



PNEUMATIC DISCHARGE OF DELICATE CARGOES

VIGAN has developed its pneumatic shipunloader type NIV to discharge any kind of granular products with the lowest electrical power consumption and also to discharge very delicate cargoes without damaging them.

VIGAN Patented Suction Piping System

The system is composed of one vertical conical pipe, one elbow and one horizontal conical pipe. The diameter from the suction nozzle placed at the basis of the vertical pipe increases continuously up to the horizontal telescopic pipe outlet.

The ratio between the inlet and outlet diameters $\phi I/\phi 0$ is between 0.4 and 0.5.

Considering the ratio between the inlet and the outlet sections and also the pressure variation in the suction pipe, the ratio between the inlet and the outlet air speed $V I/V 0$ is between 2.4 and 4.

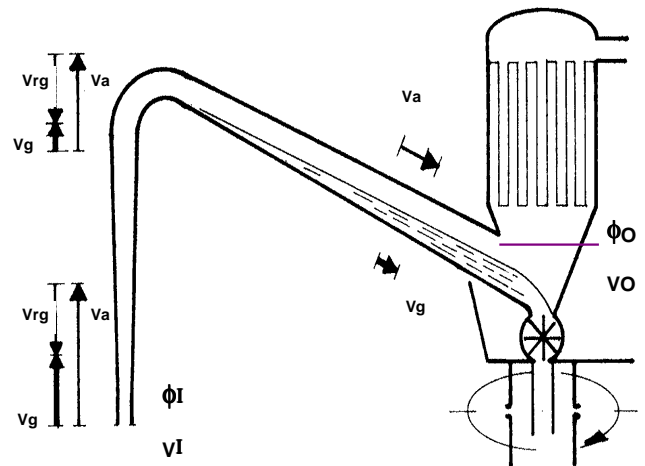
Impact of the Air Speed on the Handled Granulates

At the suction nozzle placed at the basis of the vertical line, the air speed and the vacuum effect accelerate and transmit motion to the bulk product and permit its lifting in the pipe. Therefore an important air speed is required. This important air speed is easily obtained with the reduced pipe diameter.

At the end of the vertical suction line, the bulk flow has to change of direction. Before the elbow modifying the conveying direction, the bulk materials velocity is

reduced in order to avoid the grain breakage.

An increasing of the pipe diameter permits to reduce the air speed and the materials velocity.



VIGAN horizontal line as always inclined with a minimal angle of approximately 20°. The separation air/product occurs progressively in this horizontal line which conveys the bulk materials to the receiving hopper. This progressive separation air/products is obtained by reducing the air velocity in this horizontal pipe.

Due to the pipe inclination, the bulk material flows to the receiving hopper, without laying on the bottom of the pipe.

When reaching the outlet of the horizontal line, the air is completely separated from the materials. Therefore, no cyclonic effect is requested : the bulk material flows gently into the airlock, while the air pass through the filter mounted just above the filter hopper.

Influence of the Above Piping Design on the Power Consumption

The reductions of the power consumption of the VIGAN shipunloaders type NIV compared to other classic pneumatic unloading systems are the following :

- Reduction of the air speed at the end of the vertical line permitting:

- * to reduce the kinetic power loss in the elbow, due to the direction change of the bulk flow. The kinetic power is proportional to the square of the bulk cargo's velocity;
 - * to recuperate the kinetic power of the cargo during the last metres of its lifting in the pipe and to transform this kinetic power in potential energy (mass x gravity x Δh lifting distance);
- Reduction of the air speed in the horizontal line permitting :
- * to recuperate the kinetic energy of the air flow which is proportional to the square of the velocity;
 - * to separate very slowly the bulk material and the air without energy consumption. In classic pneumatic systems, this separation is obtained with cyclonic systems absorbing a lot of power.



1996 : Holland - Gerkens Cacao (Gargill Group) - 1 NIV 160 tower for unloading of bulk cocoa beans with minimal breakage capacity : 150 MT/Hour

In practice, the VIGAN patented design of piping system permits to VIGAN in some cases to reduce the energy consumption per ton unloaded at the value of 0.65 kW/t hour.

For example : a capacity of 250 t/h is obtained with an installation having a power consumption of 160 kW.

This power is comparable to the power requested by mechanical systems and is 2 to 5 times lower than the power requested by some other classic pneumatic systems.

Influence of the Above Described Piping Design During the Handling of Delicate Bulk Cargoes

Very severe norms are existing regarding the quality of bulk products like wheat, maize, barley, rice, and more particularly of delicate cargoes such as long rice, malt, granulated sugar, cocoa beans, etc.

The value of such products is indeed directly influenced by their quality. Therefore, handling equipment manufacturers have to cope with these very severe quality norms and no breakage may occur during the handling (unloading, loading,...) of those products.

In classic pneumatic shipunloading systems, the breakage of delicate cargoes occurs at the two following sensitive points:

- * In the elbow between the vertical and the horizontal lines;
- * At the end of the horizontal line in the cyclonic separation device.

This last point is the most sensitive as the cargo speed is higher at this point.

In the vertical line, the grain speed (V_g) is indeed the difference between the air speed (V_a) and the relative speed of grain in the air (V_{rg}) due to the gravity effect. In the horizontal line of classic pneumatic installations, the horizontal pipe diameter is equal to the vertical pipe diameter. Furthermore, because of the pressure decrease in the suction line, the air speed in the horizontal line is higher than in the vertical line.

Moreover, the grain speed at the end of the horizontal line is approximately equal to the air speed, because the gravity effect is no more acting against the grain speed, as it is the case in the vertical line. High air speed is requested in the horizontal line of classic pneumatic system, in order to avoid any grain deposit and pipe obstruction in the suction line.

In conclusion, in classic pneumatic unloaders, the grain speed at the end of the vertical line is approximately 50% of the grain speed in the horizontal line.

As the breakage is approximately proportional to the grain impact energy or to the square of the grain speed, we may consider that the grain breakage is approximately 4 times higher at the end of the horizontal line than at the elbow placed between the vertical and the horizontal lines.

In the VIGAN Patented Piping System, the most sensitive breakage point at the end of the horizontal line does not exist, as the grain is progressively separated from the air in the horizontal pipe and as no cyclonic device is required.

What concerns the other sensitive point placed at the end of the vertical line, the breakage is highly reduced as in VIGAN system, the grain velocity is reduced before the elbow thanks to the conical form of the vertical pipe.



1990 : Colombia - Cartagena - 1 NIV 300 shipunloader on rails for unloading of bulk barley and malt with minimal breakage capacity : 300 MT/Hour

Tests realized with VIGAN shipunloaders type NIV including this patented piping system have proven the ability of VIGAN shipunloaders to discharge very delicate cargoes safely. VIGAN customers and quality control services reported breakage figures lower than 1% during malt unloading operations and lower than 0,3% during long rice handling : those values are within the variation limits due to sampling and analytical methods. The handling of granulated sugar and cocoa beans with the VIGAN shipunloaders occurs also without damaging those delicate products.

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Vigan Engineering s.a.
rue de l'Industrie 16 - 1400 Nivelles
(Belgium)

Phone : + 32 67 89 50 41
Fax : + 32 67 89 50 60

e-mail : info@vigan.com
WEB site : www.vigan.com