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METHOD OF SELECION FOR THE BEST VARIANT OF TECHNICAL SYSTEM FOR DUST REMOVAL IN STORING AND PROCESSING OF CEREAL CROPS

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ABSTRACT
This paper defines a method for selection of systems for removal of dust in receiving, handling and storing of cereals.
Based on the application of the method defined in this paper, the selection of the most favourable technical-technological solution for uncontrolled dust particles emission reduction system on the industrial facility of "Klas" Sarajevo has been made. Functional structure has been elaborated, morphological matrix with multiple versions of the above mentioned system has been set up, and evaluation of certain versions has been made on the basis of technical, economical, and environmental criteria resulting in selection of the most favourable version.
Keywords: dust removal from cereal crops, method of election for cereal crops dust removal system

1. INTRODUCTION
Plants and facilities for storage and processing of cereals may affect the quality of air in the working and living environment because of emission and dispersion of dust particles. At the same time, this dust is a waste of material and energy use. These include irregularly shaped mineral and organic particles of the size of 1-100 microns caused by manipulation, storage and processing of cereals [1,2].
In order to prevent or reduce dust emissions from the facility for storage and processing of cereals, different technical systems for dust removal are used.
Such systems consist of several major units, whereby for each of them should be chosen such equipment and devices which will in an integrated system provide the required operating parameters and efficiency. All influencing factors are important in selection of structural elements and technological parameters. That is why it is mandatory to perform a detailed analysis of all technical and technological characteristics of facilities and plants, as well as technical systems for dust removal with the aim of selection of the best solutions in respect to technological, environmental and economic aspects [3].
This paper describes the development of methodology for the selection of the best variants of technical systems for dust removal in facilities for storage and processing of cereals, in accordance with applicable environmental standards, BAT recommendations and IPPC directives.
Methodology is applied at the facility for storing and processing of cereals company "Klas" Sarajevo. Present uncontrolled emission of dust particles from plants and facilities of this company significantly affect the pollution of air in working and living environment, which was determined by environmental monitoring.
By measuring it was registered significantly higher concentration of dust particles in the air around the facilities for storage and processing of cereals of company "KLAS "Sarajevo, and also in a settlement that gravitates the location of this facility. Measured values of dust particles PM10 in the air ranged between 147 and 192 μg/m3, which is significantly higher than the maximum allowable value of 50

μg/m3, prescribed by the Regulations on Limit Values of Air Quality (Official newspaper FBiH. 12/05) [3].

2. METHOD OF SELECTION OF THE BEST VARIANT OF TECHNICAL SYSTEM FOR DUST REMOVAL IN STORING AND PROCESSING OF CEREAL CROPS

2.1 Functional structure of the system for dust removal

In order to prevent or mitigate emissions of dust particles in the air and controlled disposal of emitted dust at the place of formation, appropriate technical system for dust removal is applied, composed of three basic parts:

- aspiration network for suction with a suction caps, fittings, damping parts, and a network of pipelines,
- deduster (filters, cyclones, separators, etc.),
- devices to create the necessary air flow (fans, blowers, or ekshaustori).

All segments of the system for dedusting require separate but coordinated calculations, which are implemented by appropriate conventional procedures for the analysis, followed by a phase of CAD 3D modeling of the entire plant, and the preparation and realization of simulation based on the application of numerical methods. Moreover, each of these calculations has its own specifics, which should receive special attention. Basic input data are the amount of air and dust content in the waste air that is aspirated and cleaned to prevent air pollution.

System efficiency for dust removal is valued on the basis of the degree of dust separation, whereby this degree is the ratio of dust separated in system for dust removal and the amount that was taken with the waste air into the system and is expressed in %.

Figure 1 shows the functional structure of the dust removal system, which defines the flow of materials, energy and signals.

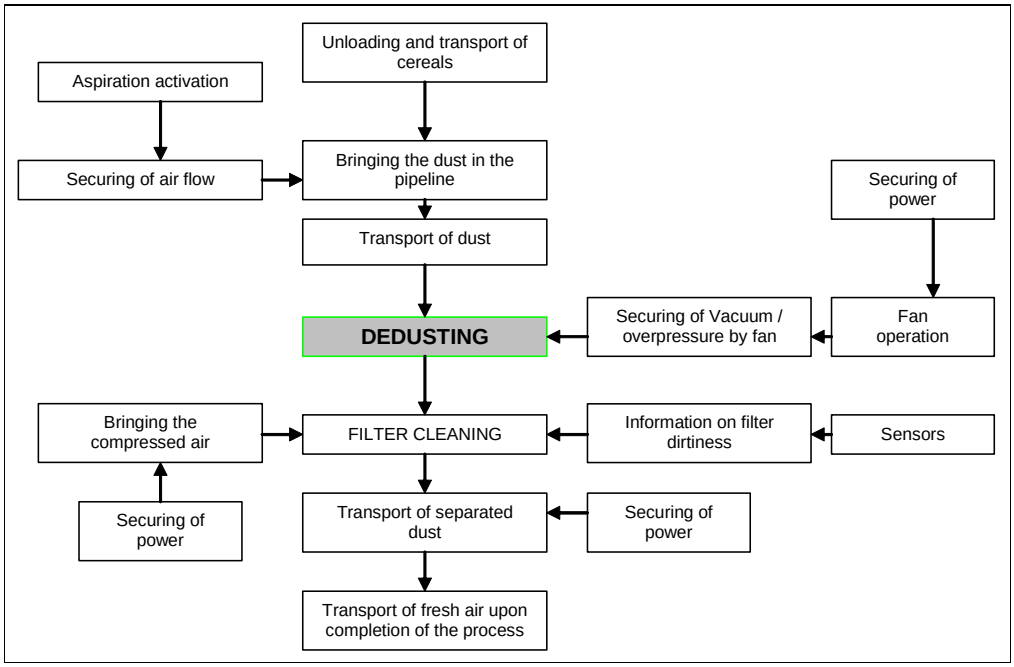

Figure 1. The functional structure of the dust removal system in company "Klas"

2.2 Morphological matrix

The main function of "Dusting" is separated to the necessary number of partial functions.

After defining the partial functions of the system for dust removal, morphological matrix is formed (Table 1), in which for each partial function possible solutions are defined, or carriers of partial

functions. Combining of individual solutions of partial functions is performed after that, in order to gain more variants of the total solution.
In the morphological matrix five solution variants for dust removal systems is given, which differ in the way: transportation of cereal crops, bringing dust into the system, transport of dust, dust separation, installation of filter cartridges, entry of contaminated air in the filter (cyclone), filtration, shaking of filter canvas, transport of dust extracted, and the inlet air velocity in the filter.

Table 1. Morphological matrix

	FUNCTION		PRINCIPLE OF EXECUTION FUNCTION / function executor						
1	Unloading of cereal crops	PF	From side of wagon	Below wagon	From side of truck				
		IF	Arm	Motoreductor					
2	Transport of cereal crops	PF	Pneumatic				Mechanical		
			Vacuum	Overpressure	Combined				
		IF	Vacuum pump	Compressor		Redler	Belt	Elevators	
3	Introduction of polluted air in pipeline	PF	Pneumatic						
			Vacuum			Overpressure			
		IF	Hood						
			Circular cross-section			Rectangular cross-section			
4	Transport of dirty mixture	PF	Pneumatic						
			Vacuum		Overpressure		Combined		
		IF	Fan			Pump (Compressor)			
			Radial		Axial		Low pressure	High pressure	
			Low pressure	Medium pressure	High pressure				
5	Dedusting	PF	Separation of dust from the air						
		IF	Cyclone			Filter			
			smaller diameter	higher diameter	multi cyclone	With cartridges	Bags	Electrofilter	
6	Filter cartridges installation method	PF	Vertical			Horizontal			
7	Way of entering of dirty air	PF	In funnel below		In funnel above		In funnel from side		
8	Inlet air velocity in the filter space	PF	High entry speed			Low entry speed			
9	Filtration (The flow of air through a filtering medium)	PF	High speed of filtration			Low speed of filtration			
		IF	Filtering media (ACR)						
			Poliester bag	Cellulose or PTFE bag Wrinkled cartridge			Cloth bag		
				Wider wrinkle spacing	Narrower wrinkle spacing				
10	Filter cleaning	IF	Impulse			Manual			
			Compressed air	Electro-mechanical					
11	Transport of separated machine	PF	Electro-mechanical			Pneumatic			
		IF	Weir	Worm spiral		Weir+Pump	Fan		
12	Securing of power for machines	PF	Electric Propulsion			Other types of propulsion			
			El. engine with frequency converter	El. engine with constant speed					

2.3 Evaluation of Solutions

In the table 2 evaluation criteria are defined, and identifying the technical and economic values of individual solutions is performed.

Table 2. Evaluation of solution variants - determining value factors

		SOLUTION VARIANTS					
	EVALUATION CRITERIA	1	2	3	4	5	Ideal
Technical and technological	Safety	3	2	3	4	3	4
	Legal Standards	1	1	3	4	3	4
	Work Stability	3	2	3	3	3	4
	Reliability	3	3	3	3	3	4
	Handling	3	3	3	3	3	4
	Maintenance	2	2	2	3	3	4
	Service life	2	2	3	3	3	4
	Method of filtration (separation)	2	2	3	4	3	4
	Sum of value factors	19	17	23	27	24	32
	Relative rating	0,593	0,531	0,718	**0,843**	0,750	1
Ekonomic	Number and complexity of parts	3	2	3	3	3	4
	Power Consumption	1	2	1	4	3	4
	Complexity of assembly	3	2	3	3	3	4
	Sum of value factors	7	6	7	10	9	12
	Relative rating	0,583	0,500	0,583	**0,833**	0,750	1

3. RESULTS OF THE RESEARCH

The main result of the practical application of the proposed methodology is the selection of the best variant of technical system for dust removal in handling and storing of cereal crops for the company "Klas" Sarajevo. Application of the selected technical and technological, guarantees the achievement of minimal air emissions and preservation of the prescribed air quality in working and living environment with storage and processing of cereals. In addition, the process employed enabled the reduction of the number of modules and systems for dust removal from the existing 16 to 8 systems, where 8 defined modules include 4 new, for dedusting intake hoper, which until now did not exist. It is expected that this will accomplish considerable saving of electricity. In the variant of simultaneous operation of all systems for dust removal, expected electricity savings are about 28%.

4. CONCLUSIONS

The research results showed justification for the application of principles and procedures of methodical constructing. The same allow that a wide range of solutions that are available for all partial functions of systems for dust removal in cereal crops processing plants can be put into the database of functional solutions that can then be combined and evaluated with the purpose of selecting the best variant of the said dedusting system.

Developed methodology for the selection of the best variant for the technical dust removal systems in storage and processing of cereal crops is intended for engineering and development calculation activities, and selection of the mentioned technical systems for dust removal. For further development of the presented methodology it is necessary to develop software solutions that would provide a sort of an expert system to develop a system for dust removal in cereal crops processing plants.

Especially important is that the methodology can be successfully applied to a variety of cereal crops storing and processing plants capacities, where its strength and flexibility could be shown.

5. REFERENCES

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