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SUBSTANTIATION OF PARAMETERS OF WEIGHT-MEASURING SYSTEM OF THE AMALGAMATOR OF DAMP FORAGES

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Researches of key parameters and modes of operation of electronic weit-measuring system on a basis tension gauges for the amalgamator of damp forages are carried out. As a result of researches it is established, that the amalgamator of damp forages equipped with the given system, meets to modern requirements on quality of preparation damp feed mixture under on the given a diet, and the compounding of a diet easily may change the operator from a control panel, bein was in harmony with age and weight of pigs. The system includes the complete set tension the gauges established under capacity of the amalgamator, the analog-digital converter and the controller managing executive mechanisms of loading and a unloading of the amalgamator. Weit-managing system in structure of the amalgamator of damp forages is maintained long time under production conditions of the pig unit and has passed the acceptance tests which have confirmed theoretically proved parameters of accuracy of measurement and reliability of work.

Introduction

The question feed-preparation is one of the basic in pig-breeding. Feed-processing feed-preparation in turn without preparation of the forages balanced on nutritional value, i.e. without exact weighing and batching of components acting in the amalgamator, is inefficient, that results in the over expenditure of forages.

Now on of the pig units complete sets of equipment KPS–108 with a various degree of modernization which manufacture in Russia and in Ukraine is practically stopped are used, and their application does not meet to new economic requirements and technologies. Amalgamators of damp forages with the weight mechanism of batching and microprocessor management in the countries of the CIS are not made.

Weight systems of foreign firms "Big Dutchman", "Schauer", "TEWE ELECTRONICS" are established basically on small-sized amalgamators of damp forages with propeller mixers where inertial forces are insignificant as two components mix up basically: mixed fodder and water.

In our conditions which are taking into account specificity of a forage reserve, in amalgamators of damp forages are used impellers mixers which cause the big inertial forces, it is especial in the beginning process of hashing.

Therefore it was necessary to make theoretical calculations and experimental researches on a substantiation of parameters of weit-measuring system (WMS) on domestic element base on the basis of measurement of weight tension a method.

By results of researches the amalgamator of damp forages with weight batching SWD-2 which carries out technological process of reception of the given dozes of components of a diet, weighings, mixing and a normalized unloading feed-mixture from the amalgamator under the given program with regulated parameters of quality of work was created.

WMS it is established under the case of the amalgamator and it is intended for weighing loaded raw material and distribution of managing commands to systems of loading and a unloading. The system provides accuracy of weighing of loaded components according to set programs. The display provides visual observation of quantity of loaded components and unloaded feed-mixture.

Results of researches of weit-measuring system

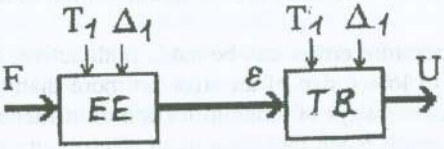
WMS consists from 3 tension gauges, accordingly 3 analog-digital converters, the controller and the relay module of interface.

The main principle of work incorporated in basis WMS, measurement of force (weight) by an electric method with the help tension gauges of force that allows to provide the best accuracy, reliability is and to receive set of additional service functions in comparison with mechanical systems. The electric signal from the gauge acts in ADC (the analog-digital converter) where it amplifies, will be transformed to the digital form and is transferred in the controller.

The controller is intended for processing the perceived weight information, its display to a board and distribution of commands of management by load-unloading devices and represents computing-managing device on the basis of the single-crystal electronic computer such as 1830BE31.

The basic element determining parameters WMS from the point of view of a brought error during work of the amalgamator of damp forages, are tension the gauge of force and the analog-digital converter. We shall consider theoretically design features of gauges, processes in them occurring, the errors arising at their operation, and we shall choose the most rational constructive decision of the gauge, with the purpose of maintenance of required parameters at work in structure of the amalgamator of damp forages.

Generally, abstracting from a design, tension the gauge of force can be considered as the physical system consisting of two elements: mechanical, as an elastic element, and electric, as tension the bridge, perceiving external influences. Schematically it is possible to represent as follows (Fig.):



EE - an elastic element; TB - tension the bridge; F - loading;
ε - deformation; U - a target signal

Fig. The block Diagram of the gauge in view of external influences

On this scheme the following basic external influences are shown:

T_1 - the temperature influencing a material of an elastic element. This influence is expressed in change of the module of elasticity of Young of a material at change of temperature;

Δ_1 - errors of perception the loadings caused by defects of manufacturing it is elastic an element and defects of transfer of loading on the gauge;

T_2 - temperature which influences on tension the bridge pasted on an elastic element, and also on a glutinous layer. On size T_2 it is equal T_1, but its influence on measurement more essential and practically does not give in to the preliminary analysis;

Δ_2 – errors resistive-strain sensor, and also their labels.

The specified external influences result in occurrence of errors in the static characteristic of the gauge. The errors arising in the gauge can be classified to several basic attributes: on a way of occurrence, on character of occurrence, on character loading [1].

Total influence of the listed errors is so great, that for normal work of the gauge of them it is necessary to compensate.

Really, at a stage of manufacturing of the gauge, in part it is possible to compensate the regular errors arising because of imperfection of the "know-how" and caused by imperfection of initial materials, and also initially incorporated in a design of the gauge.

Proceeding from the constructed model tension the gauge of force and a digitizer, it is possible to allocate 4 basic directions of indemnification of regular errors in weit-measuring system to system: passive and active ways of indemnification of errors of the gauge both passive and active ways of indemnification of converters [2].

As it was already marked, the basic regular errors of gauges are nonlinearity and temperature errors operating transfer constant (OTC) and starting transfer constant (STC). We shall consider the basic methods of their indemnification.

Indemnification of nonlinearity is possible only active ways. The main thing from them is calibration of a signal of the gauge processed ADC, computing methods. Application of

calibration allows to lower an error of nonlinearity to 0.02 % from opeOTC. Now calibration is carried out by means of the computer program written in language C++.

Indemnification of temperature errors can be made both active, and passive ways. Active indemnification allows to lower size of an error no more than to 0.05 %/10°C However more perspective are passive ways of indemnification of influence of temperature. At passive indemnification of result reach inclusion in an electric circuit of the gauge additional thermistor.

It is necessary to note, that theoretically received values of compensating elements will well be coordinated to practically received results and allow to reach temperature indemnification of the gauge at a level 0.01 %/10°C.

Except for indemnification of the gauge it is necessary to make for achievement of necessary accuracy also indemnification of the regular errors brought by the converter of the information. As it was already marked to number of such errors, basically, dependence of elements of entrance circuits ADC on temperature and nonlinearity of transformation concerns.

Best indemnification of temperature drift of the converter is given with active ways which consist in inclusion in the circuit of processing of the additional block of normalization. The block of normalization makes updating received values in view of the measured sizes of parameters ADC.

Results of tests

Weit-measuring system has passed acceptance tests in structure of amalgamator SWB-2 on PI "Belarussian MTS". Key parameters of system are given in the table and basically correspond to the technical project.

Table.

The name of a parameter	Value
The greatest limit of weighing, kg	2000
The least limit of weighing, kg	20
The price of testing division and step-type behaviour of indication, kg	1
Admitted error of static weighing, kg	±1
Range of working temperatures, °C	+5...+35
Capacity consumed by the microcontroller, VA	50
Degree of protection of electronic units in accordance with GOST 14251	IP 54
Quantity(amount) of discrete channels of outputs(exits), inputs(entrances) (24 V, 0.35 A)	8
Time between failures, h. not less	1000

Conclusions

1 Theoretical research and mathematical modelling has allowed to analyse variants of construction tensiosystems to choose optimum on conditions chenge-over from revolting factors of an environment and errors of manufacturing, without significant expenses of material means and time for manufacturing and test of the big number of experimental samples WMS.

2 WMS provides accuracy of weighing of accepted components according to set programs. The display of the controller provides visual observation of quantity of loaded components and unloaded feed mixture. The error of static weighing in a range from the least (20 kg) up to the greatest limit of weighing (2000 kg) has made 1 kg.

3 As a result of acceptance tests it is established, that the amalgamator with weight batching SWB-2 on quality of performance of technological operation-technical parameters, technical reliability (factor of readiness 0.99), to parameters of safety basically corresponds to normative and ecology requirements

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