

BINDER FOR LIGHT METALS NO BAKE BINDER SYSTEMS

Case Study

Improving Erosion Resistance and Odor in Large Aluminum Castings

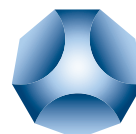
Traditional polyol urethane foundries are making the switch to a new modified polyol urethane no bake that has better erosion resistance and reduced odor, without sacrificing shakeout properties.

» Background

Fort Worth, Texas; A custom manufacturer of large and small aluminum sand castings using a no bake and green sand production method required support for improving their erosion resistance issues and odor problems. The foundry had already updated their green sand foundry with an automatic molding machine to compliment the squeezers, floor molding, and rotolift operations. They can now make castings from prototype to high production up to 1000 pounds.

In March 2019, the foundry approached ASK Chemicals and Porter Warner Industries (PWI - a regional foundry consumable distributor) with a major problem: Their polyol resin supplier was discontinuing polyol offerings and was proposing phenolic urethane resins as a replacement. Unfortunately, after many failed trial attempts from various vendors, they decided phenolic urethane was not a suitable replacement system. Ultimately, maintaining the status quo was not an option; rather, the foundry wanted to make a positive change that would advance their capabilities and position them better to serve their customers' demands. ASK Chemicals was given the opportunity to assist in their efforts to make product and process improvements while also dealing with the inevitable discontinuation of their polyol resin.

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>> Objectives

The foundry uses a Tinker Omega 350 mixer capable of running four different recipes to control amounts of new sand, mechanical reclaim sand, resin, and catalyst. The incumbent polyol system offered very little to no control over the reaction rate. Small cores take just as long to strip as large molds. The foundry trialed a conventional phenolic urethane no bake resin prior to collaborating with ASK Chemicals. This tripled the shakeout time, increased burn in defects, and increased odor complaints. Without question, phenolic urethane systems can be used successfully to produce aluminum castings, but without support or a viable product from their supplier, their foundry processes were spiraling out of control. They decided on staying with a polyol-type resin system.

Primary requirements

- Reduce erosion casting defects in larger castings
- Maintain/improve shakeout
- Better control of resin reaction rate
- Reduce odor

(1) Reducing erosion in larger castings:

The foundry has numerous high-running jobs in the 30 – 40 pound casting weight range that always have a small amount of burn-in defects. They also get erosion defects on larger castings that cause increased time in the cleaning room.

(2) Maintain shakeout characteristics of a polyol, or a significant reduction in shakeout compared to a conventional phenolic urethane:

The increased shakeout time of phenolic urethane systems is unacceptable. A proposed resin system must be comparable to a traditional polyol system.

(3) Work time / strip time control:

A single mixer produces both small cores and large molds. Having the ability to control the curing speed will increase productivity of core making while maintaining larger mold quality.

(4) Odor reduction:

The foundry is accustomed to the polyol resin system odor. They did not care for the smell of the competitive phenolic urethane binders. A proposed resin system should have odor equal to, or better than, their incumbent polyol system.

» Resin System Lab Evaluation

Polyol urethane systems are designed to break down quickly to maximize shakeout in nonferrous castings. This has historically been an issue with large pour weights, and/or long pour times. The resin can break down too soon, specifically in the gating system, which can cause erosion and corresponding sand inclusions.

A typical polyol resin system consists of two parts. The part 1 resin will react with the part 2 in absence of a catalyst due to the amine functionality in the part 1. There is no need for a separate third part catalyst or catalyst pump. The downside of this setup is lack of cure rate control. ASK Chemicals accounted for both these issues in the product recommendations.

Resin system lab evaluation:

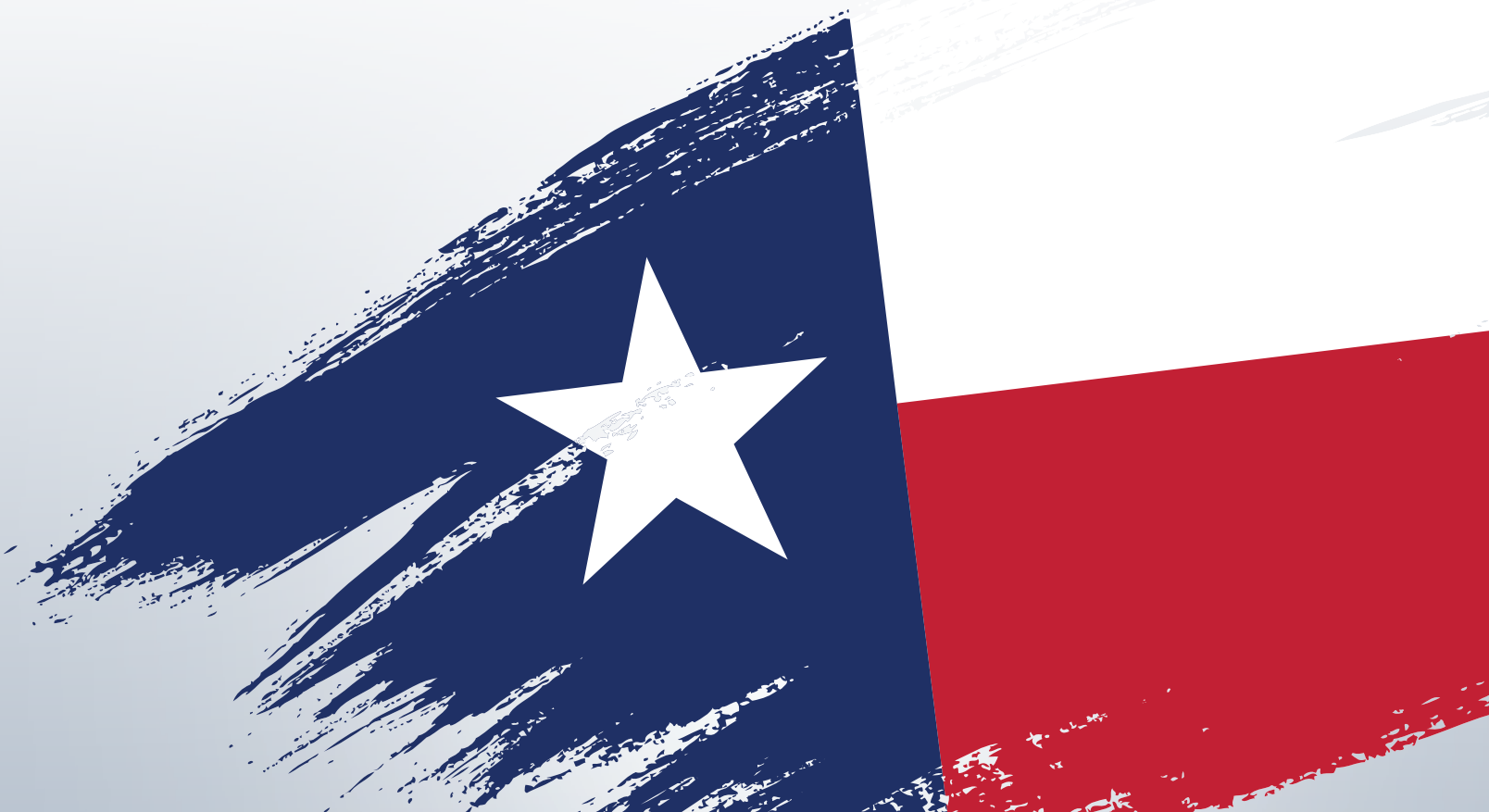
ASK Chemicals tested two no bake binder systems using the foundry's new sand in March 2019. The sand is a round grain, 86 GFN, four-screen silica.

- PEP SET 5140S / 5250 / 5325
- PEP SET 7000 / 7200 / 7300

Rationale:

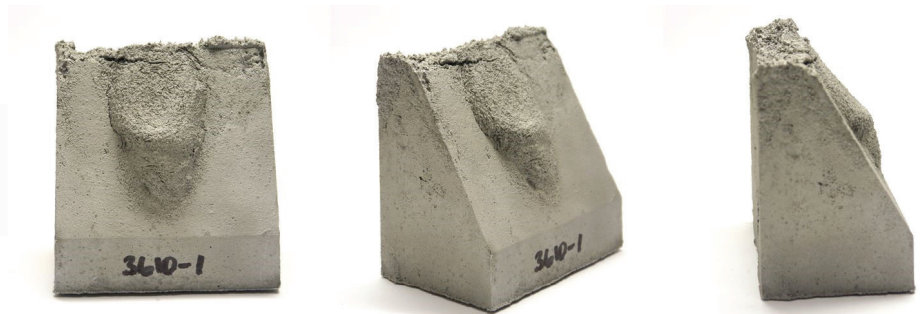
PEP SET 5000S SERIES binder system from ASK Chemicals paired with a third part catalyst was tested. This is a polyol urethane system similar to what the foundry had been using for decades. The catalyst pairing offers the cure time control necessary to improve productivity. This competitive option addresses strip time control and odor, but not erosion resistance for large castings.

PEP SET 7000 SERIES binder system is a new type of polyol resins that provide dramatically improved shakeout in aluminum casting applications over conventional systems, while retaining nearly the same erosion resistance of conventional phenolic urethane no bake. PEP SET 7000 is ideally suited for larger cores and molds that demand longer mixed sand working time, where lower odor and erosion resistance are required. These applications are usually difficult for aluminum polyol urethane systems, but PEP SET 7000 combines improved hot modulus with the attributes of a typical aluminum polyol urethane — great shakeout, low odor, and higher productivity. This premium option meets all of the requirements set by the foundry.



>> Laboratory Tests

PEP SET 5000S SERIES



PEP SET 7000 SERIES



>> Erosion Resistance Test

Approximately 60 pounds of metal, poured down a 16 inch spure, impinge on the inclined surface of the test mold. The resultant casting surface is used for quantitative comparison of erosion propensity. The erosion resistance of cores bonded with PEP SET 7000 binder and poured under these conditions, uncoated, is approximately three times better than that of our PEP SET 5000 series binder.

>> Actions

Action #1: The foundry had a limited resin supply that was running out. ASK Chemicals provided product to bridge the supplier gap and keep them producing castings:

- The Cleveland West team provided material in a “less-than-lead time” window

Action #2: Provide Technical Service during the trial:

- ASK and PWI provided technical assistance during trial and eventual full conversion to PEP SET 7000 SERIES

>> Results

The foundry chose to trial PEP SET 7000 / 7200 with PEP SET 7300 CATALYST. The resin system trial in March 2019 was a success and the foundry switched from a traditional polyol resin system. There were numerous improvements according to the workplace employees. Many were relieved that they had finally found a favorable replacement resin system after running several failed trials with other vendors.

Improvements Noted During Trial:

1. Better as-cast surface finish
2. Reduced resin level
3. Better mold quality
4. Less mixer odor
5. Less smoke and odor at shakeout
6. Faster shakeout

Requirements met:

(1) Reducing erosion in larger castings:

During the trial at the foundry, we tried making two of their medium sized jobs, ones that typically cause problems. There were no issues seen with the molds, cores, or castings. No evidence of erosion in the gating system, even without the use of refractory coatings. Two months into the conversion, the foundry reported there is zero indication of erosion in any of their no bake castings.

(2) Maintain shakeout characteristics of a polyol, or a significant reduction in shakeout compared to a conventional phenolic urethane:

A shakeout time study on Emerson 06-1914 had the following results:

- Incumbent polyol urethane, 15 minutes
- Incumbent phenolic urethane replacement offering, 45 minutes
- ASK Chemicals PEP SET 7000 SERIES, 15 minutes

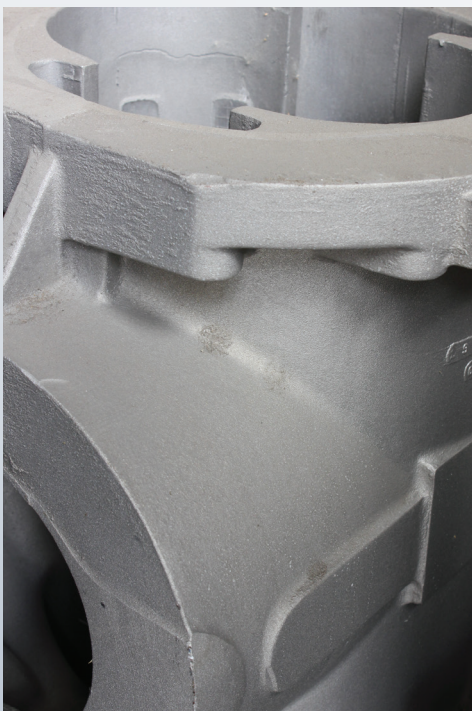
(3) Work time / strip time control:

The catalyst level was adjustable to make medium sized molds at 3.50% catalyst and smaller ones at 4.25% (based on part 1 resin). Additionally there is flexibility to make cores at higher settings to increase productivity. The PEP SET 7300 CATALYST worked well as a winter catalyst. A less reactive summer catalyst will allow them to maintain these cure speeds with elevated sand temperatures.

(4) Odor reduction:

The PEP SET 7000 SERIES was created to provide a reduction in odor compared to a traditional polyol system. The workplace employee reaction verified this improvement. Everyone from molding to pouring and shakeout commented that the odor was better.

Image 1: Casting Example



>> About ASK CHEMICALS

ASK Chemicals is one of the largest suppliers of complete solutions and tailor-made consultation services for the foundry industry. The core of our company's activity involves manufacturing all foundry consumables required for the production chain as well as providing optimum technical services in order to perfectly adapt our products to the processes on the customer's premises.

Our wide product range contains binders for all core manufacturing processes, coatings, additives, feeders, filters, release agents, metallurgical products including inoculants, Mg treatment wires, inoculation wires and pre-alloys for iron casting. Core production and prototype development as well as a wide range of simulation services round off what the company has to offer.



This information is based on our current state of knowledge and does not represent assurance of the properties of the products described. We are only liable for product-related advice and information within the scope of duties of disclosure included in collateral contractual agreements unless expressly agreed otherwise. (02/15)

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