

Processing PVC with MoldMAX® Tools

MoldMAX copper beryllium alloy tools are used in the continuous extrusion blow molding of bottles and packaging due to high hardness (30 to 40 HRC), high thermal conductivity (similar to aluminum) and corrosion resistance superior to aluminum and stainless steels.

Processing of polyvinyl chloride (PVC) can create hydrochloric acid (HCl) that can corrode even the corrosion-resistant MoldMAX tools. Resin compounding and processing must be controlled to prevent the generation of HCl. Damage to tooling by HCl can be prevented by proper compounding, processing, and maintenance. All of these variables must be in balance to avoid damaging the tools or processing equipment.

COMPOUNDING

PVC resins are typically compounded to suit the application. There are several additive systems used to produce PVC, two of which are important to the processor: lubrication and heat stabilization. These two additives work to minimize degradation of the PVC. Normally, the customer does compounding of his own when regrind is used. The following statement can be made regarding compounding:

The PVC compound must provide adequate heat stabilization and lubrication at maximum anticipated extruder output, maximum barrel temperatures, and should compensate for loss of heat stabilization due to the addition of regrind.

PROCESSING

Once it has been established that the resin is properly compounded, these processing conditions must be adhered to so subsequent processing does not degrade the material. The primary variables in processing are extruder output, controlled by barrel temperature, screw torque (as well as screw design), and mold temperature. The following statement can be made about processing:

Processing conditions under which properly compounded PVC is used must not cause degradation of the PVC and the subsequent generation of HCl. Additionally, processing

conditions should be selected that avoid condensation of moisture on the mold surfaces.

Extruder Output

An extruder that is undersized will force the processor to raise barrel temperatures and screw torque. Both will increase melt temperature and may cause degradation and generation of HCl. Faster cycle times raise the demands on the extruder and reduce residence times. The machine manufacturer should verify that extrusion/plasticizing capacity is adequate. Keep in mind that the high thermal conductivity of Moldmax tools will allow faster cycles than steel. Your resin supplier can assist you in determining if barrel residence times and throughput are appropriate.

Barrel Temperature

Barrel temperature must be kept within the range specified by the manufacturer. Exceeding this range will cause degradation of the PVC. Also, HCl may be formed, causing tool and machine damage. Typical melt temperature (not necessarily barrel temperature) is around 360 to 400°F (180 to 205°C). It is up to the processor to determine proper barrel temperature to keep the melt temperature in the proper range. Excessive shear heat can raise the melt temperature 15 to 20°F (8 to 11°C) over the barrel temperature. Inoperable, uncalibrated, or malfunctioning heater bands, thermocouples, or temperature controllers can result in melt temperatures above the recommended levels.

Regrind

Increasing the regrind percentage increases the possibility for thermal breakdown of the resin compound. Each time the material is processed through the extruder, some of the heat stabilizer system is consumed. Therefore, when this material is reprocessed as regrind, the heat stabilizer in the virgin material must also protect some portion of the regrind

material. If more regrind is used than can be properly heat stabilized by the virgin compound, either reduce the percentage of regrind used, or increase the amount of heat stabilizer added to the virgin resin during compounding. The amount of regrind should be kept constant. A common mistake is to reprocess large amounts of regrind, which is no longer adequately heat stabilized, causing temporary problems such as the generation of HCl.

Mold Temperature

The ideal situation is to keep the mold temperature above the dew point of the molding area so condensation does not occur. Condensation can interact with precipitated chlorine ions to create HCl and cause serious tool damage. Since the thermal conductivity of the MoldMAX increases with the temperature of the mold, productivity may not be adversely affected, depending on bottle design and desired cycle time.

MAINTENANCE

It is recommended that the molds be periodically cleaned with a denatured alcohol to remove any moisture buildup and condensed vapors from the resin. Also, leaking water lines should be repaired so that water is not dripped onto the molds. Water lines should be blown dry prior to being disconnected from the tool to avoid emptying the water lines into the mold prior to storage.

SUMMARY OF MAJOR POINTS

Damage to tooling by hydrochloric acid can be prevented by proper compounding, processing, and maintenance.

PVC compound must provide adequate heat stabilization and lubrication even at maximum anticipated extruder output, barrel temperatures, and the level of regrind to be employed.

Processing conditions under which properly compounded PVC is used must not cause degradation of the PVC, and the subsequent generation of HCl. Additionally, processing conditions should be selected that avoid condensation of moisture on the mold surfaces.

The resin compounder and machinery manufacturer are the best source for proper processing conditions.

SAFE HANDLING OF COPPER BERYLLIUM

Handling copper beryllium in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material. For additional information on safe handling practices or technical data on copper beryllium, contact Materion Brush Performance Alloys, Technical Service Department at 1-800-375-4205.

MoldMAX® is a registered trademark of Materion Brush Inc.

Materion Brush Performance Alloys

6070 Parkland Boulevard
Mayfield Heights, OH 44114 USA
phone: 216.486.4200 fax: 216.383.4005
e: BrushAlloys-Info@Materion.com

TECHNICAL INQUIRIES

ph: 800.375.4205

MATERION CORPORATION

www.materion.com

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