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POTCLAYS LIMITED

INFORMATION SHEET

Casting Slip Preparation

These notes are the original unabridged version of those written by CW Noake, director of Potclays, in the 1960's. They are still relevant today and are reproduced here for your reference.

SIMPLE METHODS OF PREPARATION AND CONTROL OF CASTING SLIP.

This simplified version of Casting slip Control is offered as a guide rather than as a thesis on the subject and any statements like "Sodium Silicate pushes the clay molecules apart" are not intended to be taken literally. They do however, assist in giving a working mental picture of what is happening when you add Alkalies to a Casting Slip.

When a Sodium Silicate or soda Ash are added to a clay-water mix, fluidity of the mix increases up to a maximum and then decreases with further additions. When acidic substances are added to the same mix the clay fluctuates or thickens.

When Calcium Sulphate (Plaster of Paris) is added to a Casting slip the slip gels and thickens.

When Soluble Salts are present the clay may do anything, but probably gels and thickens.

Soda Ash or Sodium Carbonate is a thinning agent, but if damp this chemical alters to a Sodium Bicarbonate which has the opposite effect. Soda Ash must be kept in a dry place, preferably in an airtight tin.

Sodium Silicates are "mixtures" which contain Sodium Oxide and Silica (originally as glass) dissolved in water. They are designated by a scale similar to specific gravity called degrees TWADDELL (^{O}T)

$$S.G. = 1 + \frac{\text{Twaddell degrees.}}{200}$$

140ºT Silicate is a very thick syrupy liquid 45% water.
100ºT Alkaline is a thin free flowing liquid 60% water.
The above are suitable for use in plastic clay bodies.

75ºT Silicate, this is also thinnish Silicate, but differs in chemical composition from 100ºT and 140ºT Silicate. It is suitable for China Clay slips where it is desired to increase rather than decrease the plasticity of the slip.

The main part of a body which is affected by alkali additions is the plastic clay content. It follows therefore that for different clay contents and clay types, you will require different ratios and amounts of Alkalies.

Before an Alkali can do its job on the clay it must reach a state of equilibrium with the impurities i.e. neutralize acids and overcome effects of soluble salts and so additions will also depend on type of water, amount of scrap clay re-used, type of plastic in moulds etc.

From the above it can be seen that two potters using the same clay require different recipes to get similar results.

The Viscosity or "runniness" of a casting slip is governed by two main factors.

1. Alkali additions.
2. Water content.

Before you can estimate the effect of alkali additions you must have a standard water content.

(A thin free-flowing casting slip can easily contain less water than a thick sludgy one and so it is quite useless to stick a finger into it and murmur "yes, that's all right" if you haven't checked the clay/water ratio, it probably isn't)

The clay to water ratio of a slip is the simplest thing to check. It takes roughly three minutes using a pair of scales and a pint measuring can. All you need to know is the weight in ounces of one pint of slip and from this you can calculate if you wish, exactly how much clay and how much water there is in the slip **<u>regardless of how thick or thin it appears.</u>**

The weight of dry clay in one pint of a clay/water slip is approximately equal to the (pint weight in ounces - 20) x 1 2/3 or W = P - 20 x 1 2/3. Example:- a casting slip weighs 35 ozs per pint how much dry clay is then in a pint of this slip?

W=(P-20) 1 2/3 ozs.
= (35-20) 1 2/3 ozs.
= 25 ozs.

There are 25 dry ozs clay. (So there must be 10 ozs water). This simple formula holds good for all materials of specific gravity 2.5 - 2.6 (approx) i.e. clays, feldspars, cornish stones, flint, grogs, (in fact most ceramic materials except colouring oxides, lead and borax etc.)

It provides an easy means of mixing two slips accurately on a dry basis and of finding out how much colouring oxides is required for a certain number of pints of slip (which is easy when you know the dry clay content of a slip).

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<u>How much alkali is required?</u>
As stated, this is governed by (1) clay content of body in use. (2) Impurities in body. Disregarding the impurities, we can consider the clay content first.

		Dry weight of
Red bodies	80 - 90%	Plastic clay equivalent.
Buff stoneware bodies.	70 - 80%	“ “ “
Ivory & White Earthenware bodies.	25 - 35%	“ “ “

It is obvious from the above, that you will need more alkalies for Red than for White bodies.

Roughly :- 25% clay equivalent required 0.25%
90% “ “ “ up to 1%

A white earthenware body (25 Ball clay, 25 China clay, 33 flint, 17 stone) of average composition contains roughly 30% “Plastic clay equivalent” (China clay is not very plastic).

As a basic starting recipe we can try 0.4% alkalies and use items in equal proportions by weight i.e. o.2% Sodium Silicate 140ºT 0.2% Soda Ash (if 100ºT silicate used: 4 parts 100ºT - 3 parts 140ºT) 100 ozs dry clay plus 40 ozs water (2 pints).

The resulting slip may not be perfect, but it should be usable, and will weigh 35 ozs per pint.

We can now consider the different properties that Soda Ash and Silicate impart to a casting slip and vary the ratio to give the best possible (and allow us to increase the pint weight) (to probably 36 ozs)

Silicate additions tend to give:-
(1) Hard brittle slip cast.
(2) “stringy” running off properties.
(3) More fluid slips than Soda Ash.
(4) Sticking to mould when emptying.
Soda Ash tends to give:-
(1) Quicker casting for plastic clays.
(2) Flabby casts.
(3) Sludgy slip.
(4) Better draining than silicate - In other words you can’t have everything, but as a general rule, the more plastic the clay the more soda Ash and the less Silicate, i.e. for a red body you might use 0.5% Soda Ash and 0.3% Silicate of Soda.

Casting Faults

The general rule for casting slips is the highest pint weight possible gives the least faults, (providing it is fluid enough to use, of course).You should aim for:-

(1) White and Ivory E/W bodies 35-36.1/2 ozs.
(2) Buff bodies 34.1/2 - 35.1/2 ozs
(3) Red bodies 34 - 35.1/2 ozs. One clay body (i.e. Ball clays used by themselves) will vary from 32 - 37 oz depending on how plastic the clay is. If you can't get at least 33.1.2 ozs then it will save a great deal of trouble if you "let the clay down" with some non-plastic materials such as grog.

Fault Finding

1. **Livering** (Slip goes sludgy on standing for a short time).
(1) Try Barium Carbonate 0.25% - 0.5%. This changes soluble salts to insoluble ones and they cannot do much harm.
(2) Reduce Soda Ash and increase silicate.
(3) Make sure you haven't dropped a piece of mould into the slip by mistake.

2. **Casting Spot.** (Brown "Flash" where glaze doesn't take) Slip falling from too great a height and hitting mould too hard. You will not want to eliminate this, but you can ensure that slip hits the mould on the bottom of the pot where it doesn't matter so much.

3. **Pinholing.**
(1) Air trapped in slip.
(2) Slip too thick (livering)
(3) Slip being poured carelessly and trapping air, rocking the mould after pouring will bring bubbles to the surface where they show as blotches on the slip).

4. **Slip not Casing up on high parts of mould.**
(1) Air bubbles trapped between slip and plaster. Cut a small vent with the tip of a knife.
(2) A higher head of slip is required on the filler. Put a collar of clay 2-3 ins. high round hole and fill to top of this.

5. **Cracking**
(1) Too dry before removing cast.
(2) Too much Silicate of soda.
(3) Pint weight too low.
(4) Mould not allowing article to contract as it dries.
(5) Moulds too dry.

6. **Flabby Soft Casts** (1) Removing too quickly.
(2) Reduce Ash increase Silicate.
(3) Livering of slip.
(4) Mould too wet.

7. **Wreathing.** (Lines running round circumference) (1) Slip too high viscosity.
(2) Uneven pouring.
(3) Very dry Moulds.

A quick assessment of a fault can often be made by examining the skin formed on top of a mould when casting up.

(1) Hard, thin - high Silicate content.
(2) Thick, sludgy layer - livering.
(3) Thick, soft - High Soda Ash content.

As can be seen from the above notes, the obtaining of a satisfactory slip is mainly a question of obtaining one property which is desirable without introducing others which are undesirable and the size of the articles.

The author hopes, however, that the above will form a practical basis of procedure for those studio Potters who are interested in the use of Casting Slips.

