



SAND MATTERS!

MOVE IT & MIX IT EFFICIENTLY

PLUG FLO® PNEUMATIC TRANSPORTERS & STATORMIX® CORE SAND MIXERS



PLUG FLO®

- Improve Sand Casting Quality
- Eliminate Sand Degradation
- Reduce Air Consumption
- Minimal Maintenance
- Efficient Sand Transfer

STATORMIX®

- High Core Strength
- Accurate & Reliable Binder Dosing System
- Reduce Binder Consumption
- Wear Resistant Lining
- Easily Process Partial Batches



Klein Palmer Inc., is a Palmer Manufacturing & Supply, Inc., Company.
We are Palmer's metal casting, rail sanding and industrial processing division,
offering a wide variety of heavy-duty processing equipment and services.

800.457.5456 • palmermfg.com

BETTER SAND MAKES BETTER CASTINGS



JIM GAULDIN
President
Klein Palmer Division



ARTICLE TAKEAWAYS:

- The difference between dilute and dense phase in conveying and sand impact
- Where sand degradation occurs prior to production

WHY SAND MATTERS

Producing defect-free castings requires more than just meeting quality control standards—it demands well-established procedures that are consistently followed. What does Defects Prevention really mean? According to renowned quality expert Dr. W. Edwards Deming, it involves improving the process by reducing variation, changing the process level, or both. He emphasized that studying the sources of defects—especially upstream—offers powerful opportunities for improvement.

Defects in castings can stem from a wide variety of sources, but for simplicity, this article will focus on just one critical factor: sand. Why?

Because sand matters.

Of course, finding a defect is just the beginning. The next step is deciding how to respond. The ideal approach is to investigate the root cause and work toward eliminating it. This may require a thorough review of your entire process, including materials, methods, and production equipment.

A while back, a foundry experienced a major incident: the roof over the pouring area collapsed after approximately 15 tons of sand fell through from above. The source? A leak in the overhead sand-conveying pipeline had gone undetected—until the collected sand broke through the roof.

When maintenance investigated, they discovered that operators in the core room had occasionally experienced sand shortages. However, they hadn't reported or investigated these shortages further.

Recognizing that something was unusual—that operations were deviating from normal—should have been the first step toward preventing a defect. But just as important is what happens next: deciding whether to fix the symptom or eliminate the root cause.

In this case, the “fix” was to weld a patch plate over the leak. No further analysis was performed. A more effective, long-term approach would have asked deeper questions:

- Why did the pipeline develop a leak?
- Was the pipeline layout poorly designed or stressed over time?
- Were the air pressure and volume settings in the pneumatic system incorrect?
- Had the sand delivery requirements increased beyond the original design capacity?

Only by asking these questions can a foundry move from reactive maintenance to proactive defect prevention—and avoid far costlier failures down the line. Every foundry moves tremendous amounts of sand as part of daily operations—and managing that volume efficiently can become a constant material handling challenge.

Traditionally, belt conveyors and elevators have been used to transfer sand, but today, pneumatic conveying systems are widely regarded as a more practical and flexible solution for distributing sand throughout the foundry.

SAND QUALITY IMPACT FROM CONVEYING SYSTEMS

However, the type of pneumatic conveying system used can significantly impact the quality of sand delivered to the production line. Factors such as sand grain degradation, dust generation, and the life expectancy of piping all vary depending on the system design and operating conditions.

In general, conventional pneumatic conveying systems fall into two broad categories: **dilute phase** and **dense phase** conveying.

Continued on next page

Dilute phase systems typically operate using vacuum or low-pressure air—up to 20 psig—with pipeline velocities of 4,000 FPM or higher. In contrast, **dense phase** systems use medium-pressure air, ranging from 10 to 60 psig, with lower velocities between 2,800 and 5,000 FPM.

Excessive conveying velocities can lead to sand grain degradation inside the piping. This breakdown increases dust levels and raises the AFS grain fineness number of the sand. If this finer, dust-laden sand is not separated before binder coating, it will require higher resin levels in chemically bonded sand systems—resulting in poorer mold and core performance during casting.

High velocities also accelerate wear on the piping and bends, leading to more frequent downtime and increased maintenance costs.

One common example is the filling of sand silos from bulk delivery trucks. Many foundries are familiar with the problems these systems cause, largely because the sand is delivered using dilute phase conveying—low pressure but very high velocity—which is not recommended for handling sand.

In another pneumatic sand conveying project, trouble began almost immediately after the new installation was completed. Just days into production, the customer made urgent calls reporting multiple pipeline leaks—sand was spraying across the foundry and onto production equipment. Naturally, the first question was:

“How could this happen?”

As it turned out, while the customer had installed all the sand piping, they hadn’t yet installed or connected the transporter pressure vessel required to push sand through the system. Due to pressing production deadlines, they bypassed this step and instead connected the sand delivery truck directly to the piping—blowing sand straight from the truck into the plant’s receiving hoppers.

The problem? Sand trucks deliver in dilute phase—using low pressure but extremely high velocities. These velocities far exceeded the design limits of the piping system. As a result, the pipeline began leaking after only a short time in operation.

Due to sand’s highly abrasive nature, it is typically transported using pressure vessels that are properly sized to match the required conveying capacity. The common approach is to use larger pressure vessels for higher conveying rates. This reduces the frequency of system component actuation, helping to extend the service life of valves, seals, and other critical parts.

In these systems, sand is pushed through the conveying pipeline in slugs. These slugs form based on the frictional relationship between the sand and the pipe wall, as well as the sand’s permeability—without any mechanical assistance inside the pressure vessel itself.

These conveyors are costly to manufacture and incorporate a relatively high number of components. The electrical controls also add to the overall expense. Additionally, the commonly used level probes—typically capacitive switches—can malfunction when sand moisture content or temperature fluctuates.

What would it mean for foundries if casting defects caused by poor sand quality could be reduced—or even eliminated? What impact would a reliable sand transfer system and lower maintenance costs have on overall productivity and profitability?

True to the various definitions of defect prevention mentioned earlier, it soon became clear that a completely different approach was needed to eliminate the problems of existing sand transfer systems—rather than simply building on outdated technology. The driving goal behind developing a better, more efficient sand transfer system was to eliminate the inherent flaws of the “old systems” and deliver a solution that could truly be “install and forget.”

To begin, an investigation into different sizes of pressure vessels (or blow tanks) was conducted. It revealed that small units with fast operating sequences and short cycle times offered advantages not only in size and cost but also in energy efficiency.

Building on these findings, a new conveying system was developed as an extension of the Dense Phase concept. It operates at air pressures between 15 and 90 psig, with sand velocities in the pipeline ranging from only 100 to 450 FPM, and uses up to 45% less compressed air than conventional Dense Phase systems.

This innovation reduced sand velocities in the piping to 6 to 10 times lower than those in conventional Dilute and Dense Phase systems. As a result, pipeline wear was drastically minimized, sand degradation was virtually eliminated, and operating costs were slashed significantly.

A major difference between the newly developed conveying system and conventional systems is the significantly reduced cycle time for batch operation. In traditional systems, the large pressure vessels require about 90 seconds to refill with sand, which consumes much of the cycle time and temporarily halts sand flow in the pipeline.

By contrast, the new system uses a much smaller pressure vessel with a total fill-and-blow cycle time of only about 14 seconds. This enables an almost continuous sand flow into the pipeline. Additionally, the individual cycle functions have been simplified, reducing the number of control components needed and resulting in further cost savings.

Advantages of a Pneumatic Sand Conveying System with Built-In Defect Prevention:

1. NO NEED FOR FLUIDIZATION!

This results in:

- 40% lower compressed air consumption
- Fewer parts to install and maintain
- Reduced compressor energy requirements
- Lower overall operating costs
- Use of standard Schedule 40 pipe
- No need for heavy-duty piping

2. YOU DON'T NEED BOOSTERS!

This means:

- Lower compressed air consumption and elimination of extra booster piping and fittings
- Smaller dust collectors
- Reduced installation labor
- Fewer parts to install
- Minimal maintenance
- A less complicated system

3. MUCH LOWER VELOCITIES.

Translates into:

- Considerably less pipeline wear
- Fewer costly repairs
- Reduced waste of compressed air (pipeline leaks cause significant air loss)

4. LOWER SAND DEGRADATION DUE TO REDUCED VELOCITIES.

This results in:

- Less dust generation
- Reduced waste material and savings in resin consumption (excessive dust soaks up resin unnecessarily)
- More efficient operation and improved maintenance

What can we expect in terms of sand quality from a system designed to prevent sand-related defects? To evaluate the feasibility of such a system, a series of tests was conducted to ensure consistent results. See the typical test data demonstrating that identifying process or equipment problems—and systematically addressing them to eliminate defects—is both practical and effective in achieving the desired outcomes.

BEFORE TEST						AFTER TEST					
SIEVE	1	2	3	4	5	1	2	3	4	5	
30	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.4	0.2	
40	27.3	27.3	27.1	27.7	27.7	28.2	28.3	28.2	27.9	29.1	
50	31.9	31.9	32.2	32.3	32.5	31.9	32.0	31.8	31.7	32.1	
70	30.6	30.7	30.6	30.3	31.1	30.3	30.3	30.4	29.7	29.3	
100	9.8	9.8	9.7	9.4	9.4	0.1	9.0	9.1	9.3	8.8	
140	0.2	0.1	0.2	0.1	0.2	0.3	0.2	0.3	0.9	0.5	
200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
270	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Pan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
AFS	43.4	43.9	43.3	43.1	43.2	43.1	43.0	43.1	43.5	42.9	



Contact:
JIM GAULDIN
jim.gauldin@palmermfg.com