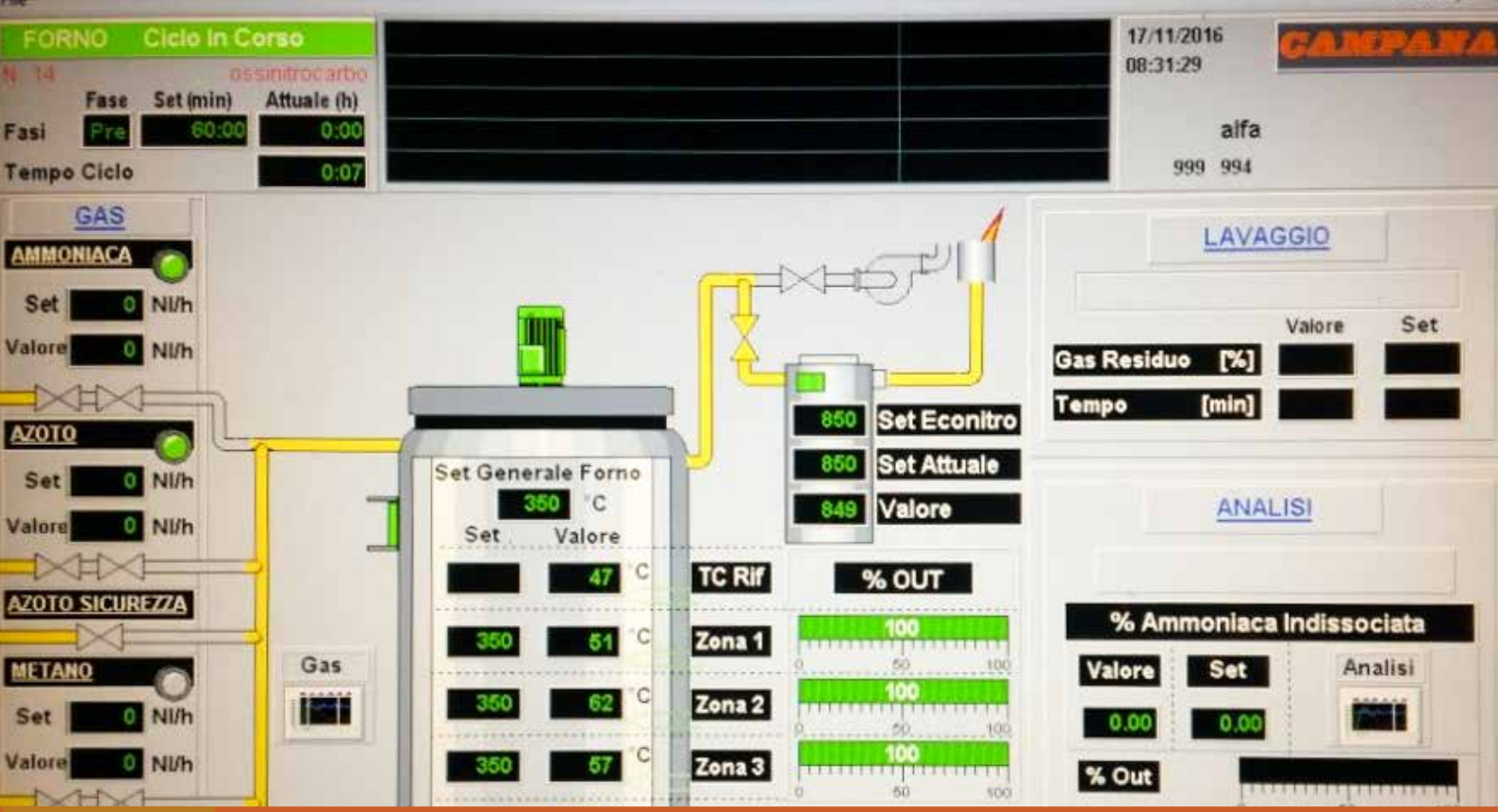
Water cooling consumption ► 300 l/h con DT 40°C




# AUTOMATIC TANK SWITCHING AMMONIA AND NITROGEN (OPTIONAL)

This equipment is used for the automatic switching of ammonia and nitrogen cylinders. When the control verifies that a line is empty, in automatic mode, switching to another line, the switching is notify by an alarm.

Normally on nitrogen second line, a small bottle is fitted for safety.




# OCTOPUS OCS 4007
## CONTROL SYSTEM

OCTOPUS OCS Series 4000 Systems have been specifically **designed for the control of heat treating furnaces**, their performance capability includes sequence control, process course programming, expert rules, overall control, real time information, alarm handling, recording, process documentation and certification, diagnostic functions.

OCTOPUS OCS Series 4000 Systems have been designed and developed for **full integration within CIM structures** for production planning and control and offer the features summarily described in present description.

OCTOPUS OCS 4007 System is specifically designed for **nitriding treatments automation**: it can be connected to H2 analyzer and to temperature probes, in order to regulate furnace atmosphere and temperature.

# TREATMENT CYCLES

OCTOPUS OCS 4007 handles each treatment as a phase sequence: for each phase it is possible to program the set point related to the main regulations: temperature, temperature gradient, duration, ammonia dissociation, gas valve activation, tolerances etc.

P.I.D. algorithms, fully programmable by means of 8 parameters, are used for heating and atmosphere control.

Heating is realized with time proportional, digital activations applied to heating elements; atmosphere control uses analogical commands and proportional valves.

Programming or modifying operation is possible also while furnace control is active, without disturbing regulation running tasks.

During treatment control, on-line display is supplied, complete with all main actual parameters values together with alarm statements.

# TREATMENT CYCLES

Color plots are provided by the system describing the temporal course of the main treatment parameters (temperature, atmosphere data, alarms, etc.).

# REMOTE HANDLING

An internet connection provides the complete plant control from Our side; this allows the upload of treatment cycles as well as the upload of new software releases.

# NITRIDING CONTROL

The nitriding control can be conducted with three different modes:

- Flow control: allows the process gas adjustments assigning a flow set point in the cycle phases. The flow is the easiest method, and does not allow any relationship to the nitriding process.
- $NH_3$ undissociated: Adjust the ammonia flow in according to Idrogen value, for reach the Ammonia undissociated set point.
- PN control (Nitriding Potential) The nitriding potential PN is an index of the reaction of formation of nitrides alpha, gamma 'and epsilon, conventionally defined with the following meanings:
  - PN between 0 and 1: nitride alpha
  - PN between 1 and 2: formation of nitrides gamma
  - PN over 2: formation of epsilon nitrides

# SYSTEM CONFIGURATION

- Monitor TFT 15" touch screen or option PC
- PLC Siemens 1500 series
- Microsoft Windows 7
- License Wonderware Intouch Run-Time 2000 tag
- IP 65 on the front panel

Software installed: Factory Suite di WonderWare with the following performance.

- Plant synoptic
- Visualization of the operating parameters
- Archive of treatment recipes
- Programming delayed start cycle
- Alarm management
- Access key management
- Trend display current and
- Storage cycles performed on magnetic media and on Compact Flash
- Print Report executed cycle.

# CYCLE N. 2

NITR
STANDARD 1
TEST NIT.

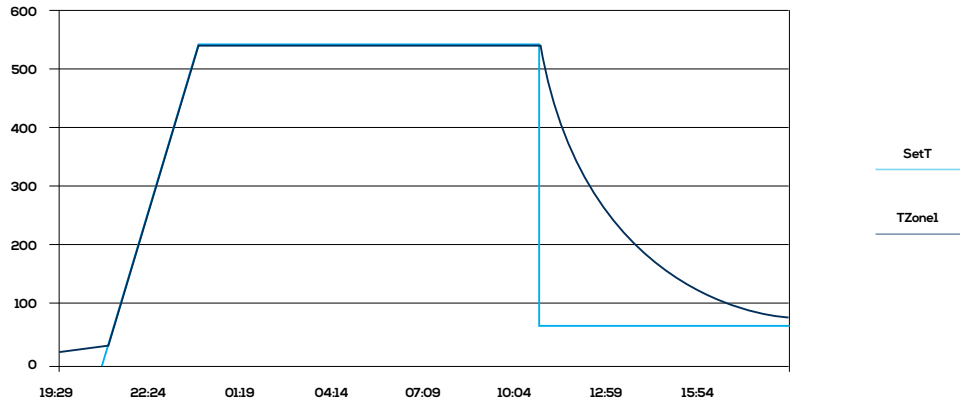
| | |
|---|---|
| Start cycle | 13/09/2010 - 19:29:13 |
| End cycle | 14/09/2010 - 18:47:37 |

| | | |
|---|---|---|
| Heating Max Time | [min] | 280 |
| Heating Max Temperature | [°C] | 650 |
| Primary Nitriding Temperature | [°C] | 480 |
| Final Nitriding Temperature | [°C] | 600 |
| % NH3 Tolerance | [%] | 10 |
| Data Storage | [min] | 10 |
| PN Tolerance | [N] | 0 |

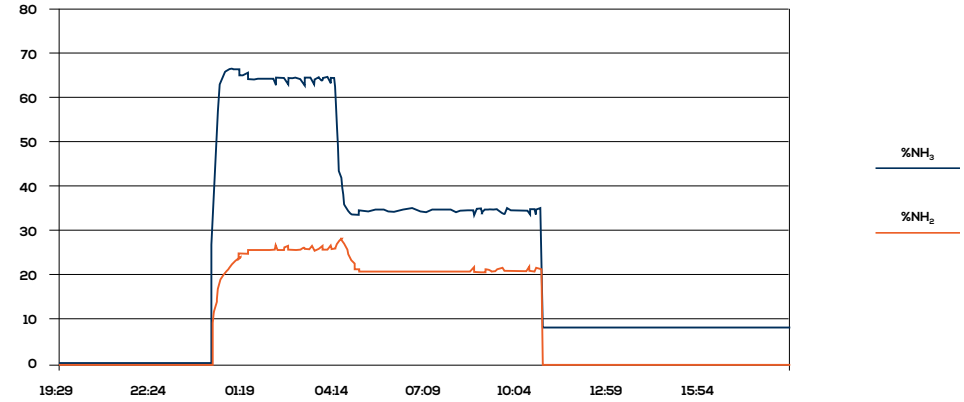
| Washing | | Primary | Final |
|---|---|---|---|
| Without Heating | | YES | |
| N2 Flow | [l/h] | 2000 | 3000 |
| NH3 Flow | [l/h] | 0 | |
| Residual Gas Volume | [m3] | 5 | 2 |
| Min Duration | [min] | 45 | 45 |
| Max Duration | [min] | 90 | 90 |

| | | Pre | t1 | t2 | t3 | t4 | t5 | t6 | t7 | t8 | t9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | [min] | 0 | 30 | 240 | 400 | 0 | 0 | 0 | 0 | 0 | 10 |
| Temperature | [°C] | 0 | 550 | 550 | 550 | 0 | 0 | 0 | 0 | 0 | 70 |
| Temper.Toler. | [°C] | 0 | 15 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 15 |
| Temper.Gradient | [°C/h] | 0 | 180 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cooling | [°C] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 |
| QN2 | [l/h] | 0 | 400 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 400 |
| QNH3 | [l/h] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| QGAS1 | [l/h] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| %NH3 Indissociated | [%] | | 0 | 65 | 35 | 0 | 0 | 0 | 0 | 0 | 0 |
| PN value | [N] | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| QNH3-1(%QNH3 T-1) | [%] | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| QGAS1-1(%QNH3 T-1) | [%] | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

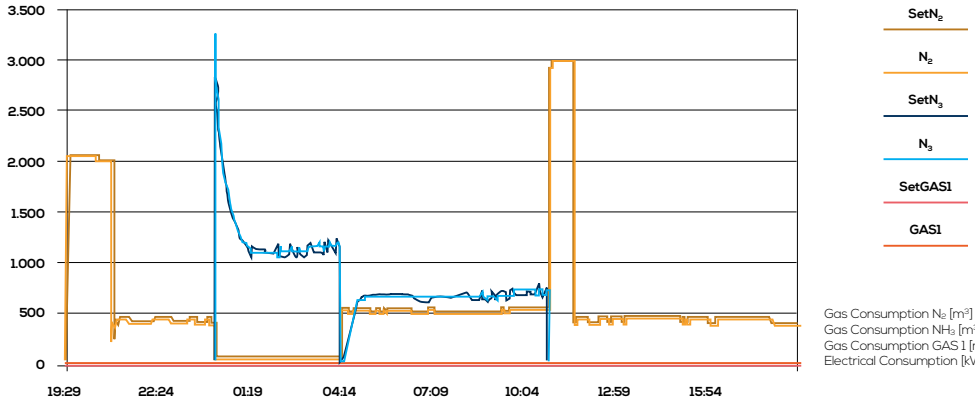
## TEMPERATURE TREND [°C]




## ANALISYS TREND [%]




## FLOW TREND [L/H]




| | |
|---|---|
| Gas Consumption $N_2$ [m³] | 12,65 |
| Gas Consumption $NH_3$ [m³] | 9,249 |
| Gas Consumption GAS 1 [m³] | 0 |
| Electrical Consumption [kW/h] | 96 |

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