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Studies on Dustiness in Processing of Cereal Grains in Mill

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Abstract: The result of concentration, size and quantity of cereal dust formed on work-stands during grain mass preparation for milling have been presented. The state of pollution with cereal dust in productive rooms in mill have been also described in the aspect of its danger for environment and human health.

Key Words: Pollution, Environment of Work, Professional Diseases

Introduction

In the mechanized processing of so called "black" mass of grains, a particular amount of dust is formed. According to PN-64/Z-0101 standard, dust is determined as "solid phase in two-phase system" i.e. solid - gas. The solid comprises organic (the most part of seed cover, microorganisms) and mineral particles (silica), which depending on their geometrical and physical features are suspended in air or fall down on work stand. The harmfulness of dust depends on its concentration and particle sizes. The cereal dust pollutes the rooms, makes the work more difficult for the staff, decreases the effectivity of processing in mills and makes impossible to obtain products of high quality and baking value (Jankowski, 1981; Szorc and Jurga, 1980 and ISO). It cause also danger of explosion because of the mixture: solid - gas. It is a serious danger for natural environment. However, regardless of the great importance of this problem, there are not many research works concerning this subject which would allow to establish the state of pollution with cereal dust in productive rooms. The dust collecting and ventilating systems at various technical levels, commonly applied in mills, decrease pollution in productive rooms and on work-stands but they do not solve the problem (Jankowski, 1981; Szefler *et al*., 2000; Szorc and Jurga, 1980; Haber and Horubalowa, 1992 and Zdanowski, 1992).

The authors have undertaken the studies in the aim to establish the occurrence of cereal dust in mills - mainly in productive rooms where grain is prepared for milling.

Materials and Methods

One of the still actual problems in millery technology is decreasing the dustiness in productive rooms and on work-stands in production line processing so called "black" mass of grains destined for milling. An attempt to determine both the dustiness in productive rooms and on basic work-stands in mill and its harmfulness for staff and environment have been undertaken. The results were the basis for determination of the optimum foredesigns for functional and environmentally friendly dust collecting system.

The spring wheat of "GRANA" variety was the material for determination of air pollution with cereal dust in productive rooms and on work-stands in mill in Bydgoszcz (Poland). Studies were carried out on the grain bulk (in amount of 42 tones) delivered by a local manufacturer. The authors, according to the rule that dust particles having diameter above 0.1 μm are not suspended in air but they fall down on the surface of room, covered the work-stands and productive rooms with plastic foil. The cereal dust collected from the plastic foil in productive room of the determined cubic capacity expressed in m^3, allowed us to calculate concentration of cereal dust in rooms under the study (expressed in mg of cereal dust per 1 m^3 of air). The quantity and sizes of dust particles were measured on the test stand presented in Fig. 1 using apparatus "Annualized 22" and were expressed in %.

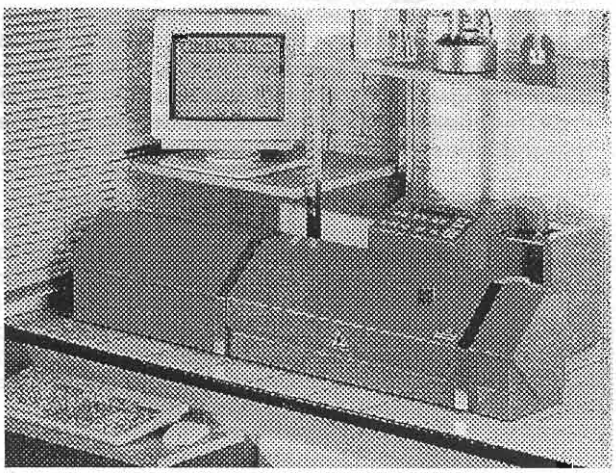

Fig. 1: Test Stand for Measurements of Particle Sizes and Concentrations
a) Monitor, b) Test Chamber, c) Programmer

Results and Discussion

The concentrations, quantity and particle sizes of cereal dust determined in productive rooms and on work-stands localized in processing line for grain bulk preparation for milling in the mill are presented in Tables 1 and 2.

As it is well-known, the permissible dustiness of air on work place can not be higher than 10 mg of silicaless dust and 4 mg of silica dust per 1 m^3 of air. A dangerously high concentration of cereal dust was observed in all the investigated rooms and on work-stands for preparation of grain bulk for milling. It is in accordance with the previous literature information (Jankowski, 1981; Szefler and Weiner, 1996; Szorc and Jurga, 1980; Cacak-Pietrzak *et al*., 1994a and 1994b). The highest concentration of cereal dust was found around the outlet of grain dump pipe and it was equal to 1814 mg per 1 m^3. However, the lowest dust concentration was around the heads of bucket elevators

and it was approximately 89 mg per 1 m^3 (Table 1).
The gramometric analysis of cereal dust showed high quantity of cereal dust particles of various size on work-stands and in production line for so called "black" processing of grain bulk (Table 2).
The highest amount of cereal dust (49%) was characterized by the particles sizes within the range from 10 to 20 µm and the smaller part of dust (6%) contained particles below 5 µm and above 60 µm.
A long professional experience showed that the dust particles of diameter above 50 µm are arrested at the beginning of respiratory system (in top part of respiratory system), while the particles of 10 to 50 µm penetrate to lungs causing various diseases. However, the most hazardous are particles within the range from 0.25 to 5 µm, since they get to lungs and cause deep morbid changes inside them. It was found that dustiness in productive rooms exceeded the permissible limits given by the obligatory standards, what could result in many diseases such as silicosis or chaliosis. It is hazardous for natural environment and decreases the effectivity of production in mill (Szefler *et al.*, 2000; Szorc, 1985; Szorc and Korpal, 2000; 2000; Amrogowicz and Kordylewski, 1990 and Bulsiewicz *et al.*, 1975).

Table 1: Results of Measurements of Cereal Dust Concentration Expressed in mg of Dust per 1 m^3 of Air

Work-stand	Dust concentration in mg per 1m^3 of air		
	Permissible	Real	Over normative
Heads of scoop elevator	10	89	79
Balances	10	242	232
Fall pipes to chambers	10	92	82
Dump truck of belt conveyers over chamber	10	334	324
Engine room of store	10	314	304
Under chambers	10	142	132
Under dump baskets from carriages	10	231	221
At the outlet of dump pipe	10	1814	1804

Table 2: Results of Measurements of Cereal Dust Particle Sizes and Quantity Expressed in mg of Dust Per 1 m^3 of Air

Particle sizes in µm	Quantity per 1m^3 in %
do 5	6
5-10	11
10-20	49
20-40	18
40-60	10
above 60	6

Conclusion

- Our results were refereed to the determined, dangerous for people and environment, concentrations of cereal dust formed during grain preparation for milling.
- It was confirmed that the formed cereal dust pollutes the work-stands and production rooms.
- The results may be of a significant applicatory value for optimization of grain bulk processing and for designing the new functional dust collectors.

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