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# APPLICATION INSTRUCTIONS

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## Fascote® Binder & Refractory System

A proprietary, water based binder for ceramic shell backup slurries.

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Update: March 2000

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The Fascote system is an innovative, colloidal silica based backup slurry system formulated to produce strong ceramic shells. Fascote shells can be dipped every 1.5 to 3 hours depending on drying environment and part geometry. This system provides greater versatility than conventional backup slurry systems.

The Fascote ceramic shell slurry operates at lower viscosities than conventional systems to allow better coverage of complex geometry and faster shell turnaround.

Fascote refractory is a proprietary fused silica based slurry refractory; and Fascote binder is a proprietary colloidal silica based binder. In addition, the Fascote system has a color indicator that signals when shells are ready to dip again.

### TYPICAL BACKUP SLURRY FORMULATION FOR APPROXIMATELY 10 GALLONS (10 LITERS) OF SLURRY

1. 60% Refractory\* (Refractory solids range 58.5-60.5%)  
Recommended for most applications.  
Fascote binder: 55 lbs. (6.59 kg)  
Fascote refractory: 82.5 lbs (9.89 kg)  
Viscosity: 27-35 seconds, #2 Signature Series Zahn Cup  
Slurry Density: 1.60-1.66 g/ml
2. 55% Refractory\* (Refractory solids range 53-57%)  
Recommended for large aluminum or medium and small ferrous castings.  
Fascote binder: 58.4 lbs (7.00 kg)  
Fascote refractory: 71.4 lb (8.56kg)  
Viscosity: 18-22 seconds, #2 Signature Series Zahn Cup  
Slurry Density: 1.54-1.58 g/ml
3. 50% Refractory\* (Refractory solids range 49-51%)  
Recommended for aluminum alloys  
Fascote binder: 63 lbs (7.55 kg)  
Fascote refractory: 63 lbs (7.55kg)  
Viscosity: 15-20 seconds, #2 Signature Series Zahn Cup  
Slurry Density: 1.49-1.52 g/ml

\*NOTE: Additional formulations can be used for specific applications. Consult with the R&R Technical Department for further details.

### APPLICATION RECOMMENDATIONS

- A. When making a new slurry or additions to an existing slurry WEIGH all materials.

- B. Properly controlled, a Fascote slurry can be expected to last one year or more.
- C. No water is required when making a new slurry, BUT IS NECESSARY LATER TO REPLACE WATER LOST TO EVAPORATION.
- D. The Fascote system operates at a viscosity much lower than conventional colloidal silica and ethyl silicate systems.
- E. New and makeup slurries MUST BE PREPARED with a propeller mixer, not in a rotating tank. This insures proper dispersion of the refractory particles. The propeller mixer must be of adequate HP and RPM. After all refractory is mixed in, it is suggested that the prop mixer should be controlled by a timer that is alternately on and off 5 minutes. Excessive mixing action can introduce air into the slurry and cause erratic viscosity and/or bubbles in the slurry coat.
- F. When making up a new slurry, the viscosity can be increased by adding more refractory and decreased by adding more binder. As with any conventional colloidal silica slurries, a new slurry must be stabilized before it is used in production. The slurry is considered to be stabilized if there is no more than a one second change in Zahn cup reading when measured after two hour intervals.
- G. SLURRY VISCOSITY SHOULD BE CHECKED AT LEAST AT THE BEGINNING OF EACH OPERATING SHIFT. Deionized or distilled water should be added as necessary to reduce viscosity, which increases as a result of evaporation. The use of tap water may lead to premature gelation.
- H. Slurry density should be checked after viscosity adjustments are made and the slurry is stabilized. The slurry density should be maintained +/-0.02 g/ml from the density of the slurry when originally made up. If slurry density deviates out of this range, then a silica solids content and a gelation determination test should be performed.
- I. Uncontrolled binder solids cause weak shells. A binder solids content check should be done at least daily. After extended, repeatable experience with water additions to correct viscosity without a change in binder solids, the binder solids content check can be made every two or three days.

- J. The pH of the binder should be checked weekly with a pH meter. Normally the pH of your slurry binder will not vary much. If the slurry pH falls outside the acceptable range, 9.25-11.00, a gelation determination test should be performed to determine the stability of the slurry.
- K. Refractory solids should be checked weekly to maintain refractory/binder ratio. (High refractory solids, above 60% can cause shell cracking, and make the shell difficult to remove.)
- L. It is best to maintain the slurry temperature within a 5F (3C) operating range and not more than 10F (6C) above ambient temperature, as with any conventional colloidal silica slurry.
- M. A detailed slurry log of refractory, binder, water additions and other checks, should be maintained.
- N. When using the recommended backup slurry formulation, it is generally not necessary to prewet between the last primary coat and the first backup coat. However, if a prewet is used, it should be straight Fascote or dilute Primcote® binder (binder solids 26%). Prewetting between backup coats may be necessary for very intricate parts, especially those that are robot dipped.
- O. SPECIAL NOTE: The Fascote system has a lower viscosity designed to reduce slurry drain time. Therefore: SHELL DRAINING TIME SHOULD BE SHORTER and stucco is applied much sooner to reduce cycle time and maintain adequate shell thickness and strength. Thirty seconds is typical. If hand dipping, use a clock or timer to avoid excessive drain time between the slurry dipping and stuccoing. DRAINING: Insert pattern in slurry slow enough to avoid air entrapment. The usual practice of rotation and angle changes in the slurry and during draining are applicable along with a shorter drain time cycle.
- P. The drying room environment affects all ceramic shell systems. Shell drying time can be reduced by lowering humidity and increasing air flow. With conventional systems, great care must be taken in making these adjustments to prevent shell problems. The Fascote system provides a broader range of capability allowing environmental changes to speed up shell drying. Shell drying time can be reduced by lowering relative humidity (10-50%). Substantial increases in airflow (250-400fpm, 1.3-2.0 m/s) can provide significant reduction in drying time. Temperature should be held constant to avoid shell cracking caused by pattern expansion or contraction.
- Q. Slurry tanks, props, slurry test tools and other equipment or containers should always be rinsed well before the Fascote slurry material dries on the surface and becomes difficult to remove.
- R. When using a rainfall sander, stucco larger than 30 mesh on the first backup coat(s) may have poor adhesion.
- S. The use of Fascote refractory without Fascote binder is NOT recommended. The use of Fascote binder without

Fascote refractory will not produce any significant benefit.

- T. Primcote binder provides the greatest benefits available for the primary shell coats.
- U. When using an autoclave, it is required that 80 psi (5.5 bars) dry steam pressure be achieved in 10 seconds or less. The autoclave should take approximately 2 minutes to depressurize.
- V. A worksheet for use during slurry control calculations is available. Contact R&R for copies if you do not already have one.
- W. Software for slurry control is also available. Contact the R&R Customer Service department for details.

### SLURRY DENSITY DETERMINATION

The following method can be used to check slurry density:

1. Pre-weigh a 100 ml graduated cylinder on a scale sensitive to 0.1 gram.
2. Fill the cylinder with exactly 100- ml of well-mixed slurry and re-weigh.
3. Subtract the empty graduated cylinder weight from the filled weight. Divide the difference by 100 to obtain the density in g/cc.

### SLURRY SILICA SOLIDS CONTENT DETERMINATION & ADJUSTMENT

To properly monitor and control the slurry silica solids content of the Customcote binder slurry, one of the following procedures can be performed. The backup slurry binder should be be:

Slurry Binder Solids Content:  
24.0% to 26.0% by weight

Binder Specific Gravity:  
1.143-1.158

#### Determination Method A

1. Collect four 50 ml centrifuge tubes of slurry and centrifuge for approximately 30 minutes or more at 3500-4000 RPM.
2. Decant the liquid from the four tubes into two tubes and centrifuge them for an additional 30 minutes.
3. Decant the pourable portion from the tube into a clean container that can be sealed. Stir this portion well.
4. Transfer a sample with a pipette or an eyedropper into a pre-weighed, 10 ml VOLUMETRIC FLASK, not a graduated cylinder.
5. Weight the flask and sample together on a scale accurate to 0.01 grams.
6. After subtracting the flask weight, calculate the specific gravity by dividing the sample weight by 10.

- Using the determined specific gravity and the chart on the inserted page, locate the percent of silica solids content. **DO NOT USE ANY OTHER CHART.** For computer application, the formula for the Fascote system curve is  $x = 138.47y - 134.39$ .

#### Determination Method B

- Prepare a sample using Steps 1-3 in Method A.
- Weight out a 20 +/- 0.1 gram sample.
- Dry this sample for about one hour at 350F (180C).
- Weigh the dry sample to the nearest 0.1 grams.
- Divide the dry weight by the original sample weight then multiply by 100 to determine the percentage of silica solids contained in the sample. NOTE: readings include non-silica solids and will be slightly higher than Method A.

#### Determination Method C (LEAST ACCURATE, NOT RECOMMENDED)

If a centrifuge is not available, this method can be used. This method is not as precise as Methods A or B and may give higher binder solid content values. To establish a comparison standard of the slurry binder solid content, follow this procedure on a freshly stabilized slurry. The value obtained from this slurry is a comparison standard and may not provide precise values.

- Place approximately 1000 ml of slurry in a sealed container. Leave the container undisturbed for at least 16 hours at room temperature. The taller, i.e. more slender, the container, the more accurate the results.
- Carefully decant liquid for the test from the top of the container, leaving the solids settled in the bottom.
- The slurry binder solids content can now be determined by Steps 4-7 Method A or B.

#### ADJUSTMENT

- For a given volume of slurry, the following chart outlines the amount of water that should be added for each percentage point that the binder solids is above 25%.

Refractory Solids (%)	Water Addition Required/Percentage Point			
	oz/10 gal	lb/10 gal	ml/10 gal	ml/10 liters
60	34.4	2.15	976	258
57	36.8	2.31	1049	277
55	38.7	2.42	1099	290
50	42.9	2.68	1271	321
45	45.6	2.85	1294	342
40	51.5	3.22	1462	386

These adjustments are very close to being linear.

- Below the normal range, the slurry is substandard and will cause weak shells. Evaporation should be allowed to remove excess water and bring the slurry binder solids content back into the normal range. The low slurry binder solids content level is usually the result of too much water being added to the slurry.

#### REFRACTORY SOLIDS DETERMINATION & ADJUSTMENT

The following procedure should be used to check the refractory solids are maintained in the recommended range.

- Pre-weigh a metal weighing pan on scale accurate to 0.1 gram.
- Place approximately 10 grams of well-mixed slurry in the pan. Subtract the pan weight and record the sample weight.
- Dry in oven at 350F (180C) for one hour.
- Once dry, re-weigh sample: subtract the pan weight and record dry sample weight.
- Calculate total solids by taking the weight in Step 4, the dry sample weight, and divide by weight in Step 2, the wet sample weight.
- Calculate % water in the slurry by subtracting total solids (Step 5) from 1.0, then multiply by 100.
- Calculate the % water in the binder by subtracting the % binder solids measured from 100.
- Calculate the refractory solids by dividing the difference in Step 6, the percentage of water in the slurry, by the difference in Step 7, the percentage of water in the binder. Subtract the result from 1.0, then multiply by 100.

#### ADJUSTMENTS

When refractory solids are low, divide the difference of 100 minus % refractory solids present, by the % binder desired, subtract 1.0 and multiply by the weight of slurry to get the weight of refractory needed for adjustment.

The weight, in kilograms, of the slurry is calculated by multiplying the slurry density (g/cc) by the volume of slurry (liters). The weight, in pounds, of the slurry is calculated by multiplying the slurry density (g/cc) by the volume of slurry (gallons), then multiplying by 8.34.

When refractory solids are high, divide the % refractory solids present by the % refractory solids desired, subtract 1 and multiply by weight of slurry to get weight of liquid needed for adjustment.

When correcting the high refractory solids, the liquid that is added is as follows:

1. When binder solids and refractory solids are BOTH high, add the required amount of WATER to bring the binder solids in control. Retest the silica solids and determine the new refractory solids.
2. When binder solids are in control and ONLY refractory solids are high, all of the liquid required to adjust the high refractory solids should be FASCOTE BINDER.

### GELATION DETERMINATION

The following method can be used to determine the potential for slurry gelation. It is important that the gelation test be conducted on a sample that has been adjusted and is in specification. Otherwise a false positive indication is possible.

1. Prepare a sample of binder from the slurry with either the Slurry Binder Solids Content Determination Method A (Steps 1-3) or Method C (Steps 1 and 2). NOTE: the sample used for the Slurry Binder Solids Content Determination by Method A or Method C only can also be subsequently used to perform the gelation test.
2. Pour 10 to 20 ml of binder into a sealable container capable of withstanding 150F (65C).
3. Place the sealed container in a temperature controlled oven at 140 +/- 5F (60 +/- 3C) for 16-24 hours.
4. Observe the viscosity of the liquid. If the viscosity has increased, slurry life will be short. If the viscosity is very high or gelled, the slurry should be discarded to avoid producing poor quality shells.

### SAFETY

OSHA approved respiratory protection should always be worn to avoid inhalation of respirable silica dust, which results in irreversible lung disease, silicosis. Such exposure includes slurry makeup, casting, knockout and cleanup. Fascote system products are completely non-flammable. Refer to MSDS for specific details.

### TYPICAL PROPERTIES

Fascote refractory:

Base Composition	Fused Silica (amorphous)
Other composition	Proprietary
Specific Gravity	2.2
Crystallinity	None
PSD: -325 mesh	93% typical

Fascote binder:	
Base Composition	Colloidal Silica
Other composition	Proprietary

Total Solids Content (incl. SiO <sub>2</sub> )	25%/wt
Particle Size	10 nm
PH @ 25C	10.6
Specific Gravity	1.15
Weight/Volume	9.60 lbs/gal (1.15 kg/l)
Viscosity @25C	<10 cps
Na <sub>2</sub> O content	0.41%/wt
Particle Charge	Negative
Color	Greenish Yellow

### STORAGE & HANDLING

Keep from freezing. Fascote binder should be maintained above 35F (2C) to prevent the silica from precipitating irreversibly and making the product unsuitable for use. Binder stored in transparent or translucent containers should be sheltered from direct sunlight. Fascote binder shelf life is 6 months and Fascote refractory is 1 year from date (MMDDYY) in batch lot number on label. Rotate stock to maximize shelf life.

### TECHNICAL SUPPORT

R&R's technical expertise and support capabilities are unmatched by other suppliers in the precision investment casting industry. Many investment casters depend on R&R's technical support and Product & Application laboratory. R&R also has an R&D foundry dedicated solely to developing and testing products for precision investment casting applications. We invite you to call us, toll free.

### PACKAGE/DISTRIBUTION CENTERS

Fascote system products are available in a variety of package sizes and from many distribution locations. Call our Customer Service department for package availability and for the distribution center closest to you.

**CALL (800)-800-7496 (USA) OR (419)865-9497.**

**E-MAIL [customerservice@ransom-randolph.com](mailto:customerservice@ransom-randolph.com)**

**FASCOTE BINDER  
SLURRY BINDER SOLIDS CONTENT**

<b>Specific Gravity</b>	<b>Percent Solids</b>	<b>Specific Gravity</b>	<b>Percent Solids</b>
1.110	19.3	1.145	24.2
1.111	19.5	1.146	24.3
1.112	19.6	1.147	24.4
1.113	19.7	1.148	24.6
1.114	19.9	1.149	24.7
1.115	20.0	1.150	24.9
1.116	20.1	1.151	25.0
1.117	20.3	1.152	25.1
1.118	20.4	1.153	25.3
1.119	20.6	1.154	25.4
1.120	20.7	1.155	25.5
1.121	20.8	1.156	25.7
1.122	21.0	1.157	25.8
1.123	21.1	1.158	26.0
1.124	21.3	1.159	26.1
1.125	21.4	1.160	26.2
1.126	21.5	1.161	26.4
1.127	21.7	1.162	26.5
1.128	21.8	1.163	26.7
1.129	21.9	1.164	26.8
1.130	22.1	1.165	26.9
1.131	22.2	1.166	27.1
1.132	22.4	1.167	27.2
1.133	22.5	1.168	27.3
1.134	22.6	1.169	27.5
1.135	22.8	1.170	27.6
1.136	22.9	1.171	27.8
1.137	23.1	1.172	27.9
1.138	23.2	1.173	28.0
1.139	23.3	1.174	28.2
1.140	23.5	1.175	28.3
1.141	23.6	1.176	28.5
1.142	23.7	1.177	28.6
1.143	23.9	1.178	28.7
1.144	24.0	1.179	28.9
		1.180	29.0

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