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EXPRESS SYSTEM OF GRAIN QUALITY PARAMETERS DETERMINATION

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Abstract—*It is proposed the method of express analysis of grain offers for determination of the integrated estimation of quality of grain. The basic indexes of quality of grain are investigational and the flow diagram of the system is worked out for their verification.*

Index terms—Grain; express analysis; humidity; impurities; photo separators; segmentation

I. INTRODUCTION

One milliard twenty million people suffer from chronic malnutrition in the world. The main consumption product – grain is the most important product of agriculture, therefore, all forces are directed on the increase of its quality. Major foodstuffs: flour, bread and pasta, grains and other essential products are produced from grain. Control of quality is the constituent of process of production of grain. Ukraine is the powerful agrarian state that has large chances to become a leader from an export at the grain market. To attain this result, we must strictly control and adhere to the requirements of quality. Today in the conditions of development of international trade the question in relation to providing of quality of grain-crops became especially active.

Production, processing and export of grain in our country give significant cash receipts to the budget and are important sectors of employment of the population. Before grain farming of Ukraine supplied not only the task of all-round development of potential of industry but also increasing of it economic efficiency and competitiveness as compared to analogical industries of large countries – exporters of grain.

Today in Ukraine there are many agricultural enterprises that are engaged in receiving and inspection of agricultural products. To ensure quick and accurate work of these organizations, we should improve process of receiving of grain. Special attention need to providing the control of quality on the initial stage for the operative decision of questions of determination of quality of grain, to the organization of traffic flow and improve the quality of employees work. This problem can be solved by express analysis, leading to a gradual improvement and automation of process of quality control of grain, so the subject of this work is urgent.

The main legal acts agricultural products are: Law of Ukraine "About standardization" from 17.05.2001 N2408-3; Law N37-4 from 04.07.2002 Ukraine "About grain and market of grain in Ukraine"; Law of Ukraine "About standards, technical regulations and procedures of estimation of accordance" and in according to the order of the Ministry of agrarian policy of Ukraine from 13.05.2008 N294; Law of Ukraine "About confirmation of accordance" from 17.05.2001 N2406–3; A law of Ukraine "About an unconcern and quality of food products"; A law of Ukraine is "About confirmation of accordance"; A law of Ukraine "About standards, technical regulations and procedures of estimation of accordance"; A law of Ukraine "About providing of sanitary and epidemiology prosperity of population"; A law of Ukraine "About standardization"; A law of Ukraine "About basic principles of state supervision (control) in the area of economic activity"; Decree of Cabinet of Ministers of Ukraine "About standardization and certification".

Regulation of Commission N 912/2001/EC from May, 10 of 2001. "Establishment of requirements is to realization of bobs in a trade network"; Technical regulation "Establishment of the maximum levels of pesticides for control of food products and forage of vegetable and animal origin"; Standart of Ukraine ISO 6322-1: 2004 Storages of grain and leguminous. Part 1. Basic provisions; Power Standard of Ukraine (PSU) ISO 6322-2: 2004 Storages of grain and leguminous. Part 2. Practical recommendations; PSU ISO 6322-3: 2004 Storages of grain and leguminous. Part 3. Protecting is from wreckers; PSU ISO 6639-1: 2007 Grain and leguminous. Determination of the hidden settling by insects. Part 1. Substantive provisions (ISO 6639-1: 1986, IDT). Part 2. Taking tests (ISO 6639-2: 1986, IDT); Standard of Ukraine 3768: a 2009 "Wheat. Technical requirements"; PSU a 46.004-99 "Wheat flour"; PSU 4234: 2003 (1307971-2: 1995, MOD) "cereals"; PSU 4117-2002 "Grains and products of its processing. Determination of indexes of quality by the method of infra-red spectroscopy"; PSU 3768: 2004 "Wheats. Technical requirements" [1].

II. DETERMINATION OF GRAIN QUALITY CRITERIA

Grain-growing mass that appears at harvesting is heterogeneous. Apart from full-grain, it includes a certain number of defective and damaged grains in the main crops, seeds of other cultivated and wild plants, mineral and organic impurities, microorganisms, and sometimes pests. At the same time at any operations with grain (purveyances, processing, storage) it is necessary to know the quality of this grain, to provide an objective calculation with suppliers and optimal use. On receiving items, the grain is delivered by the parties.

The national standard for methods of grain quality determining is envisaged that quality of every party is set on the basis of laboratory determination results of the selected middle standard. To make the middle samples that reflect the actual quality of grain, it is needed to do notches exactly in accordance with the rules of their selection.

In assessing determine the number parameters characterizing the grain party as a whole: organoleptic properties, humidity, impurities, naturalness, absence or presence of pests. In addition, it is necessary to investigate the quality of the grain of main culture: size and uniformity, filmy crops – planatory, glassiness, and other properties of grain carried in the processing.

Depending on the importance the indicators of grain quality are divided into three groups:

– required for of all parties of grain and seeds every culture used for any purpose. These parameters define at all stages of work with the grain, since the formation of parties in the harvest. These include: signs of maturity and freshness of grain (appearance, smell and taste), pest infestation, humidity and content of impurities (grade). They are included in state standards and set by restrictive conditions (quality standards);

– required at the estimation of some cultures grain parties or parties of grain for the certain setting. An example of these indicators can serve as a kind of wheat, barley, rye and oats. In the grain used for the production of cereals, it is determined: size, content and flower core films. The specific indexes of quality of wheat have a large role: glassiness, amount and quality of raw gluten;

– additional indexes of quality. They are checked up depending on a necessity that arose up [2].

The color and characteristic shine, provided good ripening grain by waxy coating on the surface, easily lost, if moist grain is not dried long, it begins to warm and microorganisms develop on its surface.

A smell and taste of healthy grain are specific at every culture and poorly expressed, almost fresh.

The development in grain of wreckers, especially tick, influences to the taste smell of grain. At their small amount grain-growing mass acquires a pleasant honey smell. The grain, that has the extraneous seasonings and smells that does not become separated at ventilation, is not subject to the food use.

The humidity of the grain mass is one of the main factors that determine its safety. The humidity in grain is in the constrained state, has a low activity and may not participate in the biological and physicochemical processes. The increase of humidity results of appearance the determined amount of free water that is characterized by low energy due to its link with grain tissues. It can take an active part in the physical and chemical enzymatic processes occurring in the grain. The standard provides four states on humidity (in %): dry - 13–14; medium - dry - 14.1–15.5; wet - 15.6–17 and raw - more than 17 [4].

The infestation of grain negatively affects the quality of processed products. However, the degree of decrease in their quality for the different fractions of impurities is different, so they are commonly divided into two groups – grain and foreign material. The grain impurities include the following components of the grain mass, which allow getting the several of products from them, although on less output and lower quality. The foreign material includes the inclusions that give sharp negative influence on quality of products of processing of basic culture.

The grain admixture includes a defective grain of the main culture: severely underdeveloped – shrunken, frost, sprouted, broken (length and breadth if more than half of the remaining grain), damaged by pests (with unaffected endosperm), such that darkened when the heating or drying; in wheat it also includes grain, damaged by chinch. At pellicle cultures the grains of impurities include collapsed (exempt from flower film) grains because they are crushed up in the processing of basic grains.

Making sure in homogeneity of coulisses, the original sample is composed. The determination of required characteristics (humidity, signs of freshness and maturity, content of admixture and infection by wreckers) is express analysis of grain quality. They are general indexes that are determined for every party. The party grain quality is set after the commodity analysis of the middle test selected from it on certain rules.

III. EXISTED SYSTEMS AND CONTROL METHODS

The examination of grain quality is based on the definition of organoleptic and analytical indicators, methods specified in state standards. Under quality it is usually understood a sum or totality of properties

and signs that determine the possibility of use of grain on the having a special purpose setting and for the protracted storage. All methods of determining the quality of grain can be divided into two groups – organoleptic and laboratory.

Color and appearance is determined by inspection of the sample for determine the type (culture) of grain, its typical partial belonging and identify its condition. Grain is fresh, normally ripening, cleaned, having the well expressed color peculiar to this culture, as, to the sort, smooth shiny surface. The grain is exposed to moisture, usually opaque, whitish, and the hulled grain crops darkened. The spoiled grain obviously grows dark, heterogeneous, sometimes with the spots of mould on a surface. Color and appearance is better defined in diffuse daylight, comparing the tested sample with normal grain of the culture and the type of samples.

The smell of grain depends on volatile substances contained therein. For determination of smell the small amount of grain is warmed by breathing. If a little grain, pour in a cup, pour hot water, cover and leave for 2–3 minutes, then drain, the smell of it felt better. Normal grain has a specific taste, typical of wheat, often fresh and slightly sweet.

The low accuracy of infestation definition of grain leads to losses. To determine this parameter from samples of wheat allocate weighing 2000 g, take apart by hand and weigh all present admixtures in 10 samples. Thus executed a 12 sifting, one of which – for the selection of admixtures without sorting out with the help of sieve with a diameter of 6 mm and by the passage-way of sieve with a diameter of 1 mm. Other sifting is auxiliary. A 500 g sample is sifted for 100 g, as laboratory sieves have a limit area (a diameter of sieve is a 200 mm), and reducing of the sample is not possible because of the small amount of impurities. All these operations are executed by hand and require plenty of time. As you can see, this method of determining the debris grain is too complex and time-consuming. Therefore, in practice, determine the content only distinct weed and grain impurities in the sample wheat 50 grams, and other impurities are determined visually. To reduce the time for manual parsing sift all the average sample – 2000 on the sieves provided by the standard – 6.0 mm diameter with holes 1.7 × 20, and a diameter of 1.0 mm. The purpose of the sieve analysis – removing all or most of impurities of a particular class [5]. Sieve analysis can not only remove certain types of impurities, but also get a uniform grain fractions and impurities and reduce the amount of manual work. Such analysis artificially increases the content of impurities in separate fractions, which increases the accuracy of their determination, including the average sample.

It should be noted that photo separators acquire popular, but they are used mainly not for an analysis, but during a production. For today photo separators, also they are named as photo electronic separators or optical sorters are presented by different models under many world companies in the trade marks. On the whole a photo electronic separator simple enough in exploitation, the tasks that it solves executed with maximal effectiveness.

The principle of work of photo separator: a product that requires a technological separation is served in the boot capacity of photo electronic separator, where by means of vibration a product is directed in the chute of machine, the chute is the tiny channel through which flows the stream of products. On the chute it is got in the zone of 4 LED lighting, where an inspection and illumination passes, allowing to get the real reflection on sensory chambers, such as CCD, BiChromatic, NIR. Camera CCD looks grain contrast: dark or light. These cameras are suitable for sorting cereal seeds, rice, wheat, barley and others. The camera BiChromatic looks the color of grain and distinguishes material color. It separates according pigmentation colors: red, green and blue, etc. This type of camera is well suited for sorting maize, soya beans, hazelnuts, etc. Camera NIR, yet it is called infrared camera is good "sees" plastic, iron, glass, who as foreign particles often get separated into the product. Cameras are scanning seed of product, getting the corresponding reflection of light, and reacting on the non-standard tint of element, recreating an electric signal that goes to the computer of photo separator. It in turn informs ejector for his plugging in work. Including of ejector in an action leads to the opening of its shutter and according to a airflow passes, that takes away the suspected element of product from general composition. Farther, the "correct" elements of products fill their storage, "wrong" own storage [6].

Humidity of grain – one of the most essential indexes of its quality, that is determined at once after a reception. Humidity of grain can be determined by direct and indirect methods. When grain comes to the items of receiving it is needed quickly to define where to direct party: on the long-term storage in silo elevator, in composition of active aeration, to a grain dryer.

Basic standard method. Superfluous humidity of grain is mostly removed by means of dehydration in an air-thermal closet. Temperature and drying with this method are fixed. After drying, grain losses are determined.

It takes place in several stages:

– preliminary measurement of humidity using electro moisture meters;

– drying (with humidity over 17 %);

– preparation for work desiccator, cups, oven;
– final measurement.

Determination of humidity using electro hydrometer – express method that allows receiving a result in a few minutes. For rapid determination of humidity of parties of grain used electro hydrometer of the different systems and constructions. The principle work is based on sensitiveness of physical devices to content of moisture. In basis of action of IVZ, VKZ, "Trans-gigro" devices it is lied the dielectric method of measuring, that takes into account a difference between the indexes of inductivity of dry grain and water. For a quick determine the humidity content of grain farms it is used the "Kolos", VZPK-1 and others. Hydrometer "Kolos-1" is designed to measure the humidity content of grain and seeds of other crops. The principle of its action is to determine the resistance of the capacitive transducer loaded some grain weight [2]. There are many hydrometers nowadays.

IV. Problem statement

The above-mentioned methods do not give the instantaneous integrated estimation of quality, secondly there is no a complex hardware, that allows simultaneously to define parameters (humidity, impurity, infection, original appearance), and all of it results to the increase of charges of time and inconvenience of realization of analysis. It is necessary to work out the system that gives the integrated estimation, on the basis of criteria determination of grain quality, that allows to do the process of express analysis more precisely and rapid. For this purpose we must work out the most corresponding and comfortable system that will allow to conduct quality of grain control for the short interval of time and give the most exact results. We must pay attention to systems of machine sight in agrarians, namely on the construction of the video digital checking of quality and authentication of grain-growing systems.

V. Development of the block diagram and operation algorithm

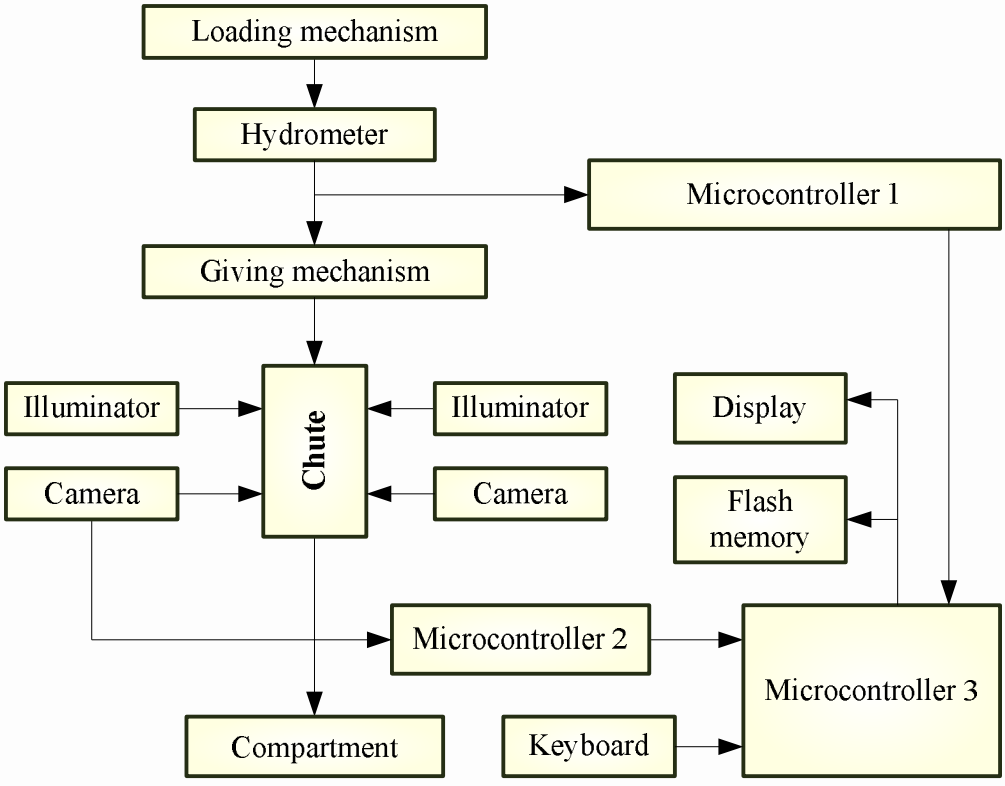
So as on some Ukrainian enterprises the old methods of estimation of quality of grain are used, it is necessary to work out and inculcate the most economic variant for domestic organizations.

Connected the processes of verification of major indexes of express analysis of grain, it is possible considerably to shorten time of reception of transport.

The operation algorithm can by represented as follows (Figure).

1. Measuring humidity W using electrometric method.

Classification of grain that is investigated, in accordance with PSU.



Operation algorithm

2. Analysis of the video images in the chute:

– processing of video images (image pre-processing, segmentation, identification of points of contours, contour analysis, correlation analysis);

– determining the amount of impurities in percentage p_1;

– determination of the number of pests in percentages p_2.

3. Determination of the integrated index of quality of grain.

$$I = k_1 W + k_2 p_1 + k_3 p_2,$$

where k_1, k_2, k_3 weighting coefficients (determined experimentally).

CONCLUSIONS

The integrated system of the grain parameter determination is proposed. The design the software of this system includes following blocks: loading mechanism, hydrometer, giving mechanism, two illuminates, two cameras, chute, compartment, three microcontrollers, keyboard, flash memory, display, compartment. The manufacturing of this system will permit the efficiency of the gain parameters control and decrease the time of the grain reception at the enter of granary.

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В. М. Синеглазов, О.С. Галатенко. Автоматизація системи визначення основних параметрів якості зерна
Запропоновано метод експрес-аналізу зерна для визначення інтегрованої оцінки якості зерна. Досліджено основні показники якості зерна та розроблено структурну схему системи для їх перевірки.
Ключові слова: зерно; експрес-аналіз; вологість; засміченість; зараженість; фотосепаратор; сегментація.

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В. М. Синеглазов, О. С. Галатенко. Автоматизация системы определения основных параметров качества зерна
Предложен метод экспресс-анализа зерна для определения интегрированной оценки качества зерна. Определены основные показатели качества зерна и разработана структурная схема для их проверки.
Ключевые слова: зерно, экспресс-анализ, влажность, засоренность, зараженность, фотосепаратор, сегментация.

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