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IMPROVEMENT OF THE ENVIRONMENTAL PROTECTION SYSTEM AT ENTERPRISES OF THE BAKERY INDUSTRY

Zatserklyany M.
Odessa National Academy of Food Technologies
9/11, Tinista Str., 65009, Odessa
doczmm@ukr.net

The main factors of the influence of the production processes of enterprises of the bakery industry on the state of the environment are given. It is shown that the effect is on atmospheric air, water resources, lithosphere and human health. The ways of solving the problem of environmental protection and working areas of industrial premises of the enterprises of the branch are proposed.
Keywords: branch of bakery products, atmospheric air, dust, environmental protection, apparatus.

Удосконалення системи охорони довкілля на підприємствах галузі хлібопродуктів. Зацерклянний М.М. Наведено основні фактори впливу виробничих процесів підприємств галузі хлібопродуктів на стан навколишнього середовища (атмосферне повітря, водні ресурси, літосфера і здоров'я людини). Запропоновано шляхи вирішення проблеми охорони навколишнього середовища і робочих зон виробничих приміщень підприємств галузі.
Ключові слова: галузь хлібопродуктів, атмосферне повітря, пил, охорона довкілля, апарати.

Совершенствование системы охраны окружающей среды на предприятиях отрасли хлебопродуктов. Зацеркляный М.М. Приведены основные факторы влияния производственных процессов предприятий отрасли хлебопродуктов на состояние окружающей среды. Показано, что воздействие осуществляется на атмосферный воздух, водные ресурсы, литосферу и здоровье человека. Предложены пути решения проблемы охраны окружающей среды и рабочих зон производственных помещений предприятий отрасли.
Ключевые слова: отрасль хлебопродуктов, атмосферный воздух, пыль, охрана окружающей среды, аппараты.

Grain is the most important product of agriculture, which is the main source of human nutrition, a forage base of livestock, poultry, raw material for technical production, etc. In Ukraine, as one of the main producers of grain and a leading grain trader in the Eastern European and Asian markets, in 2016 more than 50 million tons of grain were grown and harvested.

All technological processes at the enterprises of the field of bakery products (reception, transportation, transfer, cleaning, drying, dry methods of preparation of grain and its processing) are accompanied by intense dust formation with loss of production due to mechanical spraying.

The production processes of the bakery enterprises significantly affect the state of the environment: atmospheric air pollution by dust emissions, water during the wet method of preparing the grain for processing and the formation of various types of industrial waste entering the lithosphere.

The activity of enterprises can also lead to a deterioration of the ecological

condition of the adjacent territories and create explosive situations.

Therefore, ensuring effective air purification from dust at these enterprises is of paramount importance.

Among the scientists who studied the problems associated with the analysis of the current state of environmental safety at the objects of the bakery industry and the development of the design of air purification apparatus from dust, capable of capturing fine particles of dust in a high efficiency and with minimal energy and metal consumption, it should be noted B. Batluka [2], G. Bondareva [3], O. Gopanyuk [4], O. Dzyadio [5], Y. Dmitrukuk [6], V. Shmandia [9] from the Odessa National Academy of Food Technologies, Lviv State University of Life Safety, Kremenchuk National University named after Mikhail Ostrogradsky.

The objective of the work is to develop measures aimed at reducing the level of environmental hazard from the dust emissions of enterprises of the bakery industry through the improvement of dust treatment equipment.

To achieve the goal the following tasks are focused:

- study of characteristics of mineral and organic origin dust of enterprises of the industry depending on the production activity type;
- establishing the regularity of dust distribution in the middle of the production premises of enterprises and beyond;
- development of the design of devices for air purification from dust, capable of high-efficiency and with minimal energy and metal costs, to catch finely dispersed fractions of grain dust.

Results

Due to the lack of information on the dispersed dust composition of the bakery industry, five elevators were inspected (Odesa Port Elevator, Odessa Integrated Plant, Kulindorovsk Integrated Plant, Berezovsk and Izmail elevators in the Odessa region). Samples were taken at different points of dust removal technological schemes – from the receipt of grain to the enterprises before loading it into silos. For a wider examination of the results of the study and comparison, the indices of kaolin, quartz and flour dust, having different degrees of dispersion, median size, volume mass, ash content (Table 1) were also determined.

Table 1

Characteristics of dust

Investigated dust	Ash contents, Z,%	Humidity, W,%	Bulk mass, γ, kg/m^3	Median size, δ_{50}, μm	Degree of dispersion, $\sigma = \frac{\delta_{50}}{\delta_{16}}$
kaolin	98,5	0,5	2480	-	-
1- cereal	28,6	8,5	1660	8	2,00
2- cereal	28,5	8,5	1660	8	2,50
3- cereal	29,2	8,0	1670	10	2,50
4- cereal	28,4	8,5	1680	8	2,00
5- cereal	29,1	8,0	1660	8	2,50
quartz	99,0	0,5	2500	8	3,80
floury	0,5	13,4	1370	46	2,05

According to the dust samples used in experimental studies, the data of the sieve area of dust particles greater than 110 μm were obtained, which in the taken samples were from 50 to 95% and were described by the equation:

$$D=a+b\delta-ce^{-\kappa\delta},$$

where *a, b, c, κ* – coefficients that are determined experimentally, depending on the location of dust removal, the type, moisture and the nature of the pre-processing of grain. In the pidsitic area (particle sizes less than 110 μm), the dispersed composition of the dust samples obeys the log-normal distribution law. It was important to establish the laws of the distribution of dust in the middle of the production premises of enterprises and beyond.

In the air of the working area of industrial premises, the grain dust concentration should not be more than 4 mg/dm^3, flour – 6 mg/dm^3, since such a dust has a negative effect on the health of the attendants and causes the occurrence of fires and explosions in the grain receiving and grain processing enterprises and the inflow into the environment contaminates it.

Part of the grain dust is in a bound state, that is, in normal conditions, it does not separate from the grain surface, laying in, for example, in the grooves of the grain and shells. In the process of moving and purifying grains separation from the surface of grain of mineral and organic particles occurs. Particularly significant amounts of dust formation are observed when air is blown by a layer of grain (active ventilation) and when used for moving grain of pneumatic transport and aerosols). A dust cloud consisting of large particles (a straw, a shell of grain) is formed, a rapidly settling, much more stable dust cloud formed by small, slowly depositing particles.

Gross emissions of dust in the atmospheric air from grain-processing enterprises and elevators consist of total amount of dust from technological and transport equipment.

The amount of dust coming from the transport and process equipment is equal to the total amount of dust from the dust collectors of the aspiration and pneumatic conveying units serving this equipment [4].

The concentration of dust in the air, which is deducted from the equipment of elevators, is given in Table 2.

Table 2

The average concentration of dust in the air, which comming from different types of elevator equipment

Aspirates equipment	Concentration of dust in air comming from equipment mg/dm^3
Acceptance of grain from railway transport	1,3
Elevator boot	2,0
Bulk trays of under-carriage conveyors	0,6
Bulk trays of over-bearing conveyors	1,5
Discharge boxes of under-carriage conveyors	2,0
Automatic scales, undercarriage and overhead bunkers, elevators heads	1,2
Swivel wheels, over-separator bins	0,6
Tire trucks	0,7
Chain ocnveyors	0,8
Pneumatic conveyor of waste	3,0
Air sieve separators	3,0

Air, which is removed by ventilation systems, before being released into the atmosphere should be purified from dust with the maximum possible techno-economic completeness. The degree of air purification from dust is determined by the permissible residual content of dust in the air after cleaning, as well as technical and economic considerations (in the case if the dust is of some value and can be used for useful purposes and fully or partially covers the cost of air purification).

Reducing the amount of pollutants releasing into the environment from the enterprises of the sector of grain products and determining their level of environmental impact is an urgent problem of the present, it has ecological, social and national economic significance. The development of new technologies for the processing of grain materials with advanced and new methods and means of dust purification will allow them to be designed with pre-forecasted parameters and is an actual scientific and practical task, the solution of which will help reduce the amount of man-caused pollution, increase the level of environmental safety of the objects, the region and the state.

The existing devices of aspiration systems are morally obsolete and technically worn out and are no longer able to provide an adequate degree of air purification from dust, which needs improvement. There was a contradiction: on the one hand – the potential of the purification systems should be substantially increased, and on the other hand, difficulties in implementing these opportunities have increased due to the operational capabilities of the equipment. Complicating the dust removal systems while simultaneously increasing the requirements for the efficiency of their operation requires taking certain measures to develop high-efficiency dust-collecting apparatus [7, 8, 9].

According to the results of the analysis of information and the practical assessment of the conditions for the formation of environmental hazards during the implementation of technological processes on grain elevators, the need to purify the air of working areas from grain dust by creating new constructions of dust-collecting equipment has been proved.

Accordingly, a new improved device for separating impurities from the air environment has been developed in which, by introducing a cyclone device at the inlet of the airflow of the charging pocket of the cylindrical body, additionally provided with a bulk filtering granular backfill with a screw and a driving mechanism for moving it, almost complete separation of impurities from gases, increased reliability during operation and efficiency of cleaning gas emissions from pollutants [1].

Conclusions

The analysis of the dust of the bakery industry enterprises showed that its properties depend on the type of production activity, and the concentration – from aspiration equipment.

It is established that the dustiness of the air in industrial premises of the enterprises of the industry is affected by the sealing of transport and technological equipment, the design, the state and modes of operation of the equipment operating devices, the efficiency of aspiration systems and the production culture.

Research has allowed the development of devices for cleaning air from

dust, which are highly efficient and with minimal energy and metal consumption, trap small-grain fractions of grain dust.

Based on the results of the analysis of published sources and the practical evaluation of the conditions for the formation of an environmental hazard in the implementation of technological processes at grain elevators, it is proved necessary to carry out further studies of the cleaning of air in working areas from grain dust and the creation of new designs for new dust collection equipment.

Tasks for further research and development:

- definition of optimal parameters of the design of apparatus for catching pollutants from the air, which is deduced from transport and technological equipment of the enterprises of the field of bakery products;

- development of new types of equipment and methods of engineering calculation of non-dusting systems for production premises of bread making and flour mills, which would allow to improve the systems of atmospheric air protection;

- search for more efficient means of combating atmospheric air pollution in industrial premises of the industry;

- substantiation of the scheme of analysis of aerodynamic processes within the proposed dust collectors, which will enable to determine the efficiency of separation of solid impurities;

- creation of a system for monitoring the parameters of the atmosphere in the zone of location of the enterprises of the sector of bakery products.

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