NedForm
Moulding and Casting Solutions

MANUAL FOR THE CERAMIC SHELL METHOD

SYSTEM: CONTINUOUS MIXING

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Products of : Nedform B.V /

Remet Uk Limited

Shell Dummy

Imerys

INTRODUCTION

This document is intended to introduce the casting process via the ceramic shell procedure.

As you'll discover, the ceramic shell process depends a lot on your environment (temperature, humidity, airflow) as well as the molds you want to cast (details, sharp edges, etc.). Therefore, the advice and figures in this document are an average starting point and will have to be adapted to your specific situation through experimentation. Please contact Nedform if you have any questions.

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1. INTRODUCTION

This ceramic shell process aims to create a ceramic shell over a wax mold by building up the shell layer by layer, by dipping, and then sanding. After dewaxing/dewaxing/dewaxing (melting the wax), the ceramic shell remains and is simultaneously fired into a refractory mold that can be used for bronze/art casting. The shell normally consists of 5-12 layers, depending on the size of the casting.

1.1 ADVANTAGES AND DISADVANTAGES OF CERAMIC SHELL METHOD.

COMPARED TO THE TRADITIONAL METHOD OF CAST LOST WAX WITH PLASTER/CHAMOTTE, THE CERAMIC SHELL METHOD OFFERS THE FOLLOWING ADVANTAGES:

- √ The shell/mold is easier to handle due to its lower weight/mass.
- √ The shell is porous, which means that gas can escape and won't build up as quickly as it would, which could cause casting defects. Of course, this depends on the flour and stucco used and still requires some practice.
- √ After dewaxing, the shell is baked in 1-2 hours, which saves a lot of energy compared to the (days) long baking times for plaster.
- √ The quality of the casting is better and more consistent, which means that there is less work on the finish.
- √ Because fewer materials are used, you have fewer materials to throw away.

Unfortunately, there are a few drawbacks:

- X One should familiarize oneself with the process (i.e., practice) and set up a suitable space
- X Dipping and drying the layers sounds laborious and time-consuming. Normally, this is not a problem once one has become familiar with the process. And the dip time often takes less days than firing.
- X Removing the ceramic shell from the final cast can be more difficult because the shell is stronger. This is one of the reasons why we recommend using different types of flour and stucco if you want to cast in materials weaker than bronze (such as aluminium). Normally, a high-pressure water gun is an easy way to remove the shell.

1.2 BUILDING THE LAYERS

It's relatively easy to build a layer. The wax mould is simply immersed in an immersion bath. This immersion pool is filled with a slurry made of Adbond Advantage, melted silica powder (RP1 or RP2) and zircon powder. The wax object is well dipped and rotated so that the slurry gets everywhere on the wax. Then the washing part is removed from the bath and dripped in a circular manner. The trick here is to let slurry run long enough, but not TOO long. It is also necessary to check whether there are air bubbles in the slurry on the laundry. These can be blown away. In case of stubborn foaming, a defoaming agent should be considered.

Then stucco is applied to the slurry-covered wax. This stucco is normally of a coarser grind of fused silica, aluminum silicate or zircon (sand).

After each coat, the mold must be dried. When the mould is dry enough, you can start dipping and covering it with stucco again. This process is repeated as many times as necessary to give the mold the required strength.

Sometimes a mold is too big to fully submerge. The remaining parts are covered by pouring slurry from the tank over the wax mold. Be sure to cover the entire surface with the slurry and avoid air bubbles. We recommend blowing away any excess bubbles on the slurry before applying the stucco.

Sometimes people use an air gun to cover the model with slurry, but this requires practice.

With the first layer, care must be taken to ensure that the slurry layer is thick and viscous enough so that the sand does not fall through to the wax model. This causes a defect called sand bite during the final casting. The casting surface will then look like sandpaper.

2. PREPARATION AND REQUIRED MATERIAL

2.1 ITEMS THAT ONE SHOULD/COULD USE

For the ceramic shell process to work, we recommend using the following products or equivalents:

Required/Highly Recommended

- A bucket/barrel/tank used to make the slurry and dip the wax mold in:
    - Preferably a barrel in which the slurry can easily be mixed continuously. Slurry that is left unmixed for too long settles, gels and hardens eventually and is often no longer usable. It is possible to liquefy the slurry again, but it loses much of its power. Often a vessel is also used that rotates continuously and in which a stationary profile is placed. Well-known manufacturers are MK technologies in Germany or VA technology in England.
    - The opening/diameter of the tank/vessel must be large enough to facilitate dipping. The height of the barrel should be enough to cover the entire / most of the wax mold.

Of course, one should not make the diameter of the barrel too large, as it will take too much slurry to fill the tank. The sides of the tank should be straight.

- A lid to close the barrel after use so that the remaining slurry does not evaporate. Of course, one can add back the amount of water that evaporates, but care must be taken to keep all the values/ratios of the slurry at the ideal level. Do not add more water than has evaporated. That makes the shell too weak.
- Cooling the tank to prevent the slurry from getting too hot due to the friction is especially desirable in hot environments.

- Blending / blending
  - The slurry should:
    - Be mixed for 4 hours to a full day when the slurry is made or when many new ingredients are added. This is to ensure that the flour in the slurry gets well wet. Once the viscosity changes no more than 1 second every 15 minutes, the slurry is well mixed.
    - Be mixed continuously, especially if you leave them alone for extended periods of time. Stirring can be stopped for a short time if it facilitates dipping. After that, the stirring must be started again. This continuous mixing can be prevented by adding Shellspen. More on that later in the manual.
  - The mixer must not be a high speed mixer (i.e. more than 2000 revolutions per minute). High speed mixers usually have sawtooth blades perpendicular to the rotating disc. High speed mixing can break down the latex in the binder, causing the slurry to lose green strength. Green strength is strength of the shell before it is burned.
- Sieve
  - When dipping, the mold will always lose a piece of stucco from the previous layer(s). It is recommended to periodically strain the slurry (the top layer of the slurry) with a hand strainer.
  - A strainer can also be used to sprinkle the stucco on the wet wax mold. In this way, you can be sure that the stucco does not fall too forcefully on the wet skin. Stucco that hits the skin at too great a speed can penetrate too far and thus destroy the contact layer with the wax mold. This is also known as "sand bite"
- Scales
  - To get the right mixing ratios, it is recommended to use a simple, reliable scale.
- Viscosity Cup
  - To avoid having to guess whether the slurry has the correct viscosity, we recommend using a viscosity cup (e.g. Ford cup B 4 or Zahn cup 5). Once you are satisfied with the viscosity of the slurry, measure it with this cup. When creating a new slurry or adding new materials, one has a viscosity to aim for. This speeds up the creation of new slurry.
- Thermometer and humidity meter.

  - The temperature and relative humidity affect the drying time of the layers. Although these measuring devices are not absolutely necessary, they facilitate the estimation of drying time. They are normally used in conjunction with an air conditioning unit to ensure that the room is kept at a constant temperature of 20 degrees and a humidity of around 50%. It is advisable to also keep the wax figures in the same room.

- Ventilator:
  - Most people store their drying molds in a room with a wind speed of about 1 m/s. Caution: DO NOT use fans on primary/first layer!. Also note that the (hollow) core of an image dries less quickly. You can also have extra air injected through an air hose.

- Oven:
  - Used for dewaxing the ceramic shell (i.e. melting the wax from the shell). The wax must be able to flow easily out of the oven to avoid a fire or explosion hazard. Wax is often collected at the bottom of the oven in a water shell. This also makes the laundry more recyclable.
  - After dewaxing, leave the shell in the oven and increase the temperature to about 900 ºC to bake the ceramic shell for about 2 hours. It is also possible to remove the shell from the oven first, after dewaxing. This is often done to check for cracks and defects. It does take a little more energy to bake the shell again.

- Dust Mask: One should use dust masks when handling sand, flour, and stucco. Most sands contain cristobalite, which could cause cancer if inhaled too much over time.
- Goggles.
- Waterproof gloves. The slurry has a high pH value. This is not directly harmful to skin contact, but it can dry out the skin and cause itching.
- The ceramic shell products as described in this manual in section 3.1.

Optional

- Rainfall sanding machine. A container that drops stucco from above through a sieve and collects it again under the sand and is brought back up by a conveyor belt. It is also possible to use a fluidized bed sander (a container in which the stucco is pumped with a lot of air so that it behaves like a liquid. Normally, however, the stucco is applied manually or with the help of a sieve. Be careful not to apply the stucco too forcefully so as not to pierce the skin (also known as a sand bite).
- Faucet or lever to maneuver heavy wax molds during dipping. (larger shapes become heavy after the first few layers of stucco). A threaded rod is also often made that can be screwed into the wax mold or pouring funnel so that the mold can be manipulated better.
- pH measuring device. The pH of the slurry must always be higher than 9.0, otherwise irreversible gelling of the slurry will occur. Unfortunately, it is not possible to use pH paper. A good pH meter does work.

- Wettin agent. A product to improve the wetting of the mold by the slurry. A commonly used product is Wet-in or Victawet 12. This product is normally only needed for precision casting.

- Antifoam. This product reduces foaming on the slurry by lowering the surface tension. This product is already pre-mixed into the Adbond Advantage, so normally one does not need to add this unless there are still excessive air bubbles.

- Degreasing product. Patternwash or citric acid is used to make the wax surface less greasy and thus facilitate the adhesion of slurry to the wax (also called netting). It is important to wash the washing parts well in clean water after degreasing! Some casters also use hairspray on the wax model to help the slurry adhere better to the wax.

2.2 MAKING THE SLURRY

The most important property of a good slurry is its viscosity. The right viscosity is the viscosity that people like to work with. There is no real default. Other factors are also important. If the wax mold has sharp edges, the viscosity should be high to cover these edges. If the wax mold has fine details, the viscosity should be lower.

Keep in mind that any new slurry or refilled slurry should be mixed intensively for four hours (preferably 24 hours). Mixing the slurry is done as soon as the viscosity does not change too much over time. Please do not use high shear mixing (>2000 rpm), as this will destroy the latex/polymer in the binder. A normal kitchen blender or mixer should do just fine. The mixing speed of a mixer is typically much higher than the rotation speed of the container in which the slurry is stored and mixed continuously.

The first layer is the most important, as it determines the surface quality of the casting. It is therefore important that this layer perfectly covers the entire wax mold without air bubbles. The flour used in the slurry for the first layer is very fine to be able to copy all the details and to prevent segregation for as long as possible. The "primary" slurry are slightly more viscous than the "backup" slurry. This is to be better on the wax model and to prevent sand bite. The backup slurry is also a bit thinner to save material. For this reason, a finer flour is often used in the primary slurry

The slurry for the back-up layers (third layer and beyond) has a coarser flour and therefore a slightly lower viscosity.

Most customers use two immersion tanks. One for the primary and one for the backup slurry. However, it is also possible to make a primary slurry and dip all the wax molds in this slurry and make the first or first two layers. Then material is added to turn the primary bath into the secondary bath (by adding Adbond Advantage and the coarser flour). In this way, one only has to use 1 immersion tank and normally has less material left.

For beginners using the ceramic shell method for bronze castings, we normally recommend making slurries with fused silica flour. The addition of zircon flour makes the shell a lot tougher, but the mixing ratios are a bit more precise.

Features of zircon:

- Very fine material resulting in a very detailed surface.
- Stronger ceramic shell
- The resulting shell is less porous. Gas has more difficulty escaping from this shell, making the shell more prone to cracking.
- It is easier to demold the final casting, but only if the mixing ratio is done accurately enough.

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Making the primary slurry:

- Fill the immersion tank with the appropriate amount of Adbond Advantage.
- Add fused silica flour to the Adbond. Use RP1 (200 mesh) or RP2 (120 mesh). RP1 is slightly finer than RP2 and is used for better details, but normally only for precision castings. Mixing ratio is Adbond: Flour = 1 Kg: 2Kg
- If one has the necessary experience, it is possible to add zircon flour 200 mesh as well. This should be done in the mixing ratio Adbond: zircon flour 200 mesh = 5 Kg: 2 Kg. If you prefer to use RP2 instead of zircon, you should use the ratio Adbond: extra RP2 = 5Kg :1Kg.

e.g. Bath 1 (primary slurry):

	60 kg	Binder Adbond Advantage of Adbond Artcast	
	120 kg	RP 2	
+	24 kg	Zircon Flour ECG (200 mesh)	← Optional
=	204 kg	Primary slurry	

Or

	60 kg	Binder Adbond Advantage oder Adbond Artcast
	120 kg	RP 2
+	12 kg	RP 2 (extra RP2 instead of zircon)

= 192 kg Primary slurry

The viscosity should be about 85-95 seconds (measured with a Ford B4 cup).

Making the backup slurry (secondary slurry):

One can make the back-up slurry by adding Adbond Advantage and the necessary flour to the primary slurry or one just starts from scratch.

See the example below for a possible mixing ratio.

e.g. immersion tank 2 (back-up slurry):

90 kg Binder Adbond Advantage of Adbond Artcast

120 kg RP 2

+ 24 kg Zircon meal ECG (200mesh) or 12 Kg RP2 extra instead of zircon

=234 kg Back-up slurry (also known as secondary slurry)

Viscosity should be about 50-60 seconds (measured with a Ford B4 cup)

These examples are a good starting point for most casting ideas. We recommend starting with these values and adjusting them later as you see fit. A good guideline for the density of the slurry is about 1.7 grams/cm3.

When using a 325 mesh flour, you often start with an Adbond : flour ratio of 1 Kg : 1 Kg. This will in all probability give a slurry that is a bit too liquid, but that is easy to adjust by slowly increasing the amount of flour.

2.3. CONTROLLING THE SLURRY.

Slurry control is very important. Every morning, the evaporated water must be replenished with demineralized water. This is often done by seeing how much the surface area of the slurry has decreased from the end of the working day to the beginning of the working day.

Slurry is then mixed for half an hour and the viscosity is examined. If the slurry is too thick, you can add Adbond, if the slurry is too thin, you can add flour. Always do this in small steps and mix for half an hour at a time to see what the result is!

If necessary, also test for tightness by taking 1 liter of slurry from the tank (after mixing well first) and weighing. The density is the weight per liter. Target density is between 1.5 and 1.8 Kg/Litre.

You can also test the pH every day. If the pH is too low, you can add KOH in very small increments of a few per mille dissolved in demineralised water.

In case of bacteria (cheesy smell in the slurry), you can add a teaspoon of bleach or a bactericide such as BF 3,000.

Keeping a diary about all adjustments is highly recommended! This is the only way to keep an eye on how certain slurry results are achieved and to know how best to adjust the slurry in the future.

When creating a new slurry, we recommend that you do this in a separate bucket and only after you are satisfied with the slurry add it to the larger tank.

2.4 MAKING THE LAYERS/DIPPING

As described, the layers are built up by dipping the wax mold into the slurry and sprinkling stucco on the wet wax surface. One must ensure that the entire surface is covered with the slurry. Once the stucco has been glued together, no wet surface should be visible. For the stucco it is best to use fused silica coarsely ground (RG1, RG2 or RG3). This material is coarser than the fused silica flour (RP1, RP2).

RG1 (50-100 mesh sand) is used as stucco for the first or first two layers. RG2 (30-50 mesh sand) is used for the next three layers, and RG3 (10-30 mesh sand) is used for the remaining layers. Of course, you are free to make changes to this suggestion.

Don't make the shell too dense (so don't use too much low a fine grain). A very dense shell does not allow gas to escape as well, which can cause casting errors.

ALWAYS apply stucco. Never make a layer without stucco, because then the layer adheres poorly to the previous layers. The layer may loosen during casting or dewaxing, which may cause the final casting to fail.

Make sure that the slurry is mixed constantly or at least periodically to prevent settling/segregation of the materials and gelling.

It is important to let the shell dry after each new coat. The drying time depends on the temperature, relative humidity and airflow. Proper drying is very important on parts with (sink) holes or where the ceramic shell bridges an opening.

Applying the first coat:

Dip the wax into the primary slurry, making sure the entire section is perfectly covered with slurry. Drain off any excess slurry, making sure there are no air bubbles. It takes experience to run the slurry off the wash sufficiently, but not too much.

Apply RG1 stucco. Be careful not to throw the stucco on too hard. The stucco should not fully penetrate the slurry skin, as it could damage the contact layer between slurry and wax, which will be seen as small dents in the final casting (sandpaper effect). One could use a sieve to apply the stucco gently and evenly. Make sure the entire shape is covered with stucco.

Allow the layer to dry for more than 4 hours (relative humidity 50%, temperature 20-25 ºC and if possible no to minimal airflow). We recommend letting the first coat dry for about 12-24 hours (e.g. overnight).

Applying the second coat:

Blow loose stucco from the sanding of the model, so that it does not end up in the slurry.

Dip the wax into the primary or secondary slurry (depending on the required detail and strength), making sure the entire section is perfectly covered with slurry. Drain off any excess slurry, making sure there are no air bubbles.

Apply to RG2 stucco. Be careful not to throw the stucco on too hard. The stucco should not fully penetrate the slurry skin, as it could damage the contact layer between slurry and wax, which will be seen as small dents in the final casting. One could use a sieve to apply the stucco gently and evenly. Make sure the entire shape is covered with stucco.

Allow the layer to dry for about 4 – 6 hours (relative humidity 50%, temperature 20-25 ºC and airflow 1 m/s if possible).

Application of the third and subsequent coats:

Blow excess loose sand off the model, to avoid contamination of the slurry.

Dip the wax in the backup slurry and make sure the whole part is perfectly covered with slurry. Drain off any excess slurry and make sure there are no air bubbles.

Application of RG3 stucco. One could use a sieve to apply the stucco gently and evenly. Make sure the entire shape is covered with stucco.

Allow the layer to dry for about 4 – 6 hours (relative humidity 50%, temperature 20-25 ºC and airflow 1 m/s if possible).

One should repeat this last process as many times as necessary to get the right number of backup layers. Normally, 5 to 6 layers in total are used for small molds and up to 10 or 12 layers in total for large molds. Shells can be additionally strengthened by twisting chicken wire around them and/or embedding the shell in a container of sand during pouring.

2.5 THE COMPLETE DRYING OF THE CERAMIC SHELL:

After applying the final coat, the entire shell should dry for about 24 hours. The ideal temperature is 20-25 ºC, the relative humidity is 50% and the airflow is 0 m/s. Do not heat the shell to speed up drying, as this will cause uneven expansions and cracking.

There are devices on the market that automate the drying of the shell. These are made at MK Technology, among others.

Drying can be facilitated by infrared radiation that heats the shell from the inside out. However, this is rarely used.

2.6 DEWAXING AND FIRING THE CERAMIC SHELL

The dewaxing and firing of the ceramic shell is done in a de-waxing oven. The wax burns out between 400 and 600 ºC. Make sure that the oven is at this high temperature when the shells with wax in them are placed in the oven. Or increase to this temperature as quickly as possible. This rapid rise in temperature means that the wax doesn't have time to expand and burst the shell. De-waxing can also be done with an autoclave or boiler clave). A high temperature also burns possible ash. And smells less strong. To prevent odour nuisance, the use of afterburning on the chimney is recommended.

Another option is to place the shells in an oven over steam. The advantage of steam de-waxing is that it causes by far the least odour nuisance for local residents.

It is strongly advised to use an oven where the wax can drain freely to avoid the risk of fire or explosion.

important to melt the wax near the ceramic surface first (and let it drain away) so that the remaining wax has room to expand. Often this is done prior to baking, when the oven is too slow to reach the thermal peak quickly.

Baking the fused silica ceramic casing is at about 700-900 ºC. You heat up to 900 ºC at the maximum speed at which your oven can work. A standard shell is normally fully baked in about 2 hours at 900 ºC. (Although many people also do this at 700-800 degrees Celsius for 3 to 4 hours.) When using larger gypsum cores, you need to take gypsum firing curves into account.

2.7 THE CASTING

The casting of the metal is normally done shortly after the dewax and firing of the shell.

Small shells with many small runners should be at about 600 ºC at the time the metal is poured. Larger shells with larger shoots can have a temperature as low as 400 ºC. The high temperature of the shell prevents cracking due to heat shock when casting the hot metal.

The heating of the shell also prevents cooling of the cast metal and thus increases the fluidity of the metal (important for parts with small openings or high details).

Note: Silicon-copper alloy (Cu 95.8%, Si 3%, Mg 1%) normally gives the best results.

CAUTION: Place the shells firmly in a container of sand so that they cannot fall over during pouring. Burying in a container of sand also increases the firmness of the shell and is definitely recommended.

Make sure that in case of cracks of the shell or other accidents, the metal can flow away and NOT run towards you!

2.8 REMOVING THE CERAMIC SHELL

When the casting has cooled down sufficiently, the shell can be removed. Removal is easiest when the shell is placed on a flexible or sandy surface and struck against the channels with a hammer. The remaining parts can be removed with a chisel or even with a high-pressure water gun/sandblaster (about 300 bar). Be careful not to damage the casting, especially with weaker materials such as aluminum.

Rapid cooling of a relatively warm shell in cold water (cold shock) is also used. This also causes cracks in the shell, making it easier to remove.

Ultrasonic bathing and sandblasting are also good options.

3. PRODUCT

All consumables in this manual are available through Nedform BV. We also give advice on machines and tools.

A brief description of the products:

3.1 STANDARD PRODUCTS

Adbond Advantage: This is the binder based on water and latex. This binder is a premix, which means it already contains the right amounts of water, latex, antifoam, and wetting agent for all basic ceramic shell applications. In the past, all of these products were only available individually, which made the ceramic process more difficult. Adbond Artcast/ Adbond Advantage is ready to use. One only needs to add flour in the required quantities. Because the latex is already in this product, there should be no high shear mixed (>2000 RPM).

RP1 (fused silica flour):

This is the fused silica flour (200 mesh) to add to the primary suspension for more detailed castings. RP1 is a finer ground flour than RP2.

This product is mostly used for precision casting

RP2 (fused silica flour):

This is the fused silica flour (120 mesh) to add to the primary and/or secondary slurry. RP2 is a coarser ground flour than RP1.

This product is mostly used for art casting.

Zircon ECG (-200): Coarse zircon flour. This zircon flour (200 mesh) can be added to the slurry as flour for a stronger shell and more details. It also makes the shell less porous, which can cause cracks during dewaxing. With some reactive or higher temperature metal alloys, it is even recommended to plaster the first layer only with zircon sand and to use zircon flour in the slurry instead of fused silica flour.

RG1 (fused silica stucco):

Stucco (coarser than the flower RP). Mesh 50/100 used for the primary layer(s).

RG2 (fused silica stucco):

Stucco (coarser than the flour RP and stucco RG1). Mesh 30/50 used for the second and third layer upon layer(s).

RG3 (Fused Silica Stucco):

Stucco (coarser than the flour RP and stucco RG2). Mesh 10/20 used for the backup layer(s).

Starter pack:

2 pockets RP1 or RP2

1 bag RG 1

1 bag RG 2

1 bag RG 3

30 kg Adbond Voordeel/ Adbond Artcast

These quantities should be sufficient for a primary slurry of about 20 Ltr and a back-up slurry of about 20 Ltr.

3.2 ALTERNATIVES TO THE PRODUCTS LISTED ABOVE

RP1 / RP2/Zircon : Alternatives are: Cerametal (Flour), Valerite (Flour), Clayrac (Flour) and Molochite (Flour). These are all aluminum silicates and are excellent replacements for the fused silica in bronze casting. Zircon is normally used when casting at higher temperatures (e.g. stainless steel). The alternatives are cheaper, but not suitable for all alloys. These alternatives can be used for bronze.

RG1 /RG2/RG3 : Alternatives are: Cerametal (stucco), Valerite (stucco), Clayrac (stucco) and molochite (stucco). Zircon is normally used when casting at higher temperatures (e.g. stainless steel). The alternatives are cheaper. Cerametal consists of 42% aluminum, the grain has edges and is therefore more suitable for artificial casting than for fine casting. Molachite and Valerite consist of 44% aluminium. The grain is rounder, making the material better suited for fine casting than the Cerametal.

If Cerametal is used, the removal of the final shell is facilitated.

Zircon separates slightly more easily than the other products in the slurry.

Molachite strengthens the shell and is therefore not really suitable for aluminum casting.

3.3 POSSIBLE ADDITIONS

The Adbond Advantage is a ready-to-use mixture with water, latex, colloidal silica, antifoam and a netting product. One only needs to add the required amount of flour to make the slurry. All ingredients are of course available separately if necessary.

Coloured drying time indicator. Sometimes it's hard to tell if the shell/layer has dried enough for dipping. To facilitate this, Nedform also offers a dye that changes color during the drying of the shell. This is called Acid Yellow or dry indicator

Shellspen is a product that ensures that the continuous mixing of the slurry is a thing of the past! This product is available through Nedform. View http://shellspen.com/

A defoamer like Burst100 can help with slurries where the air bubbles on it are very persistent. Adding defoamer will cause the air bubbles to burst faster. Burst100 is already included as standard in the Adbond Advantage and is therefore not needed in most cases.

A wetting agent or wetting agent such as Victawet ensures that the slurry runs better over the washing surface. Wetting agent is also already added to Adbond Advantage and extra addition is therefore not needed in most cases

Pattern wash. Wax must be well degreased before dipping into the slurry. You can do this by dipping the wax in a pattern wash product from Remet, a citric acid bath or in an alcohol. Please note that alcohol also softens and can affect the wax surface. After this degreasing, you must first rinse the laundry well with clean deminiralized water. Otherwise, foreign chemicals may get into the slurry. An additional help can be to treat the wax with hairspray so that the slurry does not run off the wax surface too quickly.

3.4 HARDER OR SOFTER SHELL

Instead of fused silica, one can use aluminosilicate materials (flour and stucco). These are cheaper and result in a stronger Shell. However, fused silica shells suffer less from thermal expansion, and the rigid castings are easier to knock out of the sleeve.

More flexible castings, on the other hand, are easier to knock out of stiffer shells (made of aluminum silicate). Of course, combinations of materials are also possible.

To further soften the ceramic shell, you can add calcined coals and/or dilute the slurry with water.

Adding a stucco layer consisting of flammable material (such as crushed walnut husks etc) to layer 4 or 5 increases the gas permeability of the shell and also facilitates knocking out the shell.

4. NEW DEVELOPMENTS

4.1 READY-TO-USE SLURRY:

For a few years now, there have been ready-made slurries that you can order, such as the Remet JusDip and Ransom and Randolph SuspendaSlurry.

The advantage is that you don't have to formulate your own slurry, as this product contains everything you need. Also, the slurry remains in suspension without mixing continuously. However, you should mix regularly (1 time a week) and always mix well before using it.

In addition to the slurry, you still need the stucco/sand to do the sanding.

4.2 HOMEMADE READY-MADE SLURRY

Because ready-to-use slurries are often more expensive, more difficult to store for a longer period of time, come in only a few packaging sizes and because it is more difficult to influence the slurry yourself, more and more customers are choosing to make their own slurry that does not need to be stirred continuously. This can be done by making the slurry as described in this manual and then adding a third component called Shellspen.

Contact us for more information and a manual.

5. CHECK AND NOTE!

Whether you use the traditional slurry, a ready-made slurry or the newer slurry that does not need to be stirred continuously. In all cases, you need to maintain the slurry properly.

If possible, measure the slurry every day for density, viscosity and pH and adjust where necessary with demineralized water (usually only needed to replenish the evaporated water!), adbond liquid and flour.

Keep a journal of your adjustments and the final casting results so that you learn over time what slurry recipe is needed to get the right casting results for a particular image.