

APPLICATION OF A DISCHARGE TUBES IN THE GRAIN SILOS
(a technical note)*

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A b s t r a c t. Dynamic pressures on the silo during the flow of materials is high and causes failure of silos. In this paper the authors describe a device that reduces dynamic pressures and improves the flow of materials by means of a discharge tube.

K e y w o r d s: silo, bulk solids, discharge tube, pressure reduction, application

INTRODUCTION

A discharge tube also called an "anti-dynamic" tube allows the management of flow characteristics of stored materials. Among the best known tubes the Reimbert's concept, which consists of the installation of a perforated tube in the center of the silo, extending from almost the top of the silo slightly over the outlet (Fig. 1).

ACTION OF THE DISCHARGE TUBE

The researchers used a discharge tube to reduce the dynamic pressures of the silo to prevent the static equilibrium of the ensiled materials from that is broken during the emptying of the silo. The breaking of the equilibrium causes dynamic pressure.

The pressure exerted on the silo wall and within the ensiled materials. The pressure is a function of the mean hydraulic radius of the silo and is much greater than the mean hydraulic radius of the discharge tube inside the silo,

which is much smaller. This makes the materials from the silo to the tube. Hence, when the discharge hole of the silo is opened, the material inside the discharge tube start to move and the other materials remain at rest until the upper surface of the material inside the discharge tube reaches the uppermost holes in the discharge tube. Then the materials in the upper part of the ensiled material enter through these holes and fall inside the discharge tube following the emptying movement. The rest of the ensiled materials remain at rest. It can be seen in Fig. 1. The ABCDEFGH volume moves and enters the discharge tube from the FG hole, when the upper surface of the materials reaches the EFGH line, the second EFGHIJKL layer moves and enters the discharge tube JK. The materials below remain at rest.

It is necessary for the holes of the discharging tube to be located close by for the emptying to take place in a continuous manner and without an increase of the pressure on the silo wall.

The silos fitted with discharge tubes have been examined by many researchers. Generally speaking, the investigations carried out aimed at the improving of the following principal issues:

- the reliability of silo structure [3,4,6-8];

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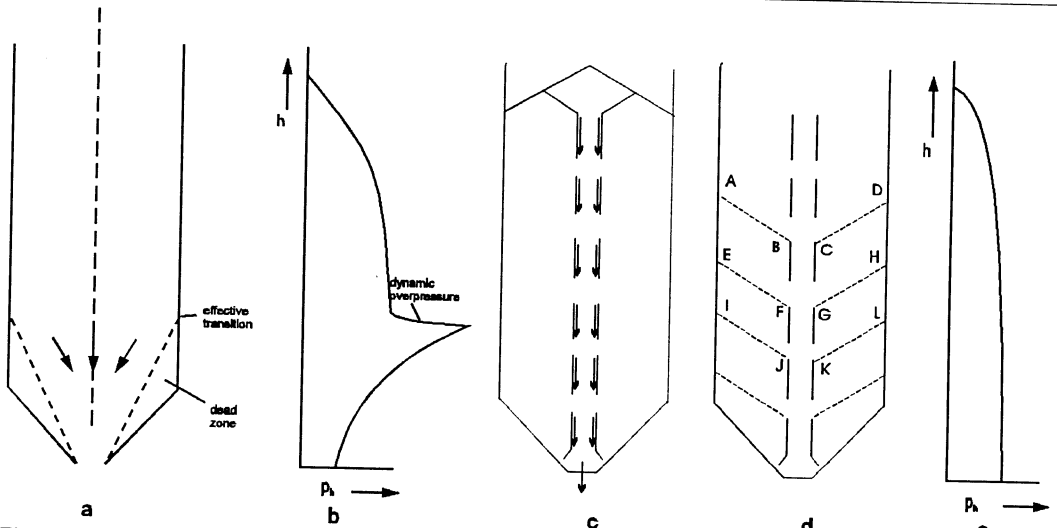


Fig. 1. A Reimbert's discharge tube: a) a funnel flow channel; b) dynamic pressures; c) flow of the materials in the discharge tube; d) flow of the materials in the silo; e) pressures when a discharge tube is used.

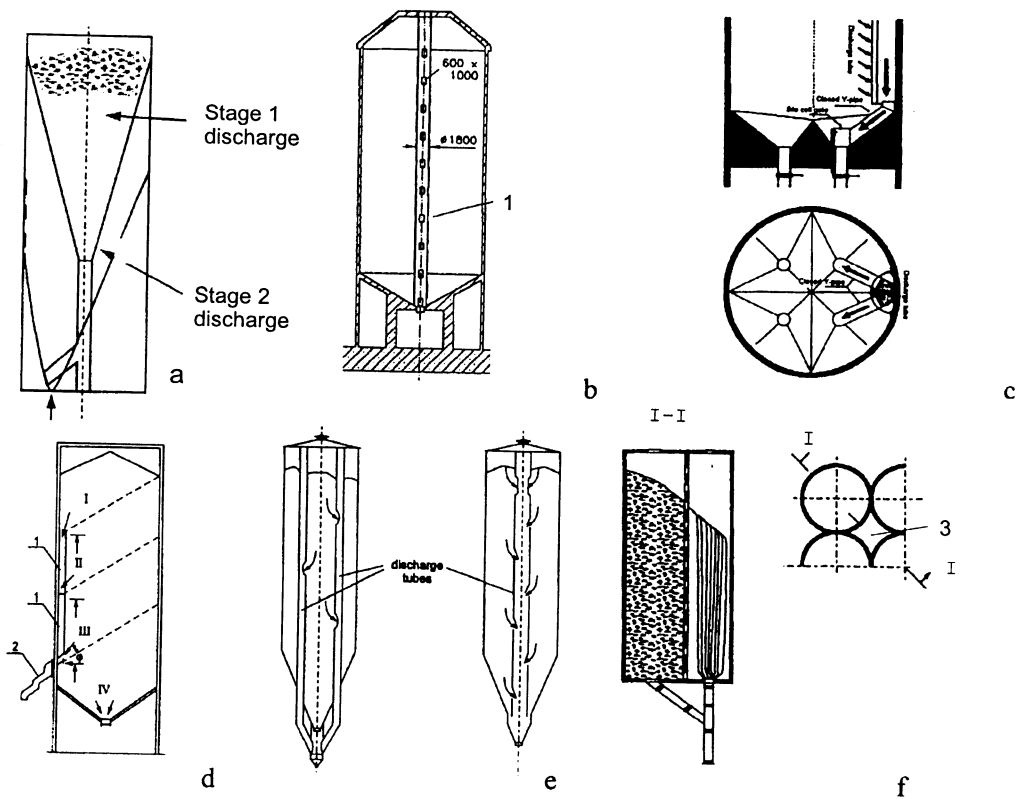


Fig. 2. Examples of silos fitted with discharge tubes for various applications: a) with an eccentric discharge [6]; b) a high-capacity silo with a central discharge tube; c) with a multi-outflow [5]; d) with a side discharge; e) a blending silo [7]; f) grain outflow from the silo through a star-chamber 1 - a discharge tube, 2 - a inclined chute, 3 - a star chamber; I, II, III and IV - the numbers of discharge layers.

- the engineering process by decreasing internal stresses to minimize grain damage or blending (mixing) of the products [1,2, 10,11].

TYPE OF DISCHARGE TUBES AND ITS APPLICATION

Discharge tubes have been used for the following purposes:

- to reduce the horizontal pressure acting on the silo wall and prevent vibration that might occur while discharging bulk solids from the silos: correct placement of the opening and the conveyor belt is advisable to prevent vibration;
- to reduce the vertical pressures acting on the feeder, thereby saving the driving power;
- blending and homogenization: a desirable blender homogenizes the product - with a minimum energy input and number of material re-circulation [1];
- to prevent the damage (mostly unwanted) to the particles of the material stored in the silo [2];
- to increase the discharge mass flow rate by decreasing the probability of arching and piping;
- to reduce segregation in the funnel silo flow.

Figure 2 presents some examples of the silos fitted with discharge tubes for various applications.

CONCLUSIONS

The following main conclusions can be drawn from the authors experiences:

1. The use of discharge tubes is an advisable and cheap method to reduce horizontal pressures acting on the walls. This can also

prevent grain breakage, reduce vibrations and eliminate segregation of material.

2. A discharge tube must be fixed vertically in the silo and it must be designed to carry the tube load.

3. The flow of materials is uniform.

4. Hungarian, Australian and American experience [5,7,9] showed that the tubes were deteriorating after some time of operation, causing discharging without any benefits. The best height of the discharge tube is the maximum height.

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