



Technical Data Sheet

ALpHASET[®] System An Ester Cured Phenolic No-Bake System

Product Features:

The ALpHASET System is a no-bake foundry binder system utilizing new, unique technology developed and patented by Borden Chemical. Providing improvements to the foundry environment, this two-part, water soluble resin system allows the production of improved quality castings.

Background:

In the mid 70's, Borden Inc. undertook a research program to develop an organic foundry binder system that offered:

1. Improvements to the foundry environment (internally / externally).
2. Superior casting performance like the "silicate" binders.
3. The advantages of existing "organic" binders.

The resulting product was the ALpHASET System which consists of an alkaline phenolic resin cured with an organic ester. Initial introduction was made in England in the early 80's and since then the ALpHASET System has grown to become a commercially significant binder throughout Europe, North America, South America and the Far East.

Recent developments in phenolic ester technology have provided a series of resins and hardener systems designed to meet the specific needs of individual foundries to optimize performance, especially where reclaimed sands are utilized.

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Sand Handling Characteristics:

Designed for the foundryman, ALpHASET no-bake systems offer several advantages in the production of molds and cores.

Low Odor at Mix Station
 Low Chemical Toxicity
 Water Clean-up (Uncured)

Use Any Sand
 Excellent Pattern Release
 Complete Through-set

These system advantages result in an improved environment, better employee acceptance/working conditions, less pattern maintenance and increased productivity.

**Table 1
 Sand Handling Comparison of ALpHASET to
 Other No-Bake Systems**

	AlpHa SET	FNB ACID	PHENOLI C ACID	PHENOLIC URETHAN E	ALKYD ISOCYANA TE	SILICATE ESTER
Odor at Mixing (Hot Sand)	Very Low	High	High	High	Moderate	Very Low
Pattern Release	Excellent	Poor	Poor	Poor/ Moderate	Excellent	Good
Water Cleanup	Yes	Partly	Partly	No	No	Yes
Work Time to Strip Time Ratio	30%	30-40%	30-40%	50+%	25%	25%
Effect of Hot or Cold Sand	Moderate	High	High	Moderate	Moderate	Moderate
Use any Sand	Yes	No	No	No	Yes	No
Core / Mold Storage	Long	Long	Long	Medium	Medium	Short
Fast Set Times	Yes	Yes	No	Yes	No	No
Slow Set Times	Yes	Yes	Yes	No	Yes	Yes
Reclaimability	High/ Moderate	High	High	High	High	Low

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**Table II
Casting Comparison of ALpHASET to
Other No-Bake Systems**

	ALpHAS ET	FURAN ACID	PHENOLI C ACID	PHENOLIC URETHAN E	ALKYD ISOCYANA TE	SILICAT E ESTER
Nitrogen	No/Yes	Yes/No	Yes/No	Yes	Yes	No
Scab Tendencies	Low	Low	Low	Moderate	Moderate	Low
Sulfur	No	Yes/No	Yes	No	No	No
Veining Tendencies	Low	High	High	Moderate	Low	Low
Gas Defect Potential	Low	Moderate	Moderate	High	High	Low
Shakeout	Good	Moderate	Moderate	Moderate	Moderate	Poor
Lustrous Carbon	Low	Moderate	Moderate	High	High	Low
Pour Off Smoke	Low	Moderate	Moderate	High	High	Low

Casting Characteristics

Reduced expansion defects, such as veins and scabs, are a primary benefit of the ALpHASET System: The chemistry of the system allows for the binder to absorb the initial sand expansion at pouring before final cure. Containing low nitrogen and no sulfur, related gas defects are minimized and iron oxide addition is usually not necessary.

Steel Casting

The benefits of the ALpHASET System are most noticeable in steel castings resulting in a significant improvement in casting quality and reduced cleaning room costs. Expansion defects, inherent to steel metallurgy, are significantly reduced due to the system's unique thermosetting characteristics.

Binder related gas defects, common to steel castings, are markedly reduced or eliminated; the system contains low nitrogen, no phosphorous and no sulfur, all of which may impart gas defects. Most often, iron oxide addition can be eliminated.

On stainless and alloyed steel, there is reduced surface carbon pickup, reducing problems in meeting surface carbon specifications.

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Aluminum Castings

The ALpHASET System provides some specific benefits to aluminum and magnesium castings that result in improved shakeout and staining reduction or elimination. Shakeout times on cores and molds have been reduced by up to 50-90%; the resulting savings have been instrumental in the system's acceptance for aluminum castings.

THE ALpHASET® SYSTEM

The ALpHASET System is a two component liquid binder system. Part I, the ALpHASET resin, is a water-soluble, alkaline, phenol-formaldehyde polymer. Part II, the ALpHACURE hardener co-reactant, is a blend of organic esters. Three distinct series of ALpHACURE co-reactants are available. Each series provides the desired "work/strip" times; the ALpHACURE co-reactants must be used in the specified ratios to develop the strongest sand bond. ALpHACURE co-reactant series choice is dependent upon resin choice, sand conditions and resin selected. The ALpHACURE 200 series of co-reactants were developed to improve performance on mechanically reclaimed sand. They show no benefit over the other series on new or thermally reclaimed sands.

The following resins are available:

RESINS TYPICAL PROPERTIES

COLOR	9010 RED-DARK RED	9020 RED-DARK RED	9040 ALpHASET	9045 ALpHASET
Viscosity, cps	150	145	100	140
Spec. Gravity	1.29	1.30	1.234	1.256
Water Solubility	Infinite	Infinite	Infinite	Infinite
Solids %	55	58	47	48
pH	13.0	14.0	13.0	13.3
Free Formaldehyde, Max	0.5	0.5	<0.2	<0.2
Flash Point	>200°F	>200°F	>200°F	>200°F
Free Phenol % Max	2	1	<0.4	<0.7
ALpHACURE® Series ALpHACURE® Usage	900 Series Typically 25% B.O.R. 200 Series or 100 Series Typically 30% B.O.R.			
Nitrogen	1%	1.6%	<1.0%	<1.0%
Storage Stability				
90° F	3 Months	3 Months	3 Months	3 Months
75° F	4 Months	4 Months	4 Months	4 Months
40° F	6 Months	6 Months	6 Months	6 Months

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Handling:

The ALpHASET resins are highly alkaline, phenolic resoles and normal precautions for handling chemicals should be used when handling them, including protective gear such as gloves and face shields. Consult the “Material Safety Data Sheet” (“MSDS”) for specific information.

Co-Reactants:

The following co-reactants (hardeners) are available to provide varying work/strip times:

ALpHACURE	APPROXIMATE STRIP TIME * (MIN)	ALpHACURE	APPROXIMATE STRIP TIME * (MIN)
902	3	915/115/215	15
103 or 203	4	920/120/220	20
905/105/205	6	930/130/230	30
910/110/210	10	945/145/245	45
		960/160/260	60

* **Strip times** were determined at room temperature (80°F) using ALpHASET 9010 on Wedron sand. Depending on type sand, ambient conditions and type resin, the strip time will vary and should be determined under your specific plant conditions. In most cases, the ALpHASET System will produce a “work time” up to 35% of the “strip time”.

Typical properties of the ALpHACURE co-reactant organic esters are:

	902 - 960	103 - 160	203 - 260
Color	Clear - Straw	Straw - Gold	Straw - Gold
Specific Gravity	1.1 - 1.2	1.1 - 1.2	1.1 - 1.2
Storage Stability	2 Years	1 Year	1 Year

Handling

As with all chemicals, protective clothing, chemical resistant gloves and facemasks should be used. Consult the “MSDS” for specific information.

Mix Levels

The **ALpHASET resin** is used at levels on silica sand of 1-2% based on sand weight. On Olivine or very fine, angular sands, higher levels may be required.

The **ALpHACURE ester co-reactant** usage level varies with the specific ALpHACURE Hardener used as described in the preceding table of available resins. Since the

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ALpHACURE hardener is a co-reactant, its ratio to resin should not be changed from the recommended levels, as it can significantly alter the physical properties of cores and casting quality of the system.

Mixing

As with any foundry binder system, the quality of mixing of the two components is critical to developing the optimum system performance. The ALpHASET resin and ALpHACURE hardener must have intimate contact and mixing while being coated on the sand. In a few cases we have found that some mixers and / or the conditions of some mixers are not adequate due to the low levels of ALpHACURE hardener used. To assure good metering and mixing, the ALpHASET resin should approximate room temperature at the time of use.

On continuous mixers, either the resin or hardener can be added first; it is, of course, recommended that they be added as early as possible to the sand stream. On batch (muller) mixing, add the resin first; if premixing the resin / hardener system before addition, it should be mixed and added as rapidly as possible to avoid precure. Mixing / mulling time should be consistent with the system “worklife” or poor composite properties will result. Tensile strengths obtained with batch mixers are generally much lower than those obtained with high speed continuous mixers.

Cure and Characteristics

The ALpHASET System is a “through-cure” system, i.e., the curing mechanism proceeds at the same rate throughout the mold / core. When the strike-off is hard, the pattern face is also hard. This makes “strip-time” determination easy and consistent.

The reaction speed is determined by the ALpHACURE co-reactant used, not by the quantity employed; always use the quantity recommended for the specific ALpHACURE Hardener used.

While the ALpHASET System is less affected by sand temperatures than many other organic binder systems, sand temperatures do affect reaction rate and the “work / strip” time. For example, using the ALpHACURE 905 reactant, strip times will vary with sand temperature: 40° F - 12 minutes, 75° F- 6 minutes, 125° F- 2 minutes. We of course recommend the use of constant temperature sand; needless to say, this is not always practical. Wide variations in sand temperatures may require selective use of different ALpHACURE co-reactants. The use of sand heaters and coolers to control sand temperature is recommended.

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Refractory Coatings

The ALpHASET System bond is somewhat soluble in the water / solvents used in wash coatings. Proper drying techniques of the core surface before applying the coating is a desirable practice.

Alcohol washes should be ignited immediately after coating; a light torch drying has also been found helpful. On water-based washes, external heat (torch or oven) is necessary to vaporize the water; dry until no further steam comes off the sand but avoid excessive heat and /or oven cure. Modest heating prior to washing has also been helpful.

Pattern Release

The ALpHASET System releases extremely well, much like an alkyd and far superior to most other no-bake systems. Pattern release agents should be minimized.

Reclamation of ALpHASET Sand

A systematic study of the different reclamation techniques and equipment on ALpHASET bonded sand shows that one of the reasons for poor rebonding properties of these reclaimed sands, seen with earlier ALpHASET formulations, was the presence of a thin layer of inorganic compounds on the surface of sand grains. The study showed that removal of this layer (e.g. by wet reclamation) leads to significant improvements in rebonding strengths. The ALpHASET sands can be reclaimed using mechanical or thermal processes. The thermal process is preferable in that rebonding strengths can be achieved. The selection of the reclamation process will be dictated primarily by the requirements in the foundry as is the case with all organic binder systems.

ALpHA / BETA MAX® 601 Reclaimed Sand Additive

This additive allows foundries to use a high level of reclaimed sand in their operations, regardless of the ALpHASET resin in use. Experience in the field at several foundries has clearly established the effectiveness of the ALpHA / BETA MAX in maximizing reclaimed sand usage.

The ALpHA / BETA MAX 601 conditions the layer of inorganic compounds that are present in sand grains. Thus, the adhesion of ALpHASET resin to the exposed sand grains is facilitated and improved tensile properties result.

Our experience shows that ALpHA / BETA MAX 601 is very effective in reclaimed sands containing large percentages of sand grains that have been thermally reclaimed in

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the casting process or by thermal reclamation units. We have also recognized that it is relatively ineffective in reclaimed sands that contain large percentages of sand grains that have not been exposed to high temperatures during casting.

In practical terms, ferrous foundries with relatively low to normal sand / metal ratios (e.g. 3:1) are quite successful with ALpHA / BETA MAX 601. Foundries with high sand / metal ratios (e.g. 6:1) coupled with low pouring temperatures (1600° F and below) have low rates of success with ALpHA /BETA MAX 601 on mechanically reclaimed sand.

Process Control of ALpHASET Reclaimed Sand

There are three parameters that should be measured and controlled when reclaiming sand for rebonding.

Loss on Ignition

This is an important process and control test for ALpHASET (and other) reclaimed sand. Despite the fact that LOI's on phenolic esters are dramatically lower than conventional no-bakes, they must be controlled. There are no established quantitative limits for LOI because their effect varies from one foundry to another. Foundries must establish their own limits based on their practices and needs.

Screen Analysis

This test ensures that the screen distribution of sand remains under control. The level of fines in the sand must be controlled because they affect the moldings process in two ways;

i) they affect permeability of the sand, and ii) high levels of lines significantly reduce the rebonding strength of the reclaimed sand.

Here again, no quantitative limits are proposed, only what the foundry deems necessary to produce castings consistently.

Tensile Strength

The tensile strength of the sand ensures that the cores and molds prepared have adequate handling strength as well as the ability to withstand the pressure of molten metal in the mold cavity. Regular measurements of tensile strength can be used to monitor the rebonding properties of the reclaimed sand as well as to regulate the addition of new sand to the system.

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Trouble Shooting

If the ALpHASET System stops performing as expected, the problem may lie in the mixing of the chemicals. The mixing problem can arise in several areas:

1. Pumps not delivering required quantity of chemicals.
2. Mixer not picking up or utilizing the amount of hardener required.
3. Inadequate mixing due to lack of energy or intensity.

The early indicator of poor mixing is a fall off of strengths or a different color pattern of the cured new sand. If reddish spots or areas appear, the binder is not getting enough hardener. If the amount of hardener gets out of the specific range in either direction, strengths deteriorate.

Core Softness after washing is an indication that the wash was not dried sufficiently.

Core Degradation after a few days is an indicator of a poor mix or where the chemicals were not intimately mixed.

Burn - in on castings is caused by poor sand density, poor mixing, out of balance mix or improper drying of the wash.

Long set times are an indication that the sand has been moved after the usable work time for the system. A slower ALpHACURE may correct the problem.

The ALpHASET® Advantage

... Is Quality Castings

We would like the opportunity to demonstrate the range of benefits within your own operation. For more information and in-plant evaluation, please contact us now.

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