
APPLICATION INSTRUCTIONS

Customcote® Binder

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

Update: October 2000

Customcote binder is an innovative, colloidal silica based binder that produces strong ceramic shells. Based on our Fascote® system technology, Customcote binder can be used with a variety of refractories, including: Fascote refractory, other specialty refractories, and commodity refractories of various sizes and chemistries. The R&R technical staff can help you in designing the system that best meets your needs.

Customcote binder slurries are designed to give the investment caster the maximum process and economic benefits. Some of the benefits include:

- Excellent wetting properties
- Lower slurry viscosity
- Short drain times
- Reduced shell material consumption
- Short intercoat and final dry times
- Higher green strengths
- Thinner shells

The actual benefits obtained by each foundry may vary depending on the refractory type, the refractory size and the application.

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

1. **64.5% Refractory***
(Refractory solids range 63.0-66.0%)
Customcote binder: 49.24 lbs. (5.92 kg)
120 and 200 mesh fused silica refractory: 44.73 lbs (5.38 kg) of each
OR 140 mesh fused silica: 89.46 lbs (10.75 kg)
Viscosity: 14-18 seconds,
#3 Signature Series Zahn Cup (depending on refractory used)
Slurry Density: 1.65-1.69 g/ml
2. **60% Refractory***
(Refractory solids range 58.5-60.5%)
Customcote binder: 55 lbs. (6.59 kg) Fused silica refractory: 82.5 lbs (9.89 kg)
Viscosity: 12-16 seconds,

#3 Signature Series Zahn Cup (depending on refractory used)

Slurry Density: 1.60-1.66 g/ml

2. **55% Refractory***
(Refractory solids range 54-56%)
Recommended for large aluminum or medium and small ferrous castings.
Customcote binder: 58.6 lbs. (7.02 kg) Fused silica refractory: 71.6 lbs. (8.58 kg)
Viscosity: 15-20 seconds,
#2 Signature Series Zahn Cup (depending on refractory used)
Slurry Density: 1.54-1.58 g/ml

*NOTE: Additional formulations can be used for specific applications. These would include different refractory loading levels and/or different types of refractories. Consult with the R&R Technical Department for further details.

APPLICATION RECOMMENDATIONS

- A. REMIX BINDER BEFORE USING. For information on economical remixing equipment contact R&R's Customer Service department.
- B. When making a new slurry or additions to an existing slurry WEIGH all materials.
- C. Properly controlled, a Customcote binder slurry can be expected to last one year or more.
- D. No water is required when making a new slurry, BUT IS NECESSARY LATER TO REPLACE WATER LOST TO EVAPORATION.
- 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 silica solids cause weak shells. A silica solids content check should be done at least daily. After extended, repeatable experience with water additions to correct viscosity without a change in silica solids, the silica 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, 9.25-10.70, 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.
- 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. The drying room environment affects all ceramic shell systems. Shell drying time can be reduced by lowering humidity. With conventional systems, great care must be taken in making these adjustments to prevent shell problems. Customcote binder 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.
- O. Slurry tanks, props, slurry test tools and other equipment or containers should always be rinsed well before the Customcote binder material dries on the surface and becomes difficult to remove.

- P. When using a rainfall sander, stucco larger than 30 mesh on the first backup coat(s) may have poor adhesion.
- Q. 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.
- R. In most cases, the final dry time will be 12-16 hours. Some refractories or refractory blends may require a longer final dry time.
- S. A worksheet for use during slurry control calculations is available. Contact R&R for copies if you do not already have one.
- T. Primcote® binder provides the greatest benefits available for the primary shell coats, however, Customcote™ binder can also be used for primary slurries.
- U. 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:

Binder Silica Solids Control Range:
22.1 to 25.0

Binder Specific Gravity:
1.143-1.165

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. Weigh 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.
7. 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.**

Determination Method B

1. Prepare a sample using Steps 1-3 in Method A.
2. Weigh out a 20 +/- 0.1 gram sample.
3. Dry this sample for about one hour at 350F (180C).
4. Weigh the dry sample to the nearest 0.1 grams.
5. 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 silica 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.

1. 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.
2. Carefully decant liquid for the test from the top of the container, leaving the solids in the bottom.
3. The slurry silica solids content can now be determined by Steps 4-7 Method A or B.

ADJUSTMENT

- A. For a given weight of binder, the following chart outlines the amount of water that should be added for each percentage point that the silica solids is above 24%. To determine the binder weight in your slurry, follow these steps:
 1. Multiply slurry volume (gal) by slurry density (g/ml), then multiply by 8.337 to get weight of slurry in pounds. For metric system, multiply slurry volume (L) by slurry density (g/ml) to get weight in kilograms.
 2. Subtract the percent refractory solids (calculated below) from 100 to determine % binder.
 3. Multiply slurry weight (kg or lbs) by percent binder to determine weight of binder.
 4. Using the following factor, determine water addition.

Water Addition Required/Percentage Point

| Weight Binder | ml | oz | WT |
|---------------|-----|----|---------|
| 10 lbs | 198 | 7 | .44 lbs |
| 1 kg | 56 | 2 | 56 g |

These adjustments are very close to being linear.

- B. Below the normal range, the slurry is substandard and can cause weak shells. Evaporation should be allowed to remove excess water and bring the slurry silica solids content back into the normal range. The low slurry silica 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 that the refractory solids are maintained in the recommended range (+/- 1.0% from original formula in most cases unless noted by R&R Technical Department).

1. Pre-weigh a metal weighing pan on scale accurate to 0.1 gram.
2. Place approximately 10 grams of well-mixed slurry in the pan. Subtract the pan weight and record the sample weight.
3. Dry in oven at 350F (180C) for one hour.
4. Once dry, re-weigh sample: subtract the pan weight and record dry sample weight.
5. 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.
6. Calculate % water in the slurry by subtracting total solids (Step 5) from 1.0, then multiply by 100.
7. Calculate the % water in the binder by subtracting the % silica solids measured from 100.
8. 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 silica solids and refractory solids are BOTH high, add the required amount of WATER to bring the silica solids in control. Retest the silica solids and determine the new refractory solids.
2. When silica solids are in control and ONLY refractory solids are high, all of the liquid required to adjust the high refractory solids should be CUSTOMCOTE 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 Silica Content Determination Method A (Steps 1-3) or Method C (Steps 1 and 2). NOTE: the sample used for the Slurry Silica Content Determination by Method A or Method C only can 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. The Customcote binder material is completely non-flammable. Refer to MSDS for specific details.

TYPICAL PROPERTIES

| | |
|--|--------------------------|
| Base Composition | Colloidal Silica |
| Other composition | Proprietary |
| Total Solids Content (incl. SiO ₂) | 25%/wt |
| Particle Size | 10 nm |
| pH @ 25C | 10.6 |
| Specific Gravity | 1.145 |
| Weight/Volume | 9.51 lbs/gal (1.14 kg/l) |
| Viscosity @25C | <10 cps |
| Na ₂ O content | 0.41%/wt |
| Particle Charge | Negative |
| Color | White |

STORAGE & HANDLING

Keep from freezing. Customcote binder must 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. Shelf life is one year from date (MMDDYY) in batch lot number on label. Rotate stock to maximize shelf life. To insure binder uniformity, remix before using.

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

Customcote binder is 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
VISIT US ON THE WEB AT www.ransom-randolph.com
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**Customcote Binder
Silica Solids Content**

| Specific Gravity | Percent Silica | Specific Gravity | Percent Silica | Specific Gravity | Percent Silica |
|-------------------------|-----------------------|-------------------------|-----------------------|-------------------------|-----------------------|
| 1.120 | 18.90 | 1.164 | 24.90 | 1.208 | 30.80 |
| 1.121 | 19.10 | 1.165 | 25.00 | 1.209 | 30.90 |
| 1.122 | 19.20 | 1.166 | 25.10 | 1.210 | 31.10 |
| 1.123 | 19.30 | 1.167 | 25.30 | 1.211 | 31.20 |
| 1.124 | 19.50 | 1.168 | 25.40 | 1.212 | 31.30 |
| 1.125 | 19.60 | 1.169 | 25.50 | 1.213 | 31.50 |
| 1.126 | 19.70 | 1.170 | 25.70 | 1.214 | 31.60 |
| 1.127 | 19.90 | 1.171 | 25.80 | 1.215 | 31.70 |
| 1.128 | 20.00 | 1.172 | 25.90 | 1.216 | 31.90 |
| 1.129 | 20.10 | 1.173 | 26.10 | 1.217 | 32.00 |
| 1.130 | 20.30 | 1.174 | 26.20 | 1.218 | 32.10 |
| 1.131 | 20.40 | 1.175 | 26.30 | 1.219 | 32.30 |
| 1.132 | 20.50 | 1.176 | 26.50 | 1.220 | 32.40 |
| 1.133 | 20.70 | 1.177 | 26.60 | 1.221 | 32.50 |
| 1.134 | 20.80 | 1.178 | 26.80 | 1.222 | 32.70 |
| 1.135 | 21.00 | 1.179 | 26.90 | 1.223 | 32.80 |
| 1.136 | 21.10 | 1.180 | 27.00 | 1.224 | 33.00 |
| 1.137 | 21.20 | 1.181 | 27.20 | 1.225 | 33.10 |
| 1.138 | 21.40 | 1.182 | 27.30 | 1.226 | 33.20 |
| 1.139 | 21.50 | 1.183 | 27.40 | 1.227 | 33.40 |
| 1.140 | 21.60 | 1.184 | 27.60 | 1.228 | 33.50 |
| 1.141 | 21.80 | 1.185 | 27.70 | 1.229 | 33.60 |
| 1.142 | 21.90 | 1.186 | 27.80 | 1.230 | 33.80 |
| 1.143 | 22.00 | 1.187 | 28.00 | 1.231 | 33.90 |
| 1.144 | 22.20 | 1.188 | 28.10 | 1.232 | 34.00 |
| 1.145 | 22.30 | 1.189 | 28.20 | 1.233 | 34.20 |
| 1.146 | 22.40 | 1.190 | 28.40 | 1.234 | 34.30 |
| 1.147 | 22.60 | 1.191 | 28.50 | 1.235 | 34.40 |
| 1.148 | 22.70 | 1.192 | 28.60 | 1.236 | 34.60 |
| 1.149 | 22.80 | 1.193 | 28.80 | 1.237 | 34.70 |
| 1.150 | 23.00 | 1.194 | 28.90 | 1.238 | 34.80 |
| 1.151 | 23.10 | 1.195 | 29.00 | 1.239 | 35.00 |
| 1.152 | 23.20 | 1.196 | 29.20 | 1.240 | 35.10 |
| 1.153 | 23.40 | 1.197 | 29.30 | 1.241 | 35.20 |
| 1.154 | 23.50 | 1.198 | 29.40 | 1.242 | 35.40 |
| 1.155 | 23.70 | 1.199 | 29.60 | 1.243 | 35.50 |
| 1.156 | 23.80 | 1.200 | 29.70 | 1.244 | 35.70 |
| 1.157 | 23.90 | 1.201 | 29.90 | 1.245 | 35.80 |
| 1.158 | 24.10 | 1.202 | 30.00 | 1.246 | 35.90 |
| 1.159 | 24.20 | 1.203 | 30.10 | 1.247 | 36.10 |
| 1.160 | 24.30 | 1.204 | 30.30 | 1.248 | 36.20 |
| 1.161 | 24.50 | 1.205 | 30.40 | 1.249 | 36.30 |
| 1.162 | 24.60 | 1.206 | 30.50 | 1.250 | 36.50 |
| 1.163 | 24.70 | 1.207 | 30.70 | | |