

## **DATA PLANT MANAGEMENT SYSTEM - A TPS TYPE SYSTEM IMPLEMENTATION**

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**Abstract:** The automatic control and supervising system implements the Total Plant Solution (TPS) concept at a sparking plug and sintering parts manufacture. The supervising and control system is hierarchically structured; it includes the plant units and integrates the local control with the managerial level. This upper level can handle the data global information specific to the system.

**Key words:** Total Plant System, galvanization process, sintering process, electric energy management, PLC

### **1. INTRODUCTION**

The main goal of this project is to modernize the manufacture facilities through the implementation of a TPS system integrated works management, to involve the manufacturing tides management optimization from the complex equipment to the integrated manufacture.

The manufacturing supervising and automatic control system allows the production analyze in real time at each structured manufacturing units. It improves the control strategies of the main production equipment and concentrates the production and technology data to the company management level, having as results: increase plant profitability (helps to decrease the damages and rejects), reduce operating costs, use energy more efficiently.

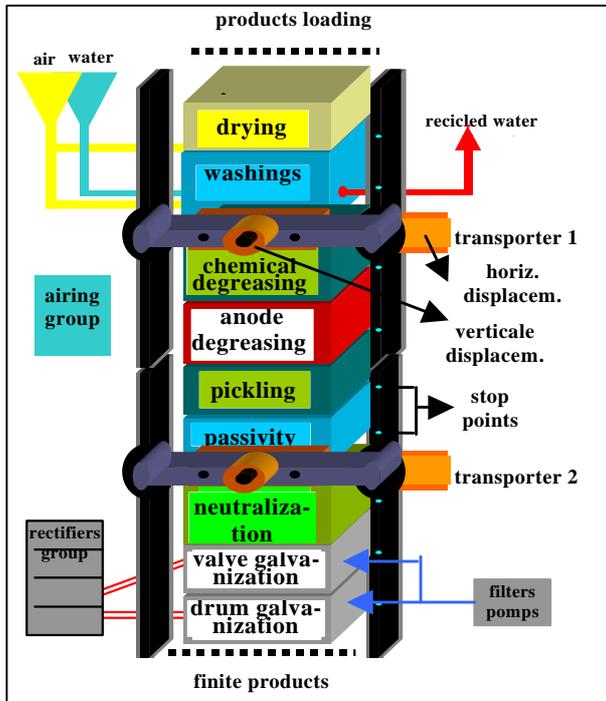
Total Plant Solutions is an industrial automation system that incorporates advanced applications for process and the operations, plant-wide history files and information management capabilities in one single system. It offers an optimum mix features and performance for cost-effective control and are generally used for plant-wide control of large processes that have critical reliability and availability.

### **2. AUTOMATION SYSTEMS**

The manufacturing company automatic supervisory and control system integrates the specific control equipment installed in the specific units at the plant level (PC and

PLC) and transfers the data related to the technologic parameters and products to the top decision level.

### The galvanization process



The galvanization process adds to a product a metallic layer for the anticorrosive protection function or the decorative purpose.

The electrolyze process - the galvanization, use an alkaline or acid solution, according to the selected procedure. The process is activated by a DC power supply.

Figure 1.- Galvanization line diagram

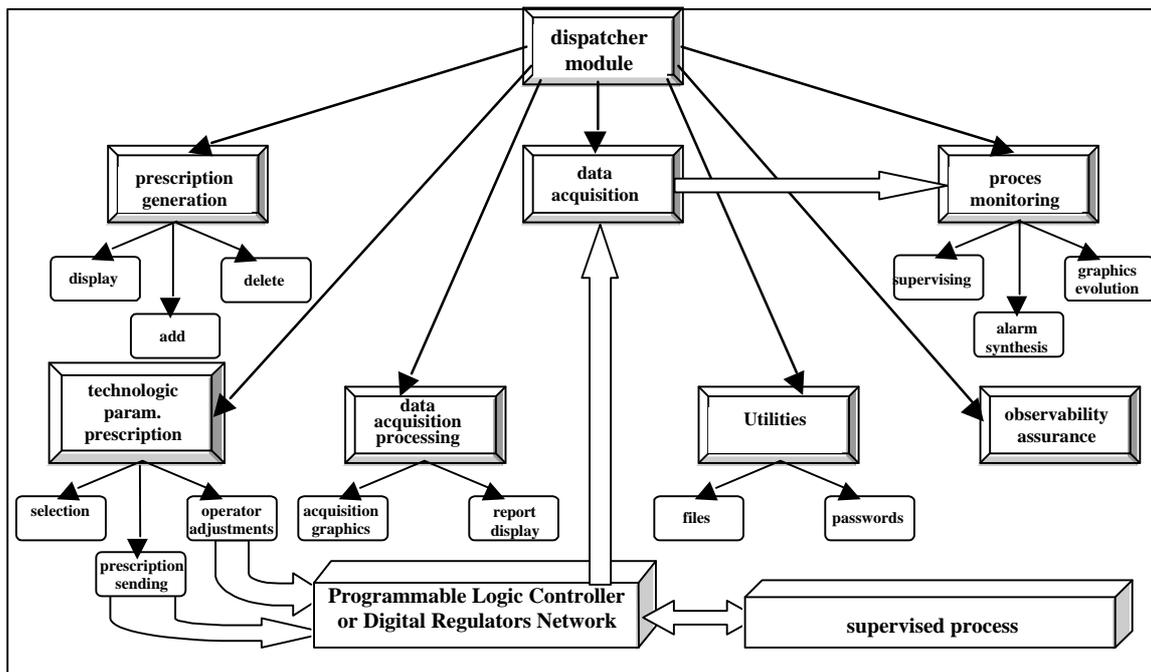
The galvanization line supervising and control system:

- *Plant floor unit computer* – the computer system allows process data acquisition, storage, processing and displaying and the system actuators status
- *programmable logic controller (PLC)* – is a Siemens SIMATIC S7-200 installed in the command room
- *process interfaces* – includes electronic modules and power relays, to provide electric isolation between the PLC CPU and the field, process actuators and measure devices
- *transducers and measurement devices*: temperature, pH, voltage and current
- *automatic transporters and automation panels* – installed in the manufacturing line, near by the galvanization line.

The galvanization process control programs system architecture can be pursuit in Figure 2.

### Sintering process

The most important sintering process equipments are the sintering furnaces, conveyor belt furnaces under controlled atmosphere. The furnaces are important electric energy consumers so a new high quality heat insulation was needed to reduce the power loss. The furnaces are supplied with other energetic resources (protection endothermic gas and methane gas). In order to improve the sintering unit manufacturing features the furnaces were totally renovated.



*Figure 2.- The galvanization and sintering system architecture*

The sintering unit modernization included several actions:

- the old automation panels were replaced and new automation panels build with electronic converter or solid state contactor breakers switch and modern accessories were installed
- the measurement devices and analog local controllers were replaced with special digital controllers with data serial communication interface
- all local sensors and transducers were replaced with modern conception and high accuracy devices
- universal power meter with industrial standard data communication interface
- a PC- based supervisory control system witch transmits the technologic parameters prescription for all six production unit furnaces

The automatic system is structured on two levels:

- *the local level* – it includes temperature transducers, control loops, actuators, analog or digital controllers
- *the central level* - an IBM PC compatible computer, dedicated peripheral equipment, data acquisition interface plugged-in computer internal bus, primary signal adjustment modules and electric insulation.

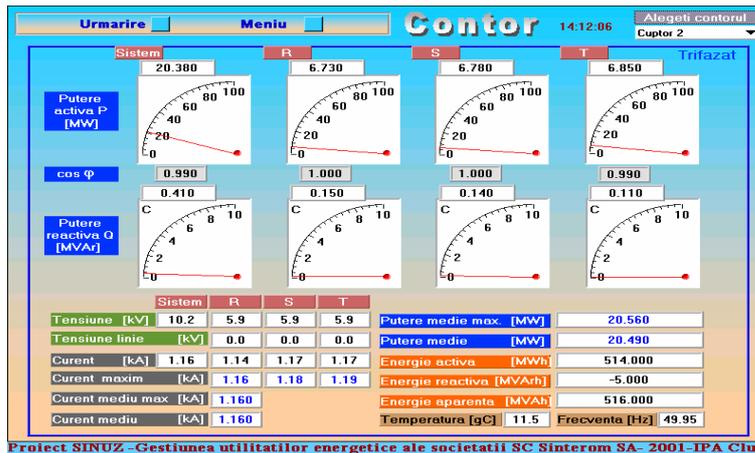
The sintering furnace process control loops are:

- seven furnace heating chamber temperature control loops: 20 ...1200 C
- speed highly heat resistant mesh belt control loop : 2...10 m/hour
- atmosphere C-potential control loop by measuring the partial pressure of oxygen by means of zirkonoxyd electrolyths
- protective gas atmosphere dew-point control.

*The TPS Electric Power management*

The TPS Electric power management system uses power energy meters and programmable transducers- “Universal Power Meter 30” (UPM 30) – produced by the

Italian company Algodue Electronics. UPM 30 measure and convert in digital format the electric power supply and consumers parameters voltage, current, power, electric energy consumption, power factor and transmit the data to the central supervising level. The communication is half-duplex in a network with a PC computer as the master on the industrial data serial bus standard RS 485. The computer provides integrated functions for the instruments recordings analysis, the centralized supervision of data recorded by the power meters and the data storage in order to create historical reports.



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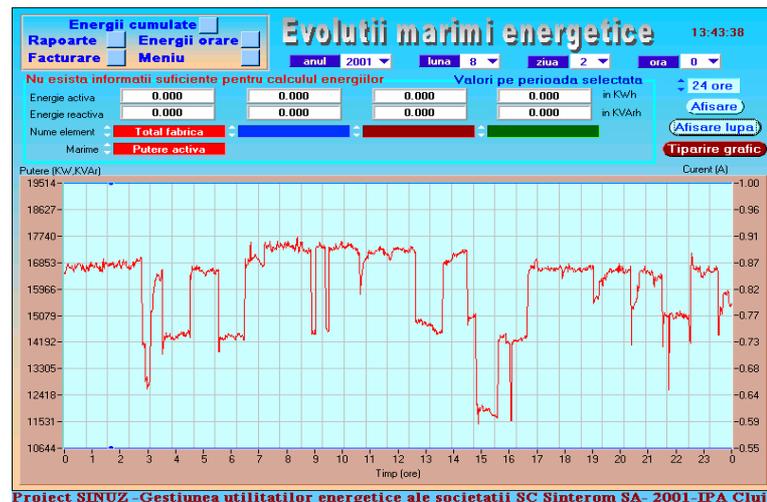


Figure 3.- Interface for visualization of the real time acquisition and retrieve of the data base energy parameters

The software application allows the parameters displaying for each consumer individually, and for maximum eight virtual power meters based on the sum of the physical power meters selected by specific criterion.. Other facilities offered by the used UPM 30 intelligent power meters are those regarding the programming from the local panel or remote control from central computer.

#### Application programs

The TPS software is composed on next software programs:

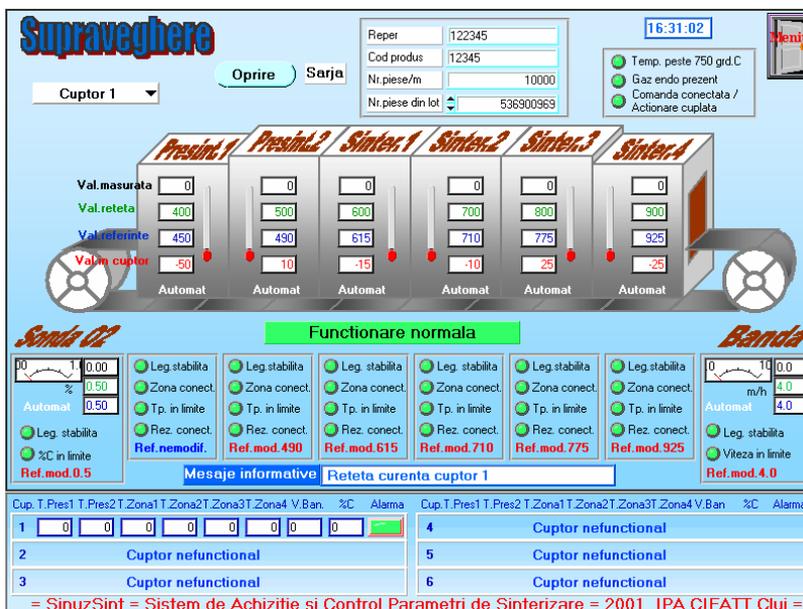
**SINUZGALV** - application program for **galvanization** process control. This program supports the next main control functions:

- ✓ pre-program technologic prescription generator (data input / instructions)
- ✓ set-point transfer to the line PLC

- ✓ sequencer manipulators command for valves according to the prescription
- ✓ automatic control for frames displacement and speed control of the tambours
- ✓ process parameters acquisition (temperatures, pH, liquid levels, electric energy)
- ✓ data management and data transfer to the central computer
- ✓ process data storage
- ✓ temperature control loop according to set-point prescription.

**SINUZSINT** - application software for **sintering** process control. This program supports the next main control functions:

- ✓ on-line supervising of all sintering furnances in a synthetic operator panel- grafical interface, implemented in the lower part of the display ; visualization and remote control for a selected furnance at once, in a window in the upper part of the screen (Figura 4)
- ✓ process data library storage for all sintering parameters for each heating chamber
- ✓ local digital setpoint transmisson , according to the parameters retrieved from the pre-programmed recipies sintering conditions library.



- ✓ process data storage parameters historical for each sintering furnance and products batch
- ✓ process historical display as diagraphes or values tables
- ✓ optical allarm signal on the computer display from the central level for prescribed parameters outranging
- ✓ communication with the upper hierarhic plant level.

Figure 4.

**SINUZENER** - application software for energy consumption management of the manufacturing unit included in TPS. The program main functions are:

- ✓ plant network electric energy monitoring
- ✓ energy parameters acquisition in a specific data base
- ✓ graphic or table displaying of the acquisition and computed parameters
- ✓ events reports and alarms
- ✓ remote programming for power meters parameters and warning and alarm limits configuration
- ✓ restricted access for critical operations by password.

**SINUZCOPY** application software for data transfer between the plant floor computer-based automation equipment and the computers network support of the software global system. This program has a component, installed in the manufacturing unit automation system computer, and one, installed in the TPS server computer where the files are transferred.

**SINUZGEST\_TPS** application software for displaying at the top company management level, the manufacturing data generated and transmitted by the plant floor automation systems included in TPS pilot, as well as the sections electric energy consumption.

The software programs, implemented by the central level computers, are developed in the LabWindows CVI development environment. The local level software programs are written in assembly language, respect the PLC real-time requirements. The software programs include the power meter and digital controllers firmware and the specific software drivers and interfaces.

The global TPS includes besides the local automation systems control functions other functions as the supervising of the whole manufacturing activity and embedding all the acquired data in the plant informational network:

- ✓ information regarding the important equipment status
- ✓ information regarding the manufacturing quantitative and qualitative aspect
- ✓ information regarding the production rhythm and product yields
- ✓ real time communication with the company management level.

### 3. CONCLUSIONS

The Total Plant System (TPS) is a computer based complex system to coordinate and control the information traffic between different sections, compartments and laboratories on an industrial platform.

TPS concept presumes the **embedding of automation and computation performance systems** as a part of the hardware and software support for the industrial plant information management.

The advanced control solutions designed help the user to improve the manufacturing possibilities, reduce operating costs, maximize operating efficiency, increase factory profitability, minimize energy consumption, increase the plant mobility regarding the new products assimilation.

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