Adapting Machines For Hard To Handle Fillers

A cultured marble or solid surface matrix is created by blending resin with filler, pigment, and catalyst in either a batch or continuous process. Each of these raw materials can have specific issues that affect flow and accurate metering of the materials. This article will discuss the issues related to obtaining a consistent flow and accurate metering of filler in Ground Hoppers, Batchmasters, and the Autocaster RC / Ultra / Economizer casting machines.

1.0 Background

1.1 Equipment Used In Handling Filler

When discussing hard to handle fillers, it is important to understand which components of the Batchmaster and Autocaster are involved in handling fillers.

Standard Ground Hopper – The standard Ground Hopper is a hopper that is connected to a motor, gearbox, auger and auger tube assembly. It is used to deliver filler to the metering hoppers on Batchmasters or Autocasters. The standard Ground Hopper is used with a bulk bag suspender frame or a bulk bag gantry to handle bulk sacks of filler.

Pneumatic Ground Hopper – A Pneumatic Ground Hopper is a hopper that uses a pneumatic diaphragm pump to deliver filler to a metering hopper located on a Batchmaster or Autocaster. The Pneumatic Ground Hopper is used with a bulk bag suspender frame or a bulk bag gantry to handle bulk sacks of filler. The Pneumatic Ground Hopper is good at handling lightweight filler concentrates or blends and can be positioned further away from the Batchmaster or Autocaster.

Filler Metering Hopper – The Filler Metering Hopper is a hopper that is placed at the top of the Batchmaster or Autocaster. The hopper contains an auger, gearbox and motor that is used to dispense the material from the hopper at a specific rate. In the Autocaster, a variable frequency drive (inverter) is used to control the speed of the auger and change the feed rate in response to the recipe and output rate desired.

Filler Drop Tube / Mixing Auger Packing Section – On the Autocaster, the Filler Metering Hopper discharges material through a Filler Drop Tube into the Mixing Auger Packing Section. The Filler Drop Tube is inlet to the mixing auger and is attached to the auger barrel. The Mixing Auger Packing Section is the first section of the mixing auger and is located under the Drop Tube. It draws the filler down into the mixing auger where the resin, base color, and catalyst are introduced.

Hard to handle fillers are those fillers that have issues with consistent flow through the Ground Hopper, Filler Metering Hoppers, Filler Metering Hopper Discharge Elbow, and Filler Drop Tube / Mixing Auger Packing Section.

1.2 Metering Methods

When dealing with hard to handle fillers, it is important to understand what methods are used when metering the materials.

Ground Hopper – The Ground Hopper does not meter the filler materials unless it was specifically designed to do so for a certain application (Example: putting a certain amount of filler into a mix tank). In cultured marble and solid surface applications, the Ground Hoppers are turned on or off.
by the level sensor in the Filler Metering Hopper on the Batchmaster or Autocaster. Issues arise when the hard to handle fillers prevent the Ground Hopper from supplying enough material to the Filler Metering Hoppers for the Batchmaster or Autocaster to operate properly.

Batchmaster Volumetric Metering – The Batchmaster has two possible ways of metering filler. The first is volumetric metering. In volumetric metering, a calibration is run to establish a factor that specifies how much filler is dispensed per revolution the auger into the mixing vessel. This calibration factor is used along with the recipe and batch size to determine how much filler is dispensed into the mixing vessel. Anything that affects the consistent flow of filler will impact the calibration factor and how much material is dispensed during the production cycle.

Batchmaster Weight Loss/Weight Gain Metering – The second method of metering use by the Batchmaster is a scale-based calculation. In this method a scale is placed either under the mixing vessel or under the Filler Metering Hopper. A weight gain or weight loss calculation is done in combination with the recipe and batch size to control the metering of the filler into the mixing vessel. The hard to handle fillers would not impact the metering of the filler but might extend the time required to dispense the required amount of material due to filler handling issues.

Autocaster Volumetric Metering - The Autocaster uses volumetric metering. In volumetric metering, a calibration is run to establish a factor that specifies how much material is dispensed per revolution of the filler metering auger at a specific motor speed. This calibration factor is used along with the recipe, drive factor, and output rate to determine the amount of filler that is dispensed into the mixing auger to meet the desired output. Anything that affects the consistent flow of filler will impact the calibration factor and how much material is dispensed during the production run.

2.0 Hard To Handle Filler Issues

The main fillers used in the production of cultured marble and solid surface material are calcium carbonate, alumina trihydrate, lightweight filler, and granite effect fillers. Each of these fillers is available in a range of particle size distributions and blends. Each has its own unique material handling characteristics. Given the unique characteristics, other factors can make the fillers hard to handle:

Moisture – Moisture in any of the fillers can cause clumping and bridging of the filler as it moves through the equipment.

Inconsistent Particle Distribution – An inconsistent particle distribution can cause issues with movement and metering of the filler. An inconsistent particle distribution makes it difficult to accurately calibrate the Batchmaster or Autocaster and can affect the look and viscosity of the material.

Lightweight Filler – Lightweight filler can cause issues with the movement and metering of the material. In the concentrated form, lightweight filler can free flow through the metering hopper and make it difficult to get an accurate calibration factor.

Particle Packed Filler – A particle packed filler has been engineered with a variety of filler particle sizes to minimize the amount of resin required to wet out the filler. This can also lead to issues with material flow since there is less room between the particles and all of the particles nest well with each other.
3.0 Ground Hopper Issues

3.1 Ground Hopper Dust Containment

Ground Hopper dust containment can be an issue with any filler type but is a major problem with light weight fillers. The solution is a Ground Hopper Cover. Gruber Systems can provide a factory-built Ground Hopper Cover or the machine operator can fabricate and install an Operator Installed Ground Hopper Cover.

Gruber Ground Hopper Cover – The Gruber Ground Hopper Cover is a steel cover with circular opening for sock and with access doors. It is powder coated, gasketed, and bolted to Ground Hopper frame. Optionally, a clamp ring can be provided to secure the outside sock to the Ground Hopper Cover while the inside sock is opened to allow filler flow into the Ground Hopper.

Operator Installed Ground Hopper Cover – Cut a piece of plywood board to the size of the top of the Ground Hopper. Cut a hole cut in center of the plywood for bulk bag sock to stick through (the hole should be slightly smaller than the diameter of the bulk sack sock). This board is placed on top of the the Ground Hopper. When the sock is opened, filler will fall into the hopper and seal as the filler flowing into the hopper backs up and the sock expands against the side of the hole in the plywood. You can also create an access door opening by cutting an opening and covering with a larger piece of plywood attached with a hinge and latch.

3.2 Bulk Sack Discharge

Bulk Sacks are positioned above the Ground Hopper using either a Bulk Bag Suspender Frame or a Bulk Bag Gantry with Bulk Bag Suspender, hoist, and trolley. Some fillers do not flow well out of the bag due to particle packing, moisture content or other issues. One solution is a Pneumatic Bulk bag Massager. The Bulk Bag Massager can be mounted on the Bulk Bag Suspender or on the Ground Hopper itself. It consists of metal paddles that are moved by pneumatic cylinders to push against the sides of the bulk sack to move the material.
3.3  Air Puffers For Ground Hoppers

An Air Puffer is a bolt on aerating vibrator that is installed inside the Ground Hopper. It vibrates as air passes between the pad and Ground Hopper wall. Periodic air pulses create a parallel air flow to the hopper wall to dislodge compacted material.

3.4  Ground Hopper Agitation

The Ground Hopper includes a metal screen that is positioned above the auger inlet. The screen prevents any trash from making its way down to the Ground Hopper Auger and also provides a spot to attach a vibrator that shakes the screen to prevent bridging and move material down towards the Ground Hopper Auger. Sometimes due to moisture, particle packing or other issues, the filler can still bridge and not consistently flow down to the auger. This can cause issues in maintaining the flow of material into the Filler Metering Hopper. One solution is to provide a constant slow agitation of the filler material in the Ground Hopper. The drawings below show the placement of the agitator in the Ground Hopper.
3.5 Ground Hopper Auger / Auger Tube Tolerances

The Ground Hopper Auger and Auger Tube are designed to work together to move filler from the hopper to the Ground Hopper discharge elbow while providing enough of a gap to prevent unnecessary wear on the auger and auger tube. The tolerance has been set to handle the most frequently used fillers. When using lightweight fillers or fillers that have an inconsistent particle distribution that contain a lot of fine particles, the standard Ground Hopper Auger / Auger Tube tolerance can allow some of the filler material to flow back towards the hopper. The resulting inefficiency of the Ground Hopper Auger / Auger Tube would create periodic problems keeping filler in the filler metering hopper. The solution is to tighten up the tolerance between the auger and auger tube to prevent this back flow. If you believe this maybe an issue, contact Gruber Systems Engineering department to discuss the issue and develop a solution.

3.6 Ground Hopper Auger Pitch Changes

Auger pitch refers to the distance between corresponding points on consecutive turns of the auger flighting. This pitch can be changed or varied over the length of the auger to help the auger pickup and move the filler. For example, the augers used on polymer concrete ground hoppers have a smaller pitch over the opening to the auger and a larger pitch over the remainder of the auger.

4.0 Filler Metering Hopper Issues

4.1 Dust Containment For Filler Metering Hoppers

The Filler Metering Hopper is installed on top of the Batchmaster or Autocaster. A fiberglass cover is provided for the Filler Metering Hopper that has a round opening to allow the filler to flow into the hopper. A filter sock and hose clamps are used to connect the discharge elbow on the Ground Hopper to the round opening on the Filler Metering Hopper Cover. Typically, dust issues associated with the filler metering hopper come from two areas:

1. The filter sock is not connected to the round opening on the Filler Metering Hopper Cover. It is fairly common to see that the filter sock clamp has been removed and the filter sock is just sticking down into the round opening on the Filler Metering Hopper Cover. This allows dust to escape from the hopper as filler is discharged from the Ground Hopper. The solution is to clamp the sock to the round opening on the Filler Metering Hopper Cover.

2. The Filler Metering Hopper Cover is typically not firmly attached to the top of the Filler Metering Hopper. This can result in dust escaping from the filler metering hopper. There are a couple of solutions that are used. First, industrial Velcro can be placed on the top of the Filler Metering Hopper and the corresponding area on the Filler Metering Hopper Cover. This allows quick access to the hopper when needed. The second method would be to drill holes in the top of the Filler Metering Hopper and Filler Metering Hopper Cover and use bolts, nuts, washers, and a foam gasket material to seal the cover to the hopper. This results in it takes more time to remove the cover when access to the inside of the filler metering hopper is needed.
4.2 Air Puffers For Filler Metering Hoppers

An Air Puffer is a bolt-on aerating vibrator that is installed inside the filler metering hopper. It vibrates as air passes between the pad and filler metering hopper wall. Periodic puffs of air create a parallel air flow to the hopper wall to dislodge compacted material. Air Puffers are not recommended for lightweight fillers.

4.3 Filler Metering Hopper Agitator

The Filler Metering Hopper includes a level sensor, an anti-bridging sensor, and a metal screen that is positioned above the auger. The screen prevents any trash from making its way down to the auger and also provides a location to attach a vibrator that shakes the screen to prevent bridging and help move material down towards the auger. The vibration is triggered by the anti-bridging sensor when the sensor does not see any material. Sometimes due to moisture, particle packing or other issues, the filler can still bridge and not consistently flow down to the auger. This can cause issues in maintaining the flow of material into the Filler Metering Hopper. This will result in issues in consistency of the filler metering or changes in the viscosity of the matrix produced. One solution is to provide a constant slow agitation of the filler material in the metering hopper. The drawings below show the placement of the agitator in the ground hopper.
4.4 Filler Metering Hopper Auger / Auger Tube Tolerances

The metering hopper auger and auger tube are designed to work together to move filler from the hopper to the discharge elbow while providing enough of a gap to prevent unnecessary wear on the auger and auger tube. The tolerance has been set to handle the most frequently used fillers. When using lightweight fillers or fillers that have an inconsistent particle distribution that contain a lot of fine particles, the standard metering hopper auger / auger tube tolerance can allow some of the filler material to free flow or have inconsistent flow characteristics. The result in inconsistent metering of the filler. The solution is to tighten up the tolerance between the auger and auger tube to help prevent these issues.

4.5 Filler Metering Hopper Auger Pitch Changes

Auger pitch refers to the distance between corresponding points on consecutive turns of the auger flighting. This pitch can be changed or varied over the length of the auger to help the auger pick up and move the filler. For example, a lightweight filler concentrate can have a tendency to free flow. This will result in inconsistent metering of the filler. In this case, the lightweight concentrated filler might need a larger pitch in the material pick up area and a smaller pitch as it moves the filler down the auger tube.

4.6 Filler Metering Hopper Discharge Elbow

The Filler Metering Hopper Discharge Elbow is positioned at the end of the auger in the Filler Metering Hopper. It directs filler down into the Filler Drop Tube and into the Mixing Auger Packing Section. At times, filler can pack in the Filler Metering Hopper Discharge Elbow and not drop or not drop in a steady flow. This will result in issues with the viscosity of the matrix. One solution is to place a vibrator on the Filler Metering Discharge Elbow to dislodge any packed material.

4.7 Metering Hopper Overfill / Not Filling

The Filler Metering Hopper uses a capacitance sensor to start and stop the Ground Hopper when filling the Filler Metering Hopper with filler. The Filler Metering Hopper can be overfilled or not filled when the Capacitance Sensor is not adjusted correctly. Light weight fillers or blends are especially prone to overfilling. The solution is to adjust the sensor by holding the filler in front of the sensor and using the screw adjustment located on the body of the sensor to adjust the sensitivity until the sensor picks up the material (A LED light on the sensor indicates when the sensor sees material).

5.0 Filler Drop Tube / Mixing Auger Packing Section Issues

5.1 Filler Drop Tube / Mixing Auger Packing Section (Applicable To Autocaster Only)

Filler flows through the Filler Metering Hopper Discharge Elbow through the Filler Drop Tube and into the Mixing Auger Packing Section. Filler flow issues can occur in this area. Moist or particle packed fillers can sometimes clog up the Filler Drop Tube and interrupt the free flow of filler into the Mixing Auger Packing Section. This can be a result of the physical properties of the filler itself or as a result of the cleaning cycle. To combat the physical properties, vibrators can be placed on the filler drop tube to get the filler moving again. Issues related to the cleaning cycle are due to the cleaning solvent getting back up into the auger packing area and drop tube. This can wet out the material and cause it to clump and build up. This is usually a result of too much solvent or purge air blowing the solvent back into the area. To correct this, the auger needs to be disassembled.
and cleaned, the air flow to the solvent diaphragm pump needs to be adjusted to decrease the solvent volume, and the purge air flow needs to be adjusted to ensure that it does not blow solvent back into the area.