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STUDY ON PHYSICAL FEATURES OF DUST CONTROL PROCESS AT WOODWORKING ENTERPRISE

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The article is devoted to the analysis of physical essence of the process of air pollution reduction for the woodworking shop of the enterprise serving the objects of urban development, within the framework of physical and energy approach. According to this approach, wood dust is considered from the position of disperse systems theory, which changes its properties under the influence of external disperse systems. The whole process is gradually illustrated by a physical model of air pollution reduction process, as well as a scheme of transformation of the disperse system (dust aerosol) in the process of air pollution reduction.

Keywords: environmental safety in construction, object of urban development, disperse system, woodworking shop, wood dust, air pollution reduction, physical energy approach, physical model of air pollution reduction process.

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ИССЛЕДОВАНИЕ ФИЗИЧЕСКИХ ОСОБЕННОСТЕЙ ПРОЦЕССА ПЫЛЕПОДАВЛЕНИЯ НА ДЕРЕВООБРАБАТЫВАЮЩИХ ПРЕДПРИЯТИЯХ

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Статья посвящена анализу физической сущности процесса снижения загрязнения воздушной среды для деревообрабатывающего цеха предприятия, обслуживающего объекты городского строительства, в рамках физико-энергетического подхода. Согласно этому подходу древесная пыль рассматривается с позиции теории дисперсных систем, которая меняет свои свойства под воздействием внешних дисперсных систем. Весь процесс поэтапно иллюстрирует физическая модель процесса снижения загрязнения воздушной среды, а также схема трансформации дисперсной системы (пылевого аэрозоля) в процессе снижения загрязнения воздушной среды.

Ключевые слова: экологическая безопасность в строительстве, объект городского строительства, дисперсная система, деревообрабатывающий цех, древесная пыль, снижение загрязнения воздушной среды, физико-энергетический подход, физическая модель процесса снижения загрязнения воздушной среды.

Introduction. Promising development of the Russian construction industry using wood products such as shuttering, frame houses elements, joists and floorboards, plywood, parquet products inevitably leads to aggravation of air pollution problems with wood dust in the processing of wood raw materials [1, 2]. Therefore, the modern level of production development involves the use of scientifically based approaches to the choice of methods and means of ensuring environmental safety in construction that meet the requirements of environmental and energy efficiency [3, 4]. At the same time, physical-energy approach is the most preferable for the above criteria for solving such problems [5].

Main part. According to this approach, dust, formed as a result of woodworking, is considered according to the theory of disperse systems [6-8]. The properties of wood dust particles as a dispersed phase suspended in air or gas flow may differ significantly from the properties of the captured dust material [9]. This difference may occur especially in the removal of wood dust from the air. This happens due to the fact that a certain proportion of wood dust particles in the ventilation air flow is an aggregate consisting of several dust particles. Such aggregates behave like large particles. The more dust aggregates in the air, the easier it is to separate them from the flow and thus ensure a sufficiently high cleaning efficiency [10].

For wood dust, an effective reduction of air pollution of the construction company working area and the atmosphere surface layer is achieved by the implementation of two main cycles [5]:

– reduction of pollution of wood raw materials or technological equipment;

– reduction of air pollution by wood dust.

It is obvious that the first cycle (consolidation and retention of wood dust particles) is more rational, but its implementation does not ensure compliance with the MPC in the working area air and in the atmosphere surface layer [12].

The second cycle (capture, cleaning, dispersion) is traditionally used to comply with the regulatory parameters of air environment in the construction industry. The second cycle of the process of reducing air pollution with wood dust includes the appropriate stages of implementation.

To investigate physical nature of air pollution reduction process with wood dust, we present this process as a set of consistently occurring targeted processes implemented at each stage of pollution in the process of woodworking at the construction industry.

The first cycle consists of the following functional elements:

– dust consolidation, which is strong consolidation of dust material particles with wood raw material;

– dust retention, namely, to retain the formed particles of wood dust in the vicinity of wood raw material.

The second cycle includes:

– dust capture, which is to prevent the spread of wood dust particles and ensure their removal from air directly in the area of its source;

– dust cleaning, consisting in the maximum separation of the dispersed phase and the dispersion medium of dust;

– dust dispersion, namely, the intensive separation of wood dust particles in air medium with subsequent settling.

Dispersion of wood dust particles in the atmosphere can occur naturally or by force. Natural dispersion involves the release of wood dust at the roof level of the working area building and is largely dependent on meteorological conditions (wind speed, temperature, relative humidity, etc.) and the state of the atmosphere surface layer (potential air pollution, stratification factor, etc.). In this case, if the efficiency of the cleaning process does not meet regulatory requirements (MPE), forced dispersion is applied. The analysis of cleaning process shows the need for dispersion of wood dust particles.

The analysis results of the process of reducing environmental pollution with wood dust formed the basis for the construction of a physical model of this process for the enterprise woodworking shop serving the objects of urban construction (Fig. 1).

In the process of interaction of raw materials (dry edged board) with the working body of technological equipment (cutting head blade of four cutter) wood dust is formed, which is an "Initial-I"("И–I") disperse system.

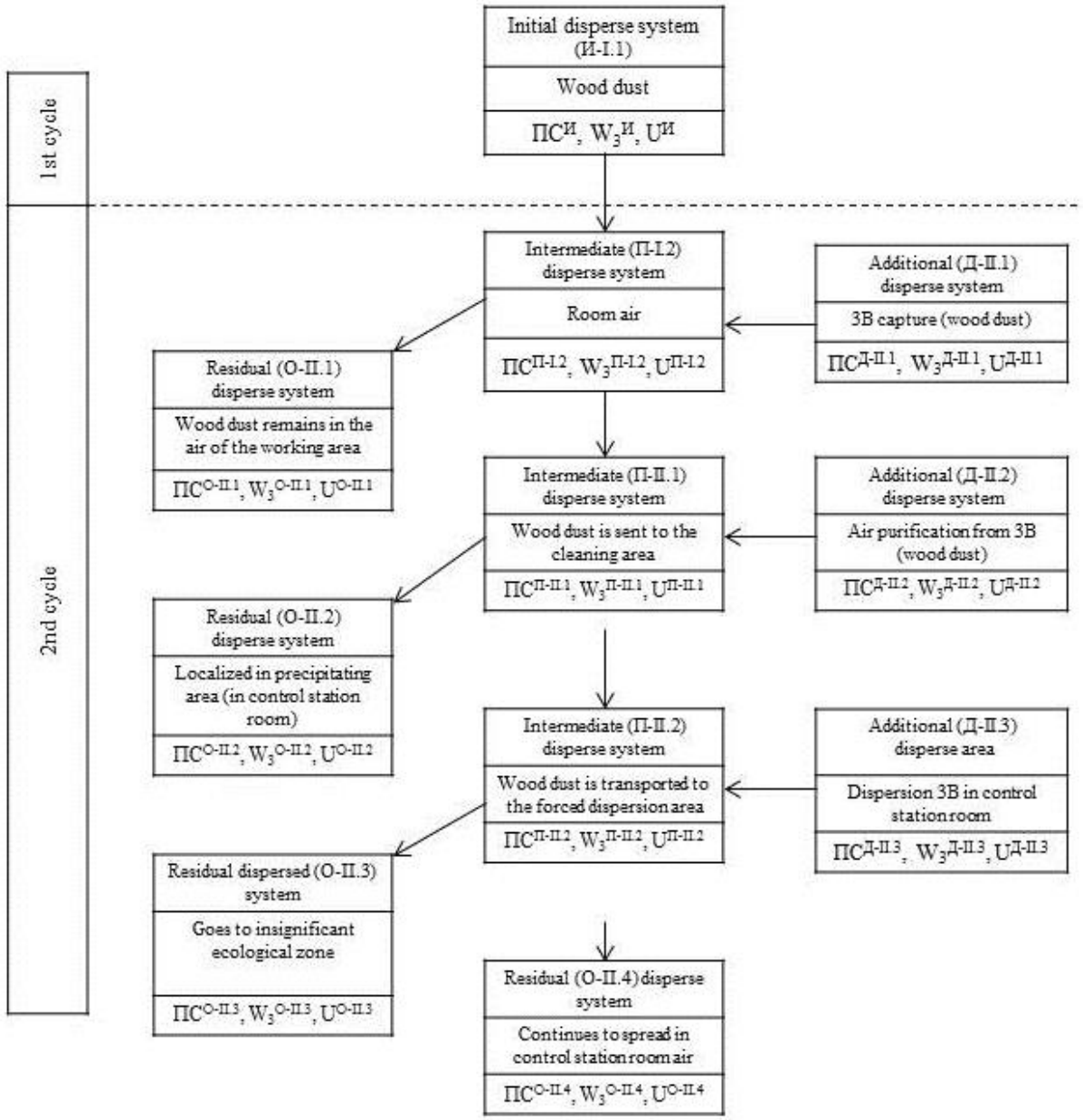

Fig. 1. Physical model of the process of reduction of air environment pollution for woodworking shop

In this case external influence on "И-I" system in the capture process is an additional disperse system "Д-II.1". Two disperse systems are formed as a result of the interaction of "И-I" and "Д-II.1." disperse systems:

– "О-II.1" system, which is initially in a state of wood dust, but loses its stability. It can go into the initial material state, but in the real world remains in the air of the working area;

– "П-II.1" disperse system contains the maximum amount of dispersed phase. The stability of the system increases slightly over time. The system moves to the cleaning area.

"Д-II.2" system has an impact on "П–II.1" in the purification process. In this case, two systems are formed:

– "О-II.2" - fixed disperse system directed to the waste system. It is characterized by a high content of dust particles and increased stability.

– "П-II.2" - a polluting dust with a certain residual concentration of wood dust particles directed either to the atmosphere (in compliance with the MPE) or to the zone of forced dispersion.

Two systems are also formed in the process of forced dispersion (when this happens "П-II.2" and "Д-II.3" disperse systems interact):

– "О-II.3" - is directed to ecologically insignificant areas in the form of aerosol. The stability of the system first falls, then it stabilizes.

– "О-II.4 " - continues to spread in the air of the atmosphere surface layer. It is represented by a minimum number of wood dust particles, remains in aerosol state; its stability grows slightly in time, then it stabilizes.

As a result of successive influence on the initial, intermediate and residual disperse systems by external disperse systems in accordance with the laws of conservation of mass and energy, there is a transformation of interacting disperse systems. This transformation means that the newly formed disperse systems differ from the interacting ones in ПС, W, U. This inter-transition of disperse systems ultimately affects their stability and can be illustrated by the following scheme. Fig. 2 provides an illustration of transformation of disperse dust aerosol systems and changes in their stability in the process of air pollution reduction.

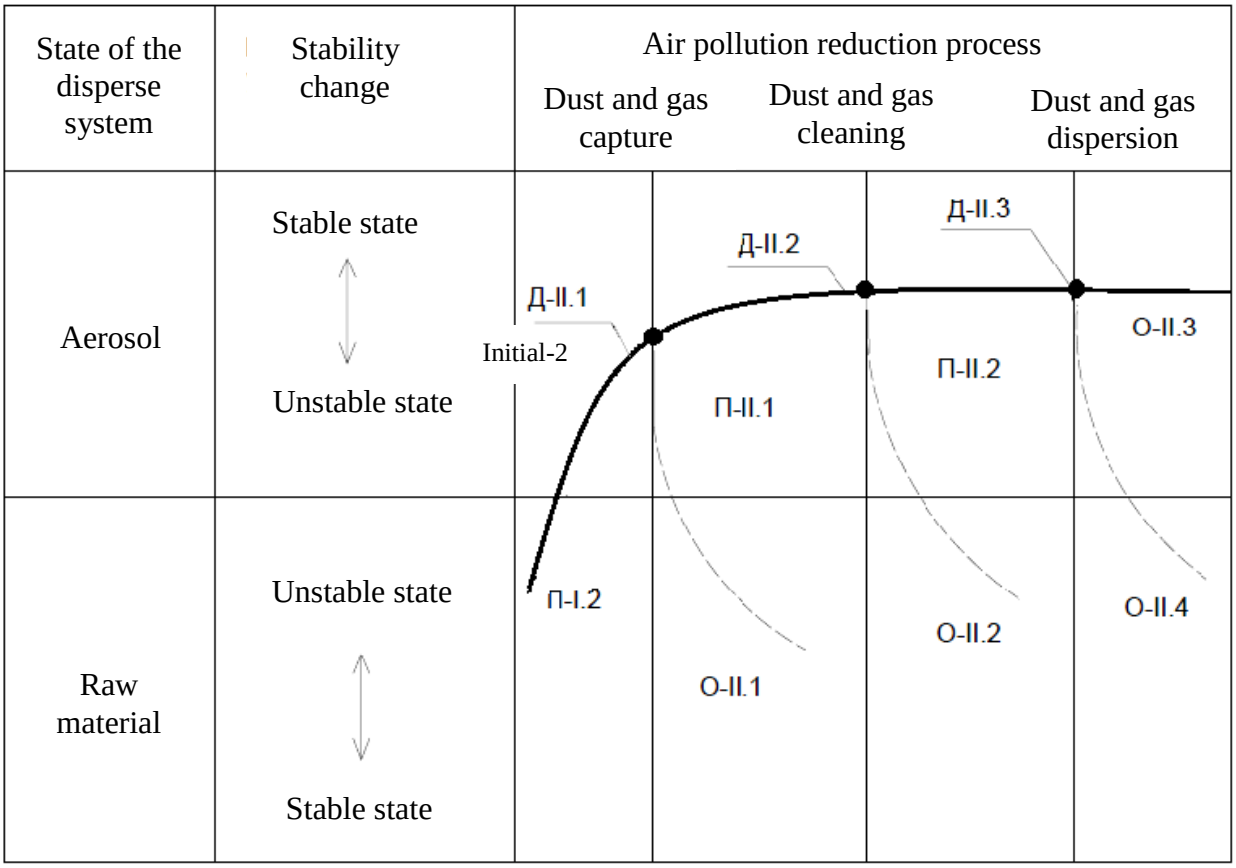

Fig. 2. Scheme of transformation of the wood dust disperse system in the process of air pollution reduction

Conclusion. The analysis of physical nature of air pollution reduction process for the woodworking shop will allow further research to move to the stage of selection of environmentally and energy efficient methods and means of ensuring environmental safety in construction, taking into account the transformations of the polluting disperse system, which "additional" disperse systems subject it to at the stages of capture, purification and dispersion of wood dust.

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