SYSTEMS AND METHODS APPLIED IN CONTROLING THE TECHNOLOGICAL PROCESS AT THE FODDER PRODUCTION

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In modern systems for fodder production new techniques for control of the process are increasingly initiated, which makes possible the realization of new technological tasks. At the development of the tense metrical weighing system a different approach had been chosen, which includes constructing a net MPI (Multi point interface) of the PLC-Siemens and microprocessor modules (based on hcs12), which have in their structure tense metrical transducers of "Analog device" – AD7730. There is a method for frequently maintenance of 3ph asynchronous motors, which are able to control at the same time only one inverter, connected to the PLC through USS protocol.

Keywords: automation, networks of the Siemens, tense sensors, astatically regulator of the dosing

1.INTRODUCTION

In modern systems for fodder production new techniques for control of the process are increasingly initiated, which makes possible the realization of new technological tasks. Defining the main problems, connected to the technological process of the production, proposing methods to overcome them, as well as the optimization of processes for control are really a complicated task for the people, who develop such kinds of systems. The ultimate aim that we chase in this article is to mould and found out a system, based on the modern achievements at control field, which gives the possibility to accomplish the final parameters of the quality production: exactness at dosing, homogeneity of mixing and higher productivity with lower energetic consumption.
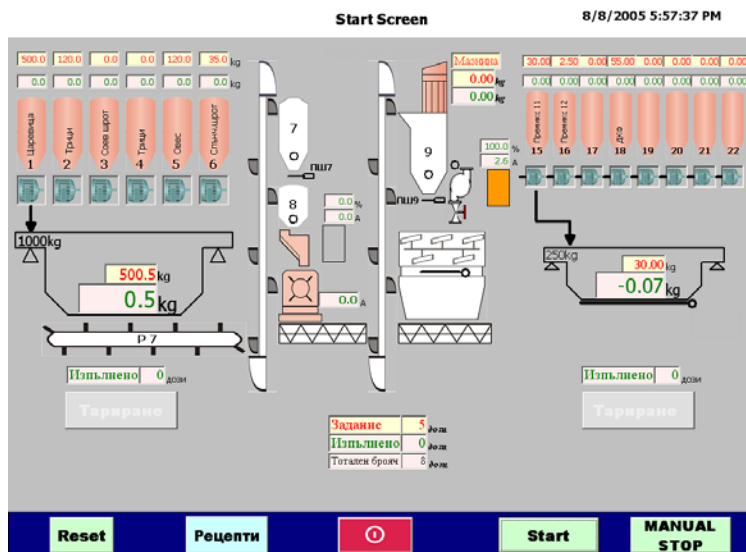

Fig. 1 Technological process of the produce of he fodder factory, controlling by PC, with software growth on base WinCC flexible (2004) - Siemens.
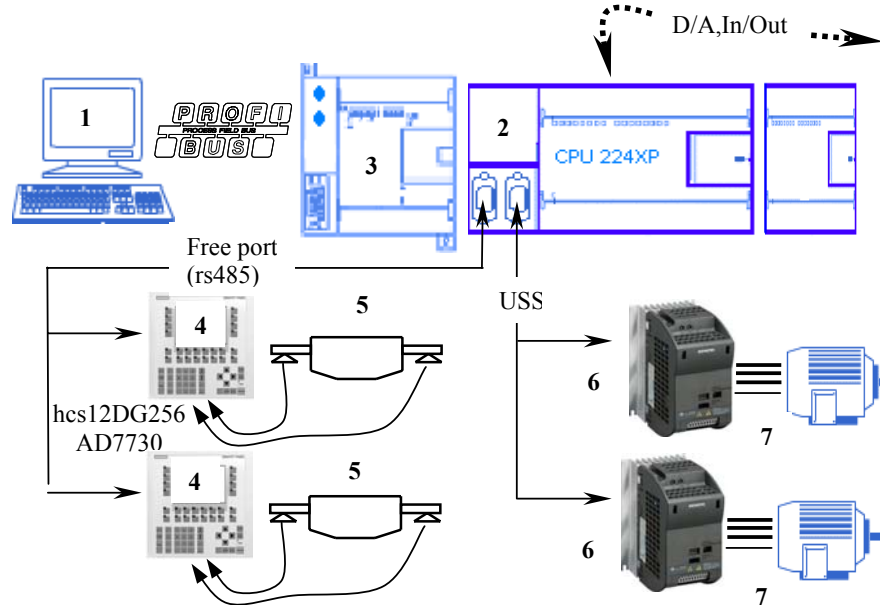
D/A,In/Out

1

2   CPU 224XP

3

Free port
(rs485)   USS

4   5

hcs12DG256   6
AD7730
                                      7

4   5

                                      6

                                      7

Fig. 2. Organization - control system. 1-PC; 2 – PLC "Siemens", CPU224XP, 3- Profibus DP
module, 4 - µp HCS12& transducer AD7730, 5 – weigh scale, 6- inverter "Sinamics"

2. ORGANIZATION OF THE SYSTEM FOR CONTROL

The system for control is shown on Fig. 2. At its construction is used PLC – Siemens, S7200 and CPU 224XP.The master interface is accomplished by PC, based on WinCC flexible – 2004, which affords great interactivity, ergodicity and flexibility at the maintenance of the system. WinCC flexible – 2004 also affords creating screens, graphics, menus, buttons etc. in a way that is easier for the programmer. The history of the process, alarms and the consistence of the controlled variables are saved in database (ACCESS) or in files with enlargement *.csv (EXCEL). There is a possibility for creating own functions and scripts, except the available systems, which gives extra chance for enriching the applications, as well as for sharing the mathematical and systematical resources between PLC and PC.

There are two special characteristics, which distinguish the construction of the system from the other existing:

-   The main factor at dosing of components and micro components, which defines the quality of the dosing process, is the exactness of measurement the weight by the electronic machines. The conventional approach, advanced by Siemens, is to develop a tense metrical control with conventional module for PLC – "Siemens". This approach requires lengthening the cables of the tense sensors, their laying through the cable devices near the high volt cables, which supposes induction of the electromagnetic disturbances, connected to the frequency of the net, as well as those who are accidental. The high sensibility of the tense metrical bridges supposes measurement of very low values of the output voltages, as well as usage of other means for increasing the measurement quality, such as: stabilization of the mass of the analogical supplement of the transformer, connection to the mass of screening the

tense system` cables, special topology of the scheme of the analogical transformer, as well as other different methods of software and hardware filtration. The increasing of the value of filtration leads to signal warping of the tense sensors, but mostly to slowing down the signal, which is the main reason for additional mistakes of the dosing system.

-    To overcome all these peculiarities at the development of the tense metrical weighing system a different approach had been chosen, which includes constructing a net MPI (Multi point interface) of the microprocessor modules and PLC(digital interface for the controlling channel),which have in their structure tense metrical transformers of "Analog device" – AD7730. The main advantage of the applied approach consists in following: stretching the distance between the tense sensors of the electronic weighing scale does not effect over the metrological characteristics of the measuring process. In case that the distance between the control panel, where usually is situated the PLC, and the electronic scales could sometimes reach a few kilometers, and this fact does not have any influence over the quality of the tense measurement and the process of dosing.
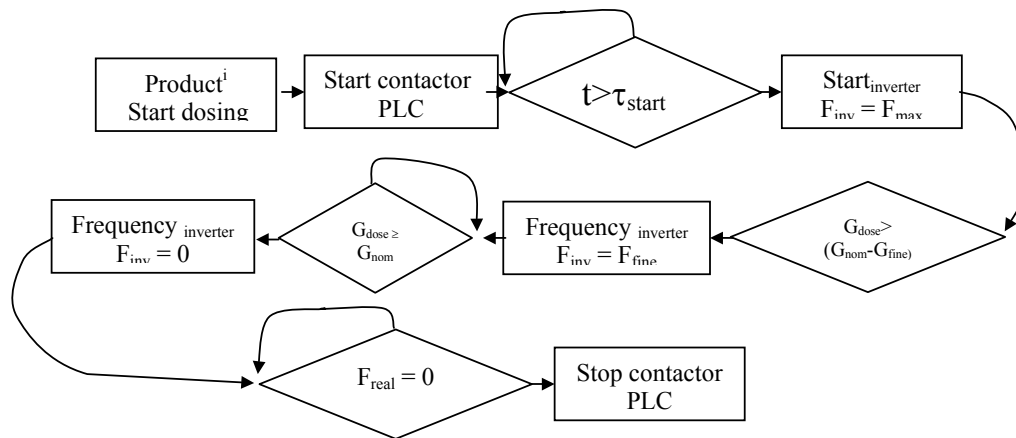
Fig. 3 Algorithm, controlling system "flying inverter": one inverter - 8 motors.

-    There is a method for frequently maintenance of 3ph asynchronous motors (Fig. 3), which are able to control at the same time only one inverter, connected to the PLC through USS protocol [3]. In this case is applied again the digital interface of the controlling channel PLC- inverter "Sinamics", at which by two conducted line could be maintained till 32 inverters, as well as unlimited access to all parameters of the inverter, which increases the intelligence of the interactivity, increases also the abilities for maintenance and control of the whole system.

-    At Fig. 4 is shown maintenance of the system with one inverter to eight motors. The consequence of activating and deactivating of the devices on the scheme is special for this case: circuit closer – inverter- circuit closer-inverter. Firstly, this guarantees protection of the inverter, and secondly it is a result of the requirements set from the 5-value speed diagram of the dosing process [1].
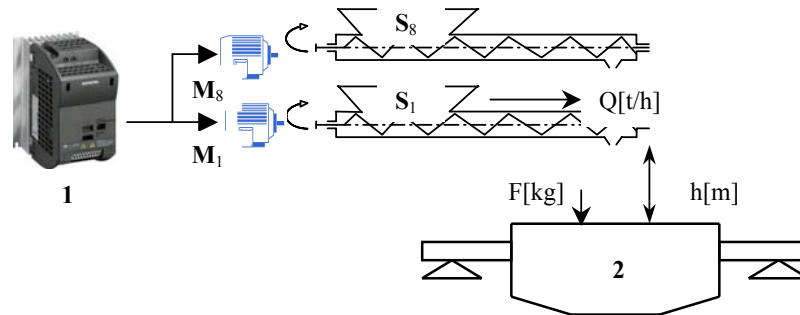
Fig. 4. Electronic system for dynamic sneak dosing
1 - Inverter; M1÷ M8 – eight 3ph asynchronous motors; S1÷ S8 – eight dosing
sneak; *2 – Weigh scale with tense sensors;*

2.DOSING SYSTEM

Main problems, connected to the process micro components dosing:
-    Organization of the tense metrical system, which includes choice of tense metrical sensors, transformers and interfaces.
-    Organization of the dosing process of main and micro components, which aim is to achieve technological criteria for exactness.
-    The quantity of the bulky product, which moves through the auger for unit per hour, should be defined by the following formula:

$$\frac{dm}{dt} = \rho S L \omega, \tag{1}$$

Where ρ is the compactness of the product; S - section of the auger; L – pitch of the auger; ω - frequency of rolling the auger.

The law for changing the force F (t), which influences over the electronic scale, contains pseudostationary component, equal to the product of the mass of the substance in the packet and of the acceleration of gravity (m (t)*g) and absolutely dynamic component, conditioned by the falling of the portion mass dm/dt over the scale from height h, which finishes /фиг.1/ with speed $V_{fc.}=\sqrt{2gh}$ for time $\tau=\sqrt{(2h/g)}$. Because of the dependence of the measured force of the tense metrical system combined with counting the influence of the "falling post" will be reached the following: $F(t) = m(t)g + \dfrac{dm(t)}{dt}\sqrt{2gh}$ (2)

As we replace the dependence (1) in (2), we get the following:

$$F(t) = m(t)g + \rho S L \omega \sqrt{2gh} \tag{3}$$

The probably errors, appearing under the influence of different factors , could be separated in two columns: determinate and conventional. At [2] is offered a method for overcoming the negative effect of the determinate factors by using the transformation of Furrier and the exploitation of the curve of weight changing.

This method presumes an extended research, complicated computing procedures and because of this fact, it could be difficult applied to wide range of tasks. We could suppose that the main errors are as a result of the deviations at the dosage that are based on accidental factors. We tried to create a method that could be applied to wider field of applications.

Influence of the factor "time":

From the moment of the effect of the force applied to the tense sensors of the electronic scale till the moment of stopping the dosing auger a defined time goes up and could be calculated by the following formula:

$$\tau = t_{\Sigma\delta} + t_{int} + t_{crawl} + t_{inv} + t_{inv\_stop,} \tag{4}$$

Where

$t_{\Sigma\delta}$ – time delay because of Sigma Delta ($\Sigma\delta$) – modulation of AD7730, defined by the computing digital filter;

t_{int} – time for maintanence of the net interuption at the microprocess modules with PLC;

t_{crawl} – time delay of the crawling integration , organized in microprocess system – hcs12;

t_{inv} – time for maintenance of the USS- protocol between the inverters "Sinamics" and PLC;

t_{inv_stop} – time for stopping the inverter

If an error appears, it will be calculated in the following way:

$$\Delta_{F(t)} = \left(t_{\Sigma\delta} + t_{int} + t_{crawl}\right)\rho SL\omega + t_{inv\_Stop}\rho SL\frac{\omega}{2} \tag{5}$$

We could make the following conclusions:

-   Stopping the process of dosing could be accomplished by anticipate(Δ_F) of the weight, defined by the dependency (5);

-   Δ_F depend on the compactivity of the product, which is very important for different kinds of products with different compactivity - ρ;

-   Δ_F depends on the frequency of rolling the aueger(the frequency applied in the inverter)

Conclusion:

The synthesis of a non-stationary regulator for maintenance the stopping of the dosing process should be separated in different augers, respectively the products.

3.CONSTRUCTING AND SUPPORTING OF RECIPES AND DATABASE

Siemens supports the structure, the organization and the conservation of the recipes, thanks to the new product WinCC flexible [3]. There is a high flexibility of data transition of the reports for the different recipes: PLC, Storage medium, External data medium.

Data archiving in WinCC flexible is shown at Fig. 5.

Data logging is used to capture, process and log process data from industrial equipment. The collected process data can then analyzed to extract important business and technical information regarding the operational state of the equipment.

Fig. 5. Method of the archiving process data value on HMI device
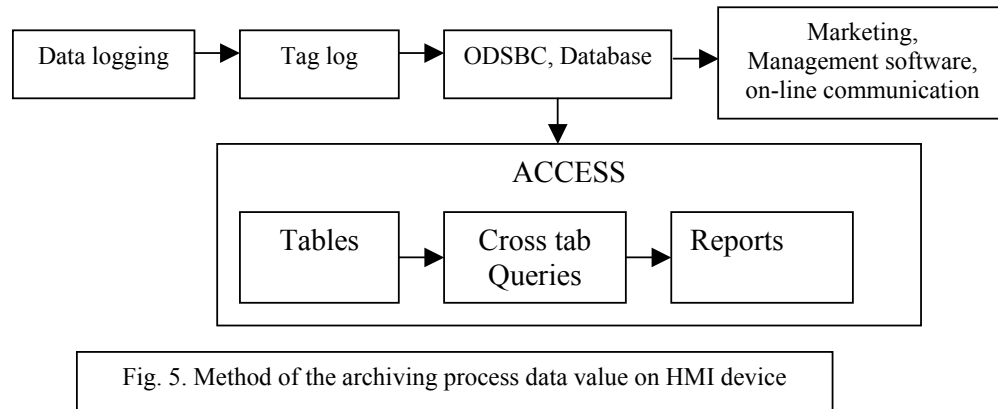
ACSESS and Crosstab Queries are used for searching and rearranging of the database, accomplished by WinCC flexible. This method enables free searching and rearranging of the tables by the following criteria: date and time of beginning, recipe, group index, and kind of the product. The accomplishment of global and local sums is part of the functions that ACSESS owns. All macros and modules increase the interactivity and make it easier for the final consumer. The applying of this method enables development of the system and its connecting to the whole marketing-manager program for batch maintenance of the production, according to the requirements of ISO 9001.

Results:
-    This system for dosing affords an opportunity for remote tense metrical measurement, as well as for higher sensibility of the measurement;
-    There is also a resource for frequently maintenance of a group of motors, that take part in the dosing process;
-    This system has already been created and incorporated in the fodder factory that belongs to the pig-breeding farm in Brushlen, Ruse.

Conclusion:
The applying of methods for digital conveyance of information from the terminal devices and sensors to HMI device, nets that already exist from type USS, FreePort, Profibus, affords an opportunity for increasing the quality of the dosing process, when it concerns fodder production. The synthesis of a non-stationary regulator for maintenance of the dosing process should not depend on the separate augers, respectively products, and should be connected to the times of transmission and transformation of the information, created in the control-measurement system.

2. REFERENCES

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[3] www.siemens.com