PRODUCT BULLETIN

INCORPORATION OF FILLERS INTO MASTER WORKS™ M1

This information was generated using laboratory prepared specimens and is not intended for specification purposes. Please contact PUMA Polymers to obtain specification information.

1. INTRODUCTION

Master Works™ M1 can be readily filled with a wide variety of fillers

Fillers can be used with Master Works™ M1 for:

- Decorative effect
- Modification of physical and mechanical properties
- Lower cost

2. DECORATIVE FILLERS

These will generally take the form of:

- Stone dusts such as sandstone, marble, slate etc.
- Sand
- Crushed aggregate
- Metal powders

These can be incorporated into gel coats or into mass castings.

If the filler is expensive, i.e. bronze, it is practical to incorporate the filler into the gel coat only.

If inexpensive stone dust or fillers are used it is more cost effective to include these in the entire mass casting as this will involve only one process and the incorporation of the filler could lower the overall cost of material used.

Incorporation of decorative stone and sand fillers

As a first step, these materials should be washed, dried and graded.

- **Washing** -removes any chemical impurities such as residual salts that will have an adverse effect on set time. Please note that some fillers although “clean” may have a latent Ph which can affect set time.

- **Drying** -ensure that no additional water is added to the mix, as this will impair the strength development.

- **Grading** -removes very fine particles that severely limit the amount of filler that can be added as smaller particle size, fillers “absorb” a higher proportion of the liquid components.

Ideally, the filler target particle size distribution should be between 0.5mm – 3mm.

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All filler should be evaluated before use in production to assess their impact on set time and to determine the amount of filler that can be added to M1 and maintain good working properties.

Fillers that have irregular, fissured or crystalline structures will absorb more of the base liquid material and therefore allow less filler to be incorporated. These fissured fillers and to hold onto water and thus delay the final strength development of M1.

Method of assessing the filler loading capability and impact on set time of particular fillers in M1

- **Step 1: Mix** a control sample of 100gm (Component A) and 45gm (Component B) and determines and record the initial set time.
- **Step 2:** Weight out a separate quantity of 100gm (Component A) and 45gm (Component B) into separate containers.
- **Step 3:** Weight out 200gm of the desired filler.
- **Step 4:** Add the filler separately to both the A and B components continuously stirring it in. Addition should cease when the viscosity of the Components reaches a level where any further addition would render the product unworkable.
- **Step 5: Now** weigh the remaining filler. This will enable calculation of the percentage of the filler that can be included i.e. say 120 gm of the initial 200gm of pre weighted filler has been used the filler incorporation percentage can be calculated as follows: 120gm divided by the 200gms of A and B weighed out in Step 2 will give an incorporation percentage of 60%.

Now the set time of product with the filler included must be evaluated.

Mix the filled A and B components together and determine the set time.

Set time influences and correction

If the set time differs from standard, this can be caused by contamination or “latent” pH of the filler.

If the set time has **decreased** this is either due to traces of metal salts or a low “latent” pH. Provided the material sets and develops full strength this set time can be corrected by the use of Master Works™ Retarder.

If the set time has **increased** this could be due to sodium/salt contamination or a high “latent” pH. This slower set time can be corrected by use of the Master Works™ Accelerator. Add the accelerator in 0.2% increments on total mix weight until the desired set time is reached.

However, if the delayed set is more than four times that of the standard then select another filler to provide the results desired.

Filled gelcoats

If filled M1 is to be sprayed as a gelcoat then the use of Master Works™ Thixotrope will assist in adjusting the gelcoat to the correct rheology and preventing slumping on vertical surfaces.

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When using stone dust fillers in order to achieve a realistic stone finish the surface should be abraded following demoulding.

This can be achieved by one of the following methods:

1. Washing with hot water and rubbing with abrasive cloth (Scotchbrite)
2. Dry sanding with sand paper if a flat surface is desired.
3. Grit blasting where a more aged and pitted surface is desired.

Incorporation of metal powders/fillers

Most types of metal fillers can be combined with Master Works™ to create decorative finishes with the exception of **aluminum**, which creates a gaseous reaction.

However if any other metal filler gives rise to gas generation this indicates incompatibility and the filler should not be used with M1.

Metal fillers fall into three main groups of particle shape: spherical, irregular and flake.

The choice of metal filler will largely be determined by the surface appearance required and what is available from the local supplier industry.

Metal filler loadings are determined by the same method as outlined above.

In selecting metal fillers the following general observations regarding the influence of particle shape apply:

Spherical particles allow greater pacing density and are easier to incorporated but give a slightly less metal-rich surface.

Irregular particles, around 350 mesh, give good results but the surface will require post mould treatment such as abrading back with metal wool or firm abrasive paper to expose the metal particles. The surface will then require patination and applications of wax to give luster and the appearance of metal.

Flakes, although more expensive, are more economical in use as lower amounts can be used as the flakes tend to layer and overlap and give a good quality metal surface without post mould treatment and the labor this entails.

3. FILLERS TO ALTER PHYSICAL AND MECHANICAL PROPERTIES

Fiber

The inclusion of chopped or unstructured fiber will enhance flexural, tensile and impact resistance properties. As there are many fiber types available, it is only possible to discuss this topic in general.

The method described above should be used to determine the appropriate addition rate of any selected fiber.

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It should also be noted that some glass strand is sized with a silane binder, this will prevent a full bond with the M1 and the maximum benefit from the fiber will not be achieved, there will however be some benefit.

Nylon fiber develops a good bond and enhances flexural, tensile and impact resistance.

Carbon, as prepared for today's industries have little benefit, the bond tends to be poor, so little is gained from the high tensile potential that is its highest yielding property.

Chopped E glass strand, in either 6mm or 13mm lengths, is commonly incorporated and gives good benefits in terms of enhancing flexural, tensile and impact resistance properties.

We recommend in our laminating methodology the inclusion of 6mm or 13mm chopped E glass in the spacer layer as this material is very easily workable.

Natural fiber such as sisal, coir and bamboo has many good characteristics, staining can be an issue and this can take place over time so careful examination is essential if colorfastness is important.

Generally, fiber should be mixed in gently as high shear can disrupt the fiber and form clumps (agglomerations).

Lightweight fillers

The inclusion of lightweight fillers will reduce the density of the product; this can be of benefit in the back up mass castings behind decorative gelcoats.

This technique can also be used in the spacer layer between the 2 layers of multiaxial reinforcement fabric when making a laminate.

Use the same method as described above to determine percentage loading. Some glass may have a negative effect on set time, some glass hollow spheres have free sodium attached, which will slow set time.

Very fine and absorbent materials should be avoided, if hollow spheres are being considered care should be taken when mixing in as violent high shear will break up the spheres.

As a general rule the inclusion of lightweight filler will reduce the compressive strength of the product, this will have a relative effect on other physical and mechanical properties.

As a guide, smooth spherical particles will greatly reduce flexural properties and have a poor bond with the matrix. Irregular particles with a high degree of mechanical key will give much greater flexural performance.

4 FILLERS TO REDUCE COST

There is a wide range of bulking fillers available and these will vary from location to location.

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Again, percentage loading and any effect on set time should be assessed by the above method and the comments on purity and particle size noted.

Obviously in order to reduce cost the cheapest material will have the most impact but care should be taken that the supply quality and consistency of the filler can be maintained.

These fillers could be calcium carbonate, sand, crushed aggregate etc. Good particle size distribution will also allow greater packing density. Material with a high percentage of fines should be avoided.

Effect on properties will be directly linked t the properties of the filler e.g. softer fillers will reduce compressive strength and surface hardness, harder fillers will increase these properties.

5. APPLICATION METHODS FOR FILLED MASTER WORKS™ M1

It is not possible to pump filled material through the double action piston pumps that are used for the continuous processing of unfilled material. This is because most of the fillers described above are either abrasive or will clog the contact areas on the valves of the pumps and therefore render the machine inoperable.

The recommended method of spraying a filled material would be to use a hopper gun, such as Sagola Premium 429 Hopper Gun. Alternatively the same gun is available with a bottom feed (Sagola Premium 419 Pressure Gun) that can be fed by a pressure pot.

Obviously, care should be taken that the mixed material in the pressure pot has been appropriately retarded for the duration of the spray operation.

Alternatively, if the filled material is being used for a gelcoat, this can be applied by brush and then the backing reinforcement can be applied by using the conventional Master Works™ M1 through the continuous process equipment.

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