PROPPANT SPILLAGE FROM MOBILE FRACTURE PROPPANT CONVEYING EQUIPMENT ELMINATION

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Introduction

Proppant spill from mobile fracture-proppant conveying units used on fracture sites is an ongoing problem industry wide. With proppant spill, comes the inability to control the flow and the levels in the blending equipment, and the creation of dust.

A solution now exists that solves the problem of spilling proppant from a mobile fracture-proppant conveying unit. It also reduces dust from the conveying unit, and creates a better job-operation environment for the equipment operator. Here we discuss a new method of operation for the standard mobile fracture-proppant conveying unit along with the benefits to the operator and the end customer. These methods, employed in over a 100 different fracture jobs, display the same results in reducing the proppant spill, equipment operation improvement, and dust reduction.

Background

Every fracture pressure pumping site uses systems for dispensing proppant onto conveying devices. Many well-stimulation fracture job sites use a proppant storage unit, such as the Sand Delivery Unit by Dragon, Inc., (Figure 1) to dispense the sand or proppant onto a conveyor for delivery to another component, such as a blender. Typically, the mobile fracture-proppant conveying unit dispenses the proppant onto a moving conveyor belt for delivery to another piece of equipment on site, such as a blender. A typical proppant conveying unit includes one or more hoppers having multiple proppant storage compartments and multiple dispenser openings. A hydraulically-driven steel plate, or slide gate, moves laterally below each dispenser opening to allow the discharge of proppant.

Issue

Presently known systems and techniques for delivering proppants by a mobile fracture-proppant conveying units have some drawbacks. For example, as illustrated in (Figure 2), the proppant often overflows off the sides of the conveyor when discharged from the slide gates of the storage compartments.

Currently, mobile fracture-proppant conveying units are being operated by turning the conveyor belt to its maximum speed and opening the proppant discharge slide gates at various intervals to control the amount of proppant placed on the conveyor and discharged by the unit. When the operator wants to stop the flow of proppant, he closes the slide gate, but still has a large residual flow of proppant left on the conveyor belt that he must account for when controlling levels in the blender. This method of operation for delivering proppants by a mobile fracture-proppant conveying units has its drawbacks. The proppant often overflows off the sides of the conveyor when discharged from the dispensing unit. This happens when the slide gate is open and the conveyor belt stops or is not moving fast enough to keep the sand flowing away from the discharge slide gate. Depending on the particular application, proppant overflow can freeze the conveyor belt, commonly called sanding-the-belt-off. This makes it difficult or impossible to control the rate of discharge of proppant from the conveyor to the desired destination or the fracture job stops.

Solution

With the sanding-the-belt-off problem in mind, a bracket or discharge-control device was created to add to the slide gate at the bottom of each proppant storage compartment located on proppant conveying units. Figure 3 shows the discharge-control device. In (Figure 3), the illustrated side restrictors extend down from the mounting brackets and run the length of the entire assembly. The restrictors keep the proppant from spilling over the sides of the conveyor belt and leaving the defined area created by the discharge-control device on the conveyor belt. The wiper and profile-adjustment slide are located on the front and travel the width of the discharge-control device. The profile-adjustment slide determines the height of the volume of proppant on the conveyor belt. With the adjustable volume height, we achieve the optimal proppant volume.

RESULTS

Figure 4 depicts how the proppant forms with the discharge-control device in place. As shown in (Figure 4), proppant is discharged from the proppant dispenser through the slide gate opening and through the discharge-control device opening. As the proppant passes through the discharge-control device opening and onto the conveyor belt, the side restrictors prevent the overflow of proppant off the sides of the conveyor. Concurrently with the movement of the conveyor belt, the wiper and profile-adjustment slide level off the top of the proppant on the conveying surface at the height H. Since the proppant on the conveyor stays on the conveyor belt with the discharge-control device, we can determine the amount of proppant retained on the conveyor.

With the discharge-control device in place, the operator can move the slide gate of the mobile proppant dispenser to a fully open position and leave it fully open for the entire time. This allows the operator to control the speed of the discharge of proppant from the perspective of the speed of the conveyor on the mobile fracture-proppant conveying unit.

To control the discharge of proppant from the mobile fracture-proppant conveying unit from a perspective of speed the operator opens all the gates of the discharge compartment that they will start the job with. Next, the operator will prime the conveyor belt by moving the conveyor until sand reaches the end of the stinger. At this time, the unit is ready to dispense. The operator can then control the speed of the belt to control the discharge from the unit. When there is no conveyor belt movement there will be no discharge of proppant and when the conveyor is at full speed the maximum discharge capabilities of proppant will be seen.

This new method of operation has the advantage of stopping the proppant flow sooner when needed. By stopping the movement of the conveyor the operator stops the flow of proppant from the unit faster than the previous methods. In the previous method, the operator had to contend with the proppant still present on the conveyor after shutting the slide gate to stop the flow. When starting an operation, the operator will have proppant ready, which shortens the reaction time. With these changes, the operator does not compensate for lags with the mobile proppant-dispensing unit, and gains a better perspective for controlling the level in a blender hopper.

The operation of the mobile fracture-proppant conveying unit does not change with the installation of the discharge-control device. It can be operated in the same way as it always has been with the installation of the discharge-control device.

The discharge-control device allows the discharging proppant from the storage compartment to self-bridge and not overflow from the conveyor belt. You can see the self-bridging effect of proppant when building a sandcastle. The particles of sand support the weight of each other, which allows it to mold into shapes. The slide gate discharge-control device also becomes a barrier for wind and other elements afflicting the fracture-proppant dispensing units.

Before the placement of the discharge-control device, non-uniform placement of proppant on to the conveyor belt caused degradation leading to dust generation and reduction in the quality of the proppant. By placing a uniform amount of proppant on the conveyor, and therefore, reducing the aeration from movement through the discharge-slide gate, the proppants ability to aerate decreases along with degradation and dust generation.

With a fixed amount of proppant placed on the conveying unit, we can calculate the amount of the proppant discharged by the mobile fracture-proppant conveying unit looking at the following equations:

VPR = volume per revolution = (C x A)

C = circumference of drive pulley 110 = $2\Pi r$

A = planar area between conveyor belt and wiper

D = bulk density of proppant

LPR = pounds per revolution = (VPR x D)

For example, if the diameter of the drive pulley in (Figure 5) is 18 inches, its circumference C is 56.54 inches, or 4.71 Ft. We can find the planar area A (Figure 4) between the conveyor belt and wiper, using computer modeling, as is and it becomes known.

If A = $.6Ft^2$, then VPR is $(4.71Ft)\,(.6Ft^2) = (2.827\ \frac{Ft^3}{REV})$

If D = $(100\ \frac{LBS}{Ft^3})$, then LPR is $(2.827\ \frac{Ft^3}{REV})\ (100\ \frac{LBS}{Ft^3}) = 282.70\ \frac{LBS}{REV}$

CONCLUSION

The mobile fracture-proppant conveying units and the bracket or discharge-control device for fracture stimulation of oil and gas wells, have increased job quality and reliability. The discharge-control device allows the sand from the storage compartment to self-bridge and not overflow from the conveyor belt. The slide gate discharge control-device also becomes a barrier for wind and other elements afflicting the mobile fracture-proppant conveying unit.

The operation of the mobile fracture-proppant conveying unit will not change with the installation of the discharge-control device. It operates in the same way as before installing the discharge-control device with the added benefit of spilling less proppant.

With the discharge-control device in place, the slide gate opens fully and places a fixed amount of sand on the belt every time. With this advantage the Sand King runs from the perspective of varying the speed to control the volume of sand discharged to the blender.

The addition of the discharge-control device adds value to a fracture-stimulation job with its simplicity and the results show that it is a needed and welcome addition to the Well Stimulation industry.

FIGURE 1

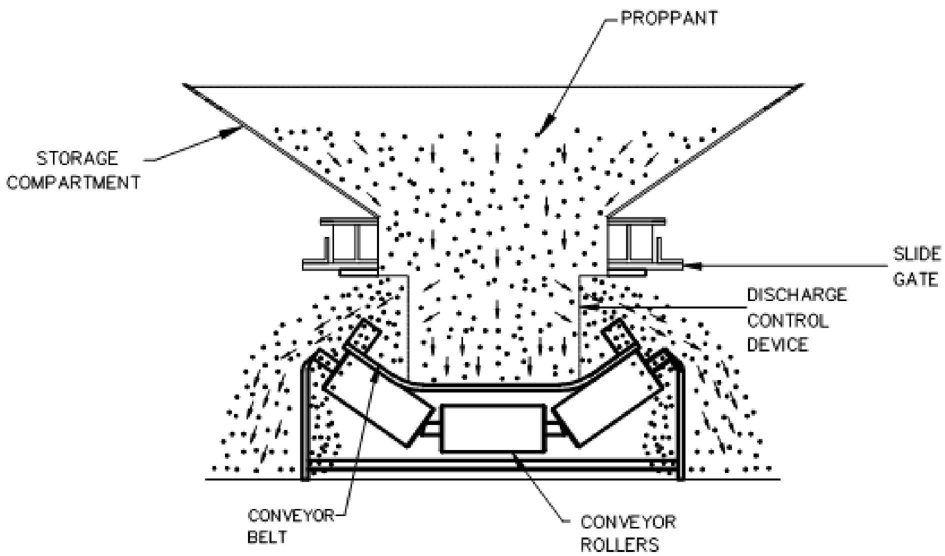

FIGURE 2

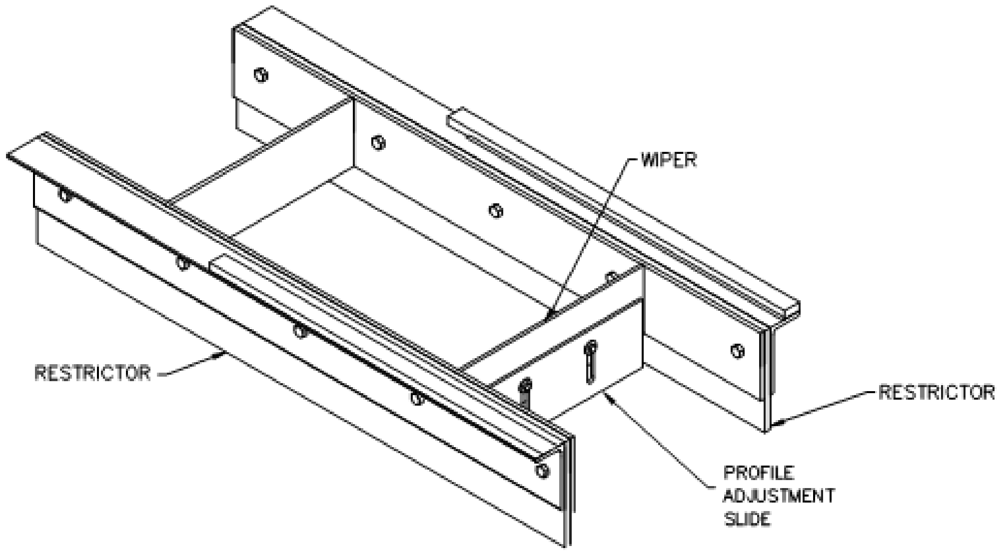

FIGURE 3

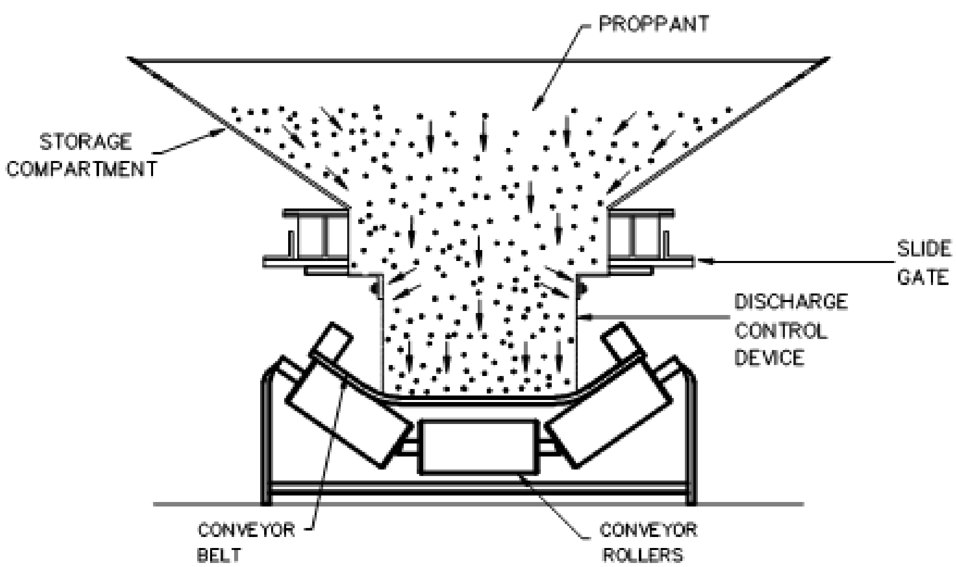

FIGURE 4

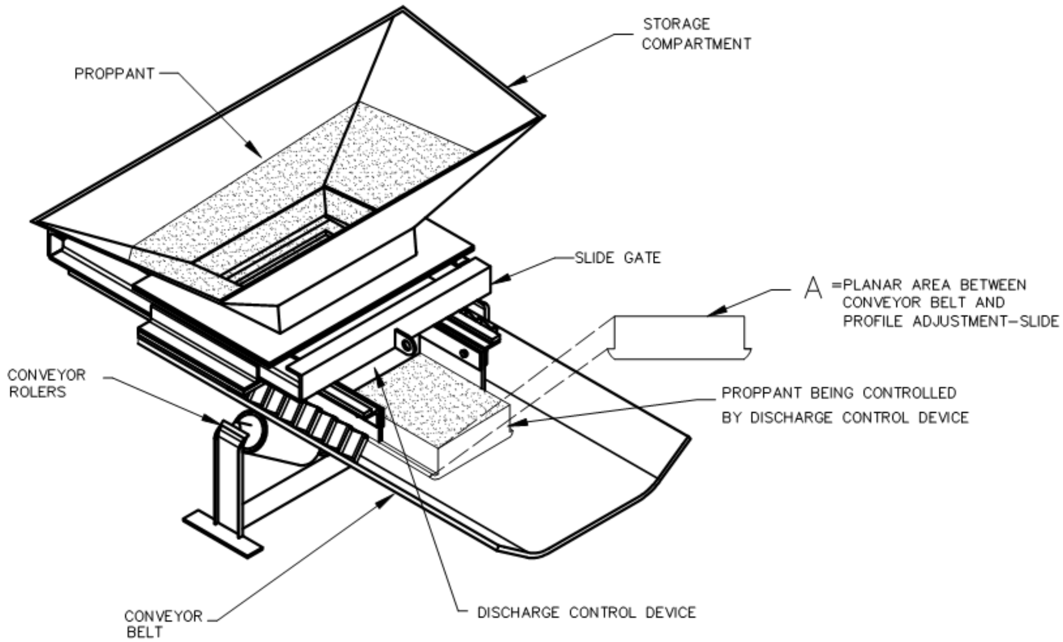

FIGURE 5

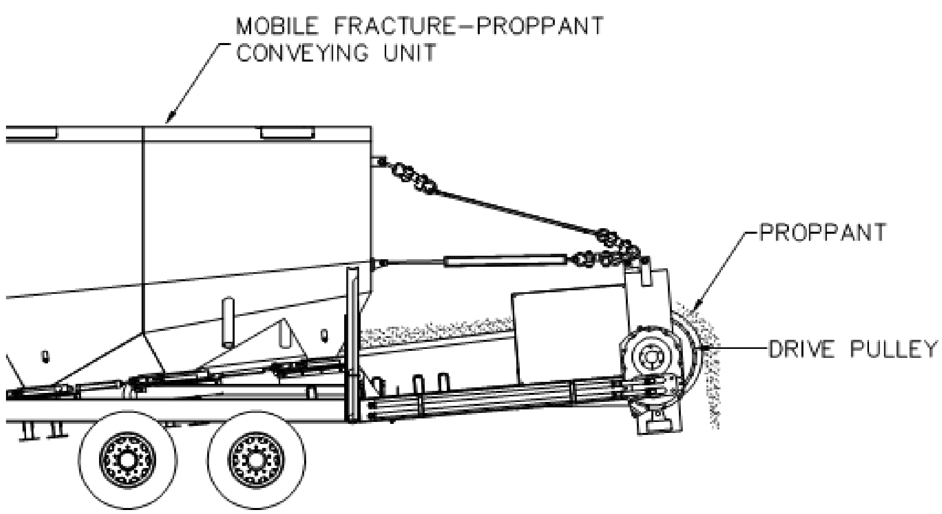

FIGURE 6