

# TAKE A LOAD OFF

Have you ever returned from a flight, maybe overseas, and gotten stuck on the tarmac at your destination? It happened to me on a return trip from a Bahamas vacation, and the airport I'll throw under the bus was Philadelphia. I was there for 3 hours, and while the pilot did his best imitation of Rodney Dangerfield over the PA system, you can only play charades for so long with the flight attendants before you need real food and a restroom you can walk around in. I looked out the window and could see the terminal—salvation was 75 feet away! So close but yet so far.

If you are the guy or gal responsible for running an extrusion or molding plant that requires a large volume of bulk raw materials, either mixed compound, resins or organics, you know the headaches associated with getting this stuff into your storage system. That means dealing with 3<sup>rd</sup> party suppliers and that means either trucks or railcars are bringing the goods to your back door, and you need to find the best way to receive it. Sounds simple enough, but if you've ever paid demurrage fees to suppliers for not getting their vehicles unloaded and gone, you know that there is quicksand on the path through the meadow, and you can drown in it if you don't know what you're doing. Don't be the guy waiting on the tarmac, looking at railcars full of silo salvation while the plant has just run dry, or you'll be running spell check on your resume by the end of shift. Let's focus on railcar unloading problems.

## The Challenges

So what are the pains associated with transferring supplied material into your plant? Here are a few nerves that occasionally get struck:

- The railcar sits at your facility longer than you agreed upon with the supplier, so he back charges you demurrage. If this happens on every delivery, multiple times per week, that adds up to a boatload of money burned without even the courtesy of heat.
- The rate on the nearest railcar is fine, but those cars that are farther from your manifold, well, there's the problem. This ends up starving the machine and shutting down production.
- Material plugs in convey lines causing untold maintenance headaches and costs of diverted labor from the plant. If not addressed quickly, your line-down situations can result again.
- A bank of railcars takes too long to unload due to time lost in switching your feed line from compartment to compartment. You can't afford to pay a full-time babysitter for a process that can take hours to complete, so what do you do?

There aren't many more issues than that. Your goal is to get the material out of the cars and send the conductor on his merry way.

## Typical Railcar Unload System

First let's describe what we have here (see Fig. 1) There are usually a series of pick-up points along a manifold to hook flex hose to that connect on the opposite end to the bottom of the railcar compartments. Unless you have multiple unloaders or something more elaborate, you're evacuating one compartment at a time. Manifold ports that are not in use are capped or closed via valving. A vacuum pump pulls the material into a vacuum receiver. A level indicator signals demand for material in the receiver, and that material subsequently drops through an airlock into a pressure convey line and is blown into a silo. For lower rates like 8,000 lbs/hr this can be plumbed such that one pump is used and it does double duty in sequence, pulling material into the receiver, then emptying it into the silo. The speed drawback is that the receiver necessarily oscillates between empty and full, so you are never continuously conveying.

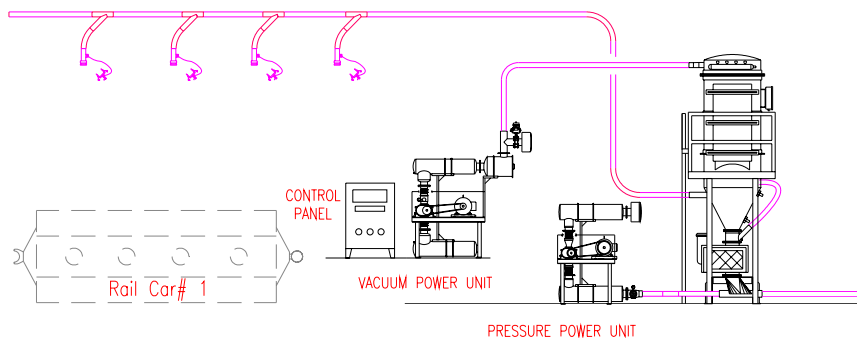


Figure 1 - Classic Railcar Unload System

## Design for Speed

In order to reliably solve the speed issue care needs to be taken in how a railcar unload system is designed. The most obvious thing to do to eliminate those demurrage fees and get the car out faster is to use a larger blower. No replacement for displacement a wise man once said. What else can you do?

Physical barriers tend to get in the way of smart, trouble-free design forcing compromises that aren't always taken into effect. Shorten the manifold length and minimize or eliminate all sources of head loss in the convey lines. This means watch out for bends, 90° elbows, excessive distance and lots of vertical runs on the way to the receiver. It's a simple calculation to account for any

necessary geometries like this to upsize line diameter and blower horsepower, but more often than not what we see is a system sized on paper, then taken to the field where these barriers cause the installers to add the head loss creators, often without clearing it with the design team. Then everyone sits around a few months later scratching heads and wondering why the mass flow rate into the silos isn't meeting design spec.

Now here's a biggie for powders and dense granulars, so pay attention. When material is dropping out of the vacuum receiver through an airlock to convey it to the silo, it is displacing a small amount of air. That air usually goes back into the receiver through a pellet material and escapes to atmosphere. The smaller granule materials trap that air and won't let it out. *The airlock needs to be properly vented to allow this the air a path out of the system.* Will this blow up your system? Not hardly, but what it will do is displace incoming material and reduce your pocket fill, meaning less material per unit time is dropping into the convey line to the silo. Translation, you killed your rate and start writing a check to the trucking company.

### Design for Consistency

The best way to tackle consistency from car to car is to locate the rail manifold central to the railcars, both north/south and east/west if allowable (see Fig. 2). Many companies have twin tracks for cars to sit on, with short runs to a manifold located on one side of the tracks, and the farthest track requiring an out-up-and-a long over to get to the manifold and convey to the receiver. Where possible, drop the manifold right where a big X would cross from the furthest cars on each track. The two tracks get identical performance, with the cars near the middle emptying the fastest, but there isn't the huge disparity seen when the pickup is off to one side.

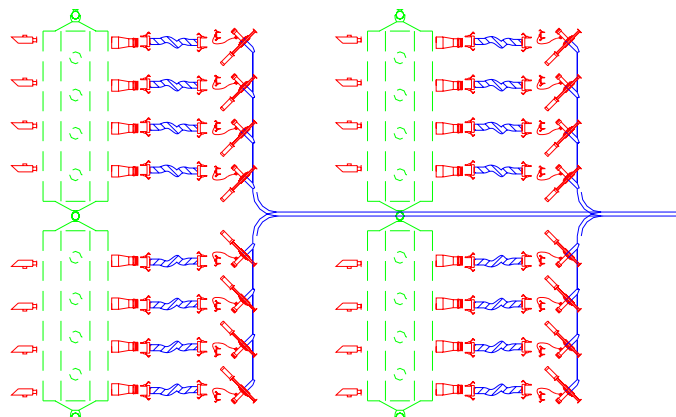


Figure 2 – Example of central manifolds

In any case the system should be sized for minimum rate to be from the farthest car from the manifold. Performance of closer car unload rates will be better.

### **Design for Clear Travel**

A couple of tricks to keep line plugs down. First, see the head loss reduction steps in the Speed section. Line plugs happen from the right conglomeration of pressure drop, material density and friction between the material and pipe walls. On the pressure side to the silo, make sure the airlock speed is matched to the blower speed per system calculations. If your blower is moving air to ideally transfer 20,000 lbs/hr of raw material and the airlock is filling the line at a rate of 25,000 lbs/hr, you're gonna have a problem. When the reverse happens, this generally means you are running inefficiently, using more air than required to move less material.

Another industry-known-but-often-sized-wrong issue is the silo venting. The bin vent filter or cap on the silo must be sized to allow the cfm of the pressure blower to be evacuated easily. For powders and granulars with filtered vents, appropriate blow-down of material, maintenance and periodic cleaning as recommended by the manufacturer are required as well. If venting is insufficient, it will add back pressure to the line and get you closer to the witch's brew of a line plug, as well as create a potentially unsafe pressure situation inside the silo. This may not always cause a line plug, but it will inevitably reduce your speed.

### **Design for Lean Process**

In most companies we have worked with, the railcar unload system is only semi-automatic. Translation: somebody is required to baby-sit it, transfer lines between compartments, help stubborn material out of discharge ports, etc. The problem is when railcars take so long to unload, you need that person doing other things too, like running blending stations or other operations, usually inside the plant. If the operator is inside attending to other things, on a smoke break or otherwise distracted, you can empty a car and the vacuum pump is outside sucking wind on your time, time that is rented from the supplier.

I use the phrase Lean Process, a term that may be familiar, because Lean Manufacturing is at its heart based upon reduction of waste. Besides the distance-reducing considerations mentioned earlier, another Lean tool is making use of signals. If you cannot afford a totally automated unloader where a low-vacuum sensor on one compartment trips a valve to start emptying another, use such a sensor to sound an alarm or flash a light inside the plant telling your guy it's time to change compartments. Yeah, he should know it takes a certain amount of time to empty a compartment and come back when it's ready to switch, but we live in a world of reality, not fantasy. Sound the alarms and dramatically reduce changeover time between cars and total time to empty a car.

## Wrap Up

Look, this topic matter is a bit dry and they're not going to make a movie of the week out of it for CBS (maybe Discovery Channels Dirty Jobs segment). That's one reason why doing it right is often overlooked. If you don't pay attention to how fast you get your raw material into your operation, it's like not putting enough gas into your tank. It's going to cost and jam you up when you least expect it. Why take the chance?

Hey, for those of you in the composites industry, you might receive organics like wood flour, cotton, grains and other fibers via truckload. I didn't get into that here, but email me at [mrbulky@oanewton.com](mailto:mrbulky@oanewton.com) and mention **TRUCK DUMP** in the subject line for some hot tips on the best way to receive this stuff too.

*Karl Walinkas is the Vice President of the Engineered Material Handling Solutions division at OA Newton, a Delaware-based firm that specializes in delivering smarter material handling solutions that increase capacities and reduce operational expense for manufacturers in the plastics, composites, rubber, food and other powder-challenged industries. He can be reached at [karl.walinkas@oanewton.com](mailto:karl.walinkas@oanewton.com) or toll free at (800)726-5745.*