CONTROL SYSTEM DEVELOPMENT FOR EMERGENCY SITUATIONS IN AUTOMATED MANUFACTURING LINE OF WOODEN BRIQUETTES

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In our research we described design of production lines with pneumatic, partly pneumatic, electrical and other control implementation. The process and position of control tools with complicated logical feedback was analyzed. In our work we described and analysed two cases. The first case of emergency breaking and design of additional control scheme for emergency regulation of production line is based on *direct regulation principle*. The second case of the factory comprised a number of wood briquettes automated production lines is based on application of *control networks* for industrial process control and alarming.

Traditionally *point-to-point wired systems* are used for industrial processes control and alarming. However last time *Control networks* started to replace traditional point-to-point wired systems while providing a number of advantages. The most important advantage is the reduced volume of wiring. Fewer physical potential points of failure, such as connectors and wire harnesses, results in increased reliability. Another significant advantage is that networks enable complex distributed control systems to be realized in both horizontal and vertical directions and increased capability for troubleshooting and maintenance. [4].

We consider three process control system versions:

1. Direct connection of the executing mechanisms' control signals, sensors and end-switches to the centralized inputs/outputs of the centralized controller.
2. Use of distributed input/output stations that are connected with the central PLC with mediation of PROFIBUS communication line.
3. Networking solution: application of AS interface (Actuator Sensor Interface) lines, in order to use distributed input/output modules for operation of electromagnetic valves and installation of sensor information. AS interface modules connect with main PLC by using PROFIBUS line.

All three versions were analyzed within' context of the given task, by taking into consideration technical solution and complex expenses.

Wood briquettes automated production line is designed for automated collection of rectangular blocks from "RUF" press outlets, for blocks transportation, grouping and further shrink with packaging film. Packing lines working process is controlled by programmable logic controllers. Line construction is made by modular principle and the maximum yield of the line is about 3-5 packs / minute. Line automatic control also provides automated crash mode realization, which includes all the modules correct working checking, error indication on the display, signalling about the possibility of errors, as well as audible and visual alarm.

The example of control system based on *direct regulation principle* is shown on Fig. 1. Alpha controller programming is realised in FBD language (functional block diagrams). The programme offered in experimental part of article is able to control such faults and make an indication about in display:

- There is no pressure in the system;
- The temperature of heating elements is lower, then minimum settled up;
- System is out of thermal film;
- The control of exceeding of actuator exposure time;
- The overcrowding of conveyer.

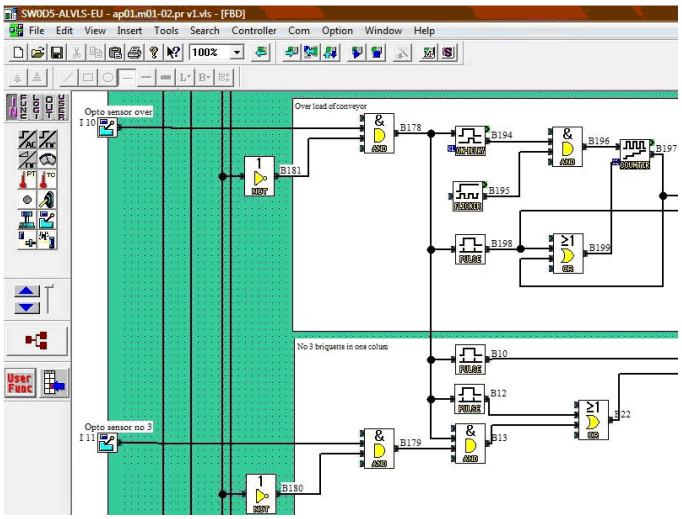

Fig. 1. Part of the program - the main line overfilling and 3 briquettes absence.

There is a high possibility to meet special alarming situations in wooden briquettes production line, for example, if one of pressure sensors may be out of order, the traffic jump in wooden briquettes transporting conveyer could appear. There is no unified safety solutions for all pneumatic systems, there is only set of "best practice" examples exists in this topic. For such pneumatic system common technical safety rules are essential. Usage of logical controllers is the appropriate solution for managing such alarming situations, and for managing all production process.

A control network of the factory comprised several production lines could be established as follow. Factory's personnel have got two computerized control workstations at their possession, which operate as mutually replaceable units. They make it possible to supervise and control the technological processes of granulation, as well as raw materials drying and preparing, and finished product discharge, too.

The automated control system includes (see Fig.2):

- Programmable controllers PLC (one for control the granulation and transportation processes and one for the material preparing process);
- Peripheral equipment: ET200, DP/AS, frequency inverters, pressure and temperature sensors and valves.
- Operators' computer workstations PC1, PC2.

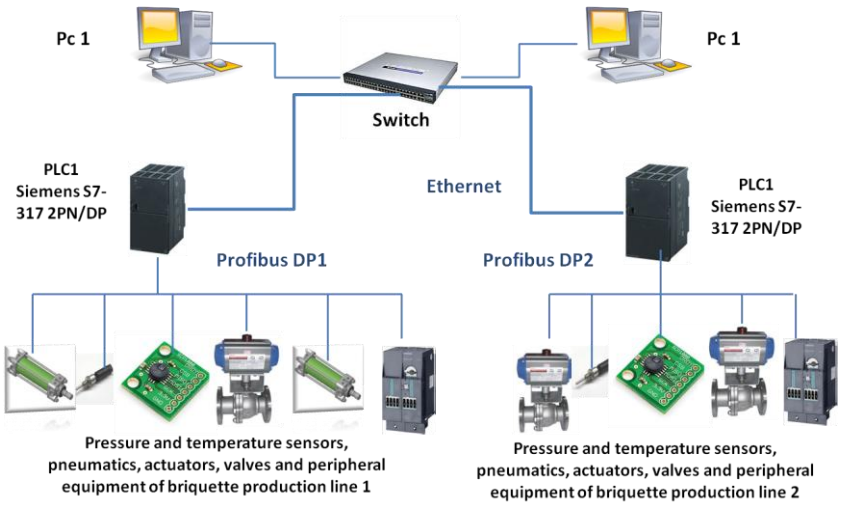

Fig.2. Control network of the factory comprised several production lines

Visualization program is based on General Electric CIMPLICITY. For the purpose of remote monitoring and editing operation regimes and programs, the relevant opportunities of the Internet are used via switch device.