



ECOLOGICAL HOPPERS
DUST SUPPRESSION SYSTEM

**How does the dust
suppression system work**

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INDEX

1	Background 03
2	How does the dust suppression system work	
	2.1 THE STANDARD ECO HOPPER MODEL (PATENT N° ES200201152) 03
	2.2 THE ADVANCED ECO HOPPER MODEL (PATENT N° GB1119753.0) 05
3	Description of the “Air Blade” anti-dust system	
	(Patent N° GB1119753.0) 06

1 Background

The dust suppression systems for Hoppers, were first applied in the market by SILVA firm, in 1997. Since then, the system has improved and nowadays is considered, by the industry, the reference or benchmark in the bulk unloading market, for top quality hoppers. Since 1997, continuous technical evolution and progress, has positioned the dust suppression system Hoppers (also called in the market, eco Hoppers), as the best in the industry.

The system represents a feature that is one of the main competitive advantages of SILVA portfolio equipment.

2 How does the dust suppression system work

2.1 THE STANDARD ECO HOPPER MODEL (PATENT N° ES200201152)

- a. Some “wind walls” above the closing system between which the grab is introduced for unloading the bulk, preventing the dust caused by opening the grab, bucket and by the bulk falling on the grating and the upper closing system from coming out of the hopper (Fig. A),

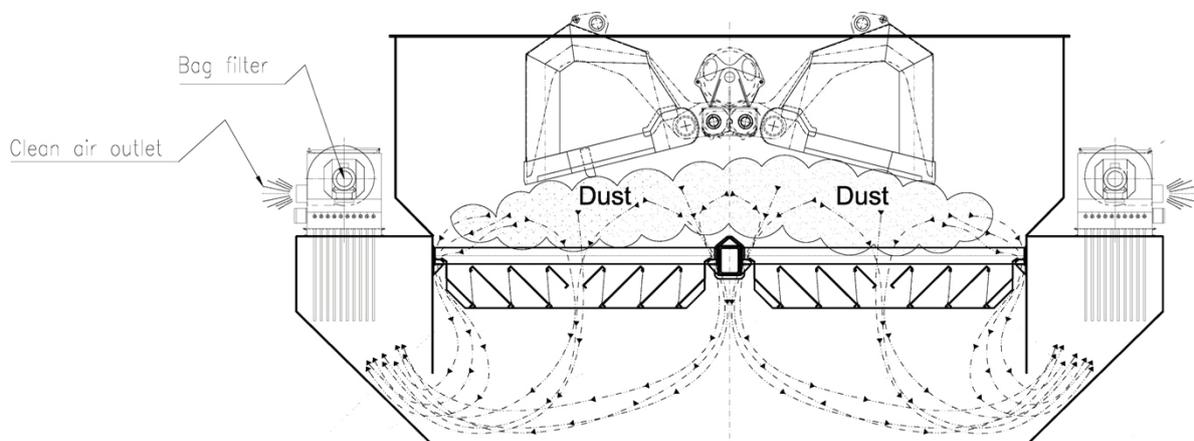


Fig. A

- b.** A flange-mediated closing system (Flex-Flap), which prevents the exit of dust produced by the bulk fallen into the hopper. A feature that is present in this version of the eco Hopper are the devices named “flex-flap”: These consists of flange-mediated closing systems that open due to the weight of the unloaded material

Once opened, thanks to the opening in the middle of the valve, they avoid the “mushroom effect”, with the consequent benefit for the unloading operation. These flex-flaps also avoid the return of the dust as they provoke an air stream (thanks to central opening) from the outside to the inside of the Hopper. (Fig. B)

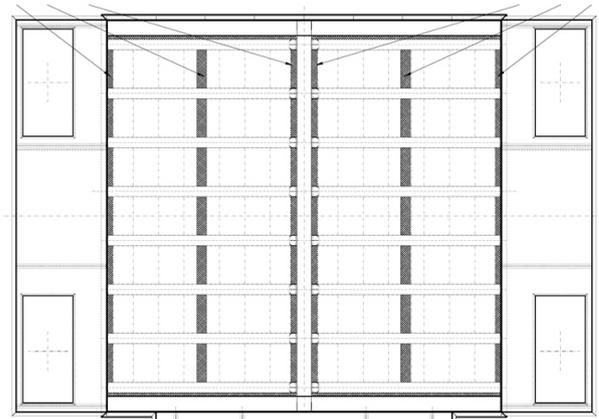


Fig. B

- c.** An air suction system for sucking air from the inside of the hopper, which gathers the air volume displaced by the bulk when it falls into the hopper, redirecting it through a series of bag filters to the outside of the hopper, the air is now clean (Fig. C),

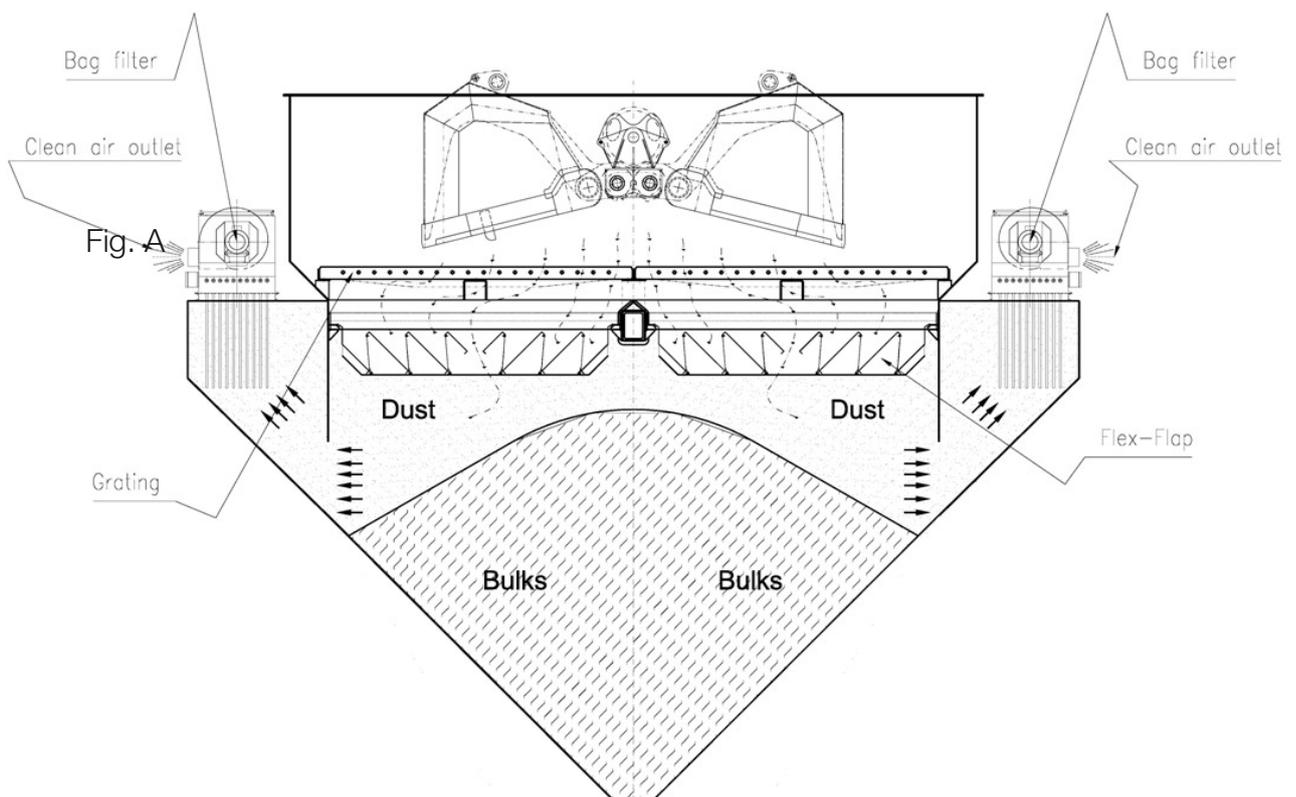
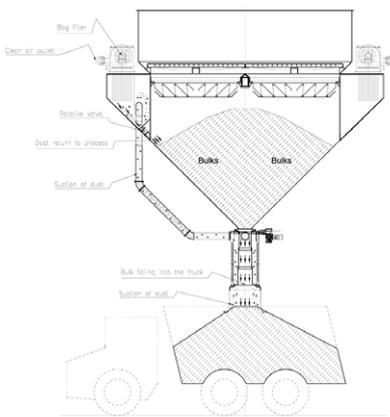


Fig. C

d. Telescopic chutes with air suction system (Fig. D).

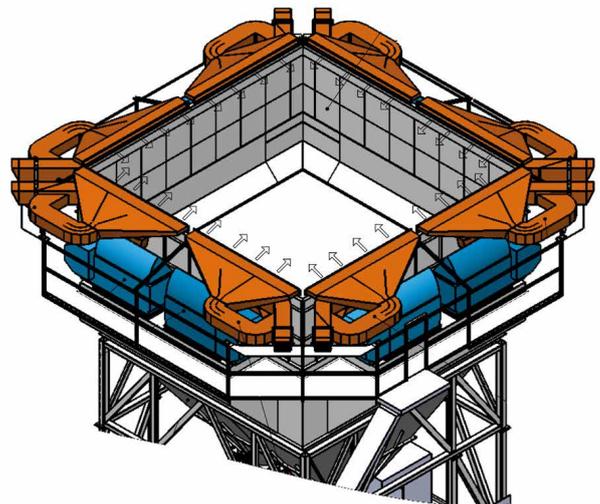
A new improvement consists of the unloading through one or more independent telescopic chutes, close to the cone that receives the material. These chutes capture dust and conduct it to a box where, the big capacity filters, separates this dust from clean air and captures again the dust to return it back to the process.



The systems having upper closing under the grab and bag filter-mediated suction system installed in the hoppers prevent the spread of the dust of the order between 85 and 90% in a conventional hopper, nevertheless, the speed of cross-wind greatly influences the operation of the hopper, especially at ports, this means that the remaining 10-15% is greatly influenced by the height of the wall faces and the speed and direction of the prevailing winds at the time of unloading.

2.2 THE ADVANCED ECO HOPPER MODEL (PATENT N° GB1119753.0)

As explained in the previous paragraph, the standard model performed really fine for heavy dust materials. But when used for high volatility materials (fe. Biomass), the remaining 10-15% of the dust was lost. For that reason the company, as a result of fruitful innovation and creativity, incorporated the “Air curtain system”, which performed optimally (almost 100% of the dust).



Solving the 10-15% of remaining dust.

Due to the absorbing force caused by the fans of the bag filters of the inside of the hopper, as the layers of the lower part of the curtain air flow are downwardly curved (towards the inside of the hopper), the provoked dust particles are pushed towards the inside of the hopper at the time of opening the grab. Therefore, the "Venturi Effect"[1] causing the prevailing winds on the wall face, absorbs the upper layers of the air curtain itself, which do not contain dust, completing therefore the operation efficiency of the hopper up to 100%.

3 Description of the "Air Blade" anti-dust system

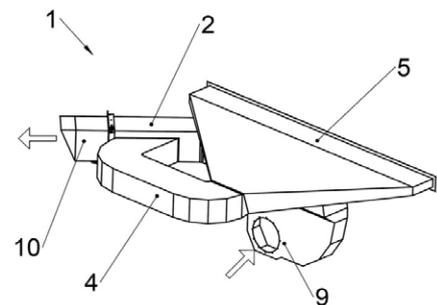
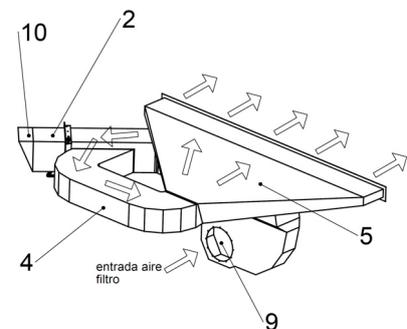
(Patent N° GB119753.0)

The "Air Blade" antidust system relates to hoppers with an upper closing system comprising an air injection system along the perimeter of the upper mouth of the hopper which produces the horizontal "air curtain" effect, preventing the dust particles produced at the time of unloading the scoop on the upper grating, which are not absorbed by the bag filter suction system from exiting to the outside.

The curtain is formed by constructing chutes with an intermediate valve (flap valve) at the upper mouth of the hopper which communicate the outlet of the fans of the bag filters sucking from inside the hopper and redirecting the now clean aspired air flow thereof through the bags, through a conduit system located along the upper perimeter of the mouth of the hopper, to the height of its closing wallfaces.

At the end of this air conduit circuit there is located a series of panoramic diffusers causing an airblast surface, calculated by their number and position, so that the entire surface of the mouth of the hopper above the unloading point of the scoop is covered. Thus the possible dust particles not absorbed by the bag filter suction means meets said curtain and are again pushed into to the suction flow of the hopper.

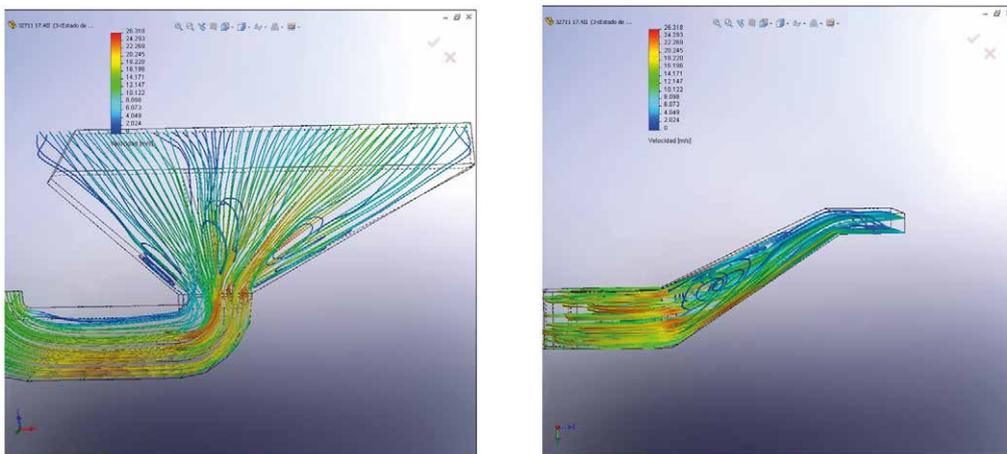
In the tests performed, the direction and speed of the prevailing winds during the unloading operation with the ecological hopper significantly influence the behavior of the "air curtain", therefore the air coming out through the panoramic diffusers must maintain a constant flow rate between 4 and 6 m³/sec., with an exit speed between 5 and 6 m/sec.



[1] The wind, in addition to a certain speed (the lower the speed the lower the side wall face), causes on the container formed by the side wall faces, a vacuum effect which absorbs the air (and therefore the dust contained therein) existing inside the wall face when the scoop is opened over the upper grating and closing system of the hopper. This vacuum effect pulls the dust generated at the time of opening the scoop to the outside of the wall face, and the wind spreads this dust all around the hopper itself, reducing the efficiency thereof.

Due to that, and taking into account that the bag filters of one and the same hopper can be of different flow rates, as well as the efficiency loss thereof as the bags being filled up, diverting means which can be a flap valve or a plurality of valves regulating and directing the air flow coming out from each of the bag filters, either towards the diffuser forming the air curtain or to the outside of the hopper are incorporated. These diverting means can be manually, hydraulically or pneumatically controlled, and they regulate the part of air coming out from the bag filters, sending the air making up the air curtain which causes the closing of the upper part of the hopper towards the diffuser, adapting the air curtain exit speed and the flow rate to the speed and direction of the prevailing winds around the hopper being achieved.

Through the mathematical models studied, the layers of the lower part of the curtain air flow are downwardly curved (towards the inside of the hopper), due to the absorbing force caused by the fans of the bag filters of the inside of the hopper, pushing the provoked dust particles towards the inside of the hopper at the time of opening the scoop. Therefore the "Venturi Effect" causing the prevailing winds on the wallface absorbs the upper layers of the air curtain itself, which do not contain dust. Completing therefore the operation efficiency of the hopper up to 100%.



The hopper described does not introduce new fans to the known hopper, but the fans of the bag filters themselves which extract the air with dust from the inside of the hopper, for redirecting it towards the upper diffusers forming the air curtain are used. In the present, future developments of the eco hoppers are in research and development process, in order to improve design and performance of the machinery.

SILVA technical department is always improving the dust suppression system to make this unique feature a sustainable competitive advantage of the firm. SILVA considers that every single client has its needs and particularities. For that reason, each Hopper is custom made, to adapt it to the characteristics of the bulk or material handled, to the facilities of the terminal, and to the operational profile of the end user.



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