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## **TIPS FOR TROUBLE SHOOTING AUTOMATED DISPENSE EQUIPMENT**

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In our experience, the following symptoms are encountered most often:

- 1) The cured material is too soft.
- 2) The gel time is too long (longer than expected).
- 3) The cured material contains soft spots (lead/lag problems).
- 4) The material cures too quickly.
- 5) The material shrinks too much during cure.
- 6) Air bubbles in the mixed product.
- 7) The cured product appears to have streaks or blush on the surface.

### **General:**

#### **Equipment related**

Automated dispense machines are carefully designed to accommodate specific types of materials, specific types of fillers, mix ratios and the application requirements at hand. They must be maintained at regular intervals according to the manufacturer's recommendation. Worn components such as seals, check valves and pneumatic components must be replaced regularly to insure proper, trouble free operation.

In most cases, there is a delicate balance between the pressure that is required to dispense the material and the resistance that is presented against the flow of the products through the dispense lines prior to the mix head. Any blockages, improperly timed or leaky check valves or leaky piston seals will upset this balance resulting in problems.

There are two basic types of mix heads in common use to day. The static or motionless mix head is most common. These are usually made out of plastic containing spiral like elements and are disposable after use. Some are made out of stainless steel, employing the same principle of mixing, and are reusable. The dynamic mix head is the other most common type employed. This type of mix head has a built in mechanical blade that turns at a pre-determined rpm to mix the components as they flow through the mixing chamber.

For obvious reasons, it is critical to keep the mix head clean and free of blockages. In the case of dynamic mix heads, depending on the type of fillers employed in the formulation being processed, it is important that the mix blade is made out of a material having sufficient hardness not to wear too quickly. Dynamic mix heads also tend to generate heat during the mixing action. This heat can raise the temperature of the mixed material to unsatisfactory levels. In addition, the eroding mix blade can contaminate the mixed material with minute metallic particles that are detrimental in certain applications such as electrical or electronic device encapsulation. Proper design is extremely important.

There are several variations of dispense mechanisms in use to day. Many of these provide continuous material flow meaning that the back end of the piston is being filled while the material is dispensed in the forward motion. The reverse takes place while the pistons move backward. Other systems dispense only while the piston is moving forward and there is a period of time that is required to re-charge after the piston is emptied. Other systems employ electronically controlled auger type mechanisms. All these systems are capable of delivering highly accurate amounts of material in the correct ratio if appropriately maintained according to the manufacturer's instructions.

There are numerous variations in the type of adaptors available to deliver the mixed material from the mix head to the component being potted or encapsulated. These are usually in the form of flexible hoses or pipes equipped with the appropriate orifice to inject the mixed product. The length of these devices must be kept to the minimum and careful consideration must be given to the mixed viscosity and the available pot life during selection. Any restrictions to material flow and/or material nearing the end of its pot life residing in this device are both undesirable.

### **Material related**

There are numerous variations of formulated products that are processed through automated dispense equipment. The most significant properties affecting dispensability are as follows:

- 1) Miscibility (the ability to mix one component into the other)
- 2) Abrasiveness.
- 3) Vapour pressure.
- 4) Component and mixed viscosity.
- 5) Filler types (if any).
- 6) Moisture sensitivity.
- 7) Gel time.
- 8) Processing temperature.

Materials that are harder to mix will require longer mix times or longer static mix heads with more elements. Abrasive products (abrasive fillers) will require hardened machine components. High viscosity products may require heat (heated reservoirs and supply lines) to process. Moisture sensitive products will require dry air and process conditions.

Shorter gel times will require frequent discharge from the mix head to prevent freezing up.

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### **GOLDEN RULE:**

**Before attempting anything else**, confirm that the material is free of large solid particles and cures as it should **by carefully weighing each individual component and hand mixing a sample**. If it cures according to the manufacturer's specification, the material is good, proceed with one or more of the following checks.

**To confirm that a lead/lag problem exists use the Bead Test**

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## Specific trouble shooting items:

### Check List:

- 1) **Check that the correct amount of resin and hardener is dispensed just prior to the mix head.** This is best accomplished by removing the mix head and placing individual cups under each opening, dispensing the material and weighing the contents of each cup. Depending on the location of the ratio check valves, a simple ratio check does not always reveal the problem because these valves are often located before lengthy feed lines and checks at this point will not reveal off ratio situations caused by back pressure.
- 2) **Check that the mix head is clean and clear of obstructions.** If the equipment has been functioning properly for some time and this problem has not been encountered before, it may be assumed that the mix head is doing its job. If the materials being dispensed are different from before or the system frequently encountered this problem all along, it may be worth while to consult the supplier of the mix head. Some products are harder to mix together than others. The number of elements, the diameter and/or the length may have to be increased. In the case of dynamic mix heads, the orifices or rpm may have to be adjusted.
- 3) **Check that the solvent flush valve is functioning properly.** Leaky solvent flush valves can allow cleaning solvent to enter the mix and interfere with the reaction, cause bubbles and soft spots. On the other hand, valves that don't fully open will not allow the lines and/or mix head to be flushed clean, leaving residual amounts of mixed material to gel or cure causing partial blockages.
- 4) **Check the dispense lines for obstructions.** Reduced dispense line diameter, due to settled fillers or gummed up material, could not only cause increased back pressure but also cause insufficient supply of the effected component, especially in the presence of the increased back pressure.
- 5) **Check the timing and synchronization of check valves.** Some shut off valves are mechanically linked to each other while others are operated individually but in sync by electronics. If they are not exactly in sync, there will be extra resin or hardener in the line and the next shot will be off ratio. Some equipment manufacturers use solenoid valves for this purpose. Particles preventing the valve from seating properly are hard to detect. Just because the valve clicks does not mean that it is fully opened or fully closed.
- 6) **Check the timing and synchronization of dispense pistons.** These pistons are mechanically linked on some equipment to facilitate changing the mix ratio. The ratio is changed by adjusting the amount of travel for each piston by adjusting a single linkage. Any worn part on this linkage could result in problems if the pistons do not start dispensing at the same time.
- 7) **Check for worn or leaky check valves.** Leaky seals or worn components will allow one of the components to leak past the valve after it is shut off. The following shot of material will be off ratio. This condition could also change the balance between the dispense pressure and the back pressure with the result being random off ratio problems. Worn or damaged components can also result in the inclusion of air into the material. Air can be sucked in as the product flows through the valve. This included air can either cause the mix to go off ratio or exhibit itself as air bubbles in the curing material. The inclusion of moist air into moisture sensitive materials will make this problem worse.

- 8) **Check for worn or leaky (dispense) pistons.** Pressure begins to develop as soon as the material is pressed toward the mix head. Due to this pressure material will leak past the seals if they are worn or damaged. The result will be an off ratio mix and lead/lag problems.
  
- 9) **Check the temperature of supply lines.** Some machines are equipped with heated supply lines to facilitate processing high viscosity (usually highly filled) materials. In order to prevent filler settling, it is paramount to keep the material moving through heated lines. Settled fillers will further compact as back pressure is developed and will result in partially blocked lines and an off ratio mix.
  
- 10) **Check resin and hardener reservoirs for filler settling.** Reservoirs without agitation, especially those that contain filled materials, tend to encounter filler settling problems. Malfunctioning agitators, especially on heated reservoirs, will have the same problems. Some dispense equipment is designed to pump product directly from the material supplier's containers. It is critical to make certain that the fillers are thoroughly dispersed and are kept in suspension until the containers are emptied. Settled fillers will cause a resin or hardener rich mix (depending on which is filled or missing more filler) and therefore will be off ratio.
  
- 11) **Check vacuum shut off (if so equipped).** Some material reservoirs are maintained under vacuum whenever the material is not being dispensed. The vacuum is shut off just before the dispense cycle begins. Any malfunction in this system could result in impeding material flow due to residual vacuum.
  
- 12) **Check compressed air supply lines and moisture traps.** Equipment requiring compressed air is prone to problems caused by fluctuating line pressure. This problem could be complicated by excessive moisture in the air supply. Severe problems could arise if moist air comes in contact with moisture sensitive material components due to leaking valves in the system.

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