

Injection Molding with SAFOAM chemical foaming agents (CFA)

Benefits:

- Faster Cycle Time
- Lower Molded-In Stresses
- Eliminates WARP during process and long-term
- Lower Machine Energy
- Weight Reduction- 5-10% polymer replaced by a very fine closed-cellular structure inside a solid skin

TEMPERATURES

- Set up baseline temperatures at normal non-foamed molding conditions.
 - Get the weight of a solid, part
 - Start adding the CFA with the nozzle at normal solid injection temperature,
 - **Lower the transition and nozzle in 5°F increments** for a smooth skin and the greatest amount of reduction in sink/warp/density.
 - Note 1: As you increase CFA addition, you will find it necessary to continue to lower the nozzle temperatures (and possibly the zone before it) to control the flow/drool/etc.
 - Note 2: The gas dissolved in the polymer will significantly **reduce the apparent viscosity** of the polymer while under pressure, in the barrel. This allows (even necessitates) the lower temperatures of the nozzle, and continued good flow at these low temperatures. **Heated runners (hot-runners) are a hindrance if above the average melt temperature; Too hot allows gas escape, thus losing efficiency.**
 - Note 3: These temperatures allow for full activation of the CFA, which will allow for variable use rates of regrind without needing to adjust the CFA feed. **Better control; Less scrap.**

CHEMICAL FOAM ADDITION

Recommendation: **0.2% for Sink; 0.5 - 3.0% for Weight Reduction.**

- Add at the rear feed with the resin.
- Equilibrate the temperatures.
- **Shoot faster** to compensate for the reduced viscosity, and then raise or lower the CFA loading by 0.1% increments until you have optimized the part and its appearance. May go up to 3.0%, if needed.
 - Note: If as much as 3.0% is needed, we suggest lowering the temperatures at the feed, runner, transition, and nozzle, and then lower CFA usage
 - If **surface splay** is visible, speed up the injection in 10% relative increments, reduce the nozzle temperature by 10°F, and increase the hold by 0.1 second increments.
- **Special Note:** Do not dry the CFA with the resin or other additives. This lowers effectiveness and may cause clumping.

BARREL VENTS/VACUUMS

Block all open vents on the barrel. Open vents will allow the gas from the CFA to escape before reaching the nozzle. **Proper vents are expected in the mold** to allow the part to fill completely.

- **Mold:** Adjust as needed for desired surface quality.
- **Injection Conditions:** **inject rapidly, pack hard & quickly, and then drop the pressure.**
 - Barrel Back Pressure: Keep 150 – 400 psi (hydraulic) when filling the barrel. Higher = better. This keeps more gas in solution in the polymer, getting better efficiency and consistency.
- **Injection PSI:** Maintain the same psi as when unfoamed. Meaning, inject faster (100% relative) than typical.

- **Injection rate:** Try for > 3.0 cu. in./sec.
 - **NOTE: Inject 100-150% faster than a typical unfoamed shot.**
 - If seeing a silvery "splay" on the surface, do the following:
 - Ensure adequate venting (to allow gas escape)
 - Inject faster (to keep the gas dissolved in the polymer until the pressure drop after the pack)
 - Increase hold time in 0.1 sec. increments (only) until eliminated. Long holds reduce foaming.
 - Lower the Nozzle and previous zone temperatures, in 10°F increments (to keep gas in the polymer, reduces out-gassing)
 - Increase hydraulic backpressure in 25% relative increments to approx. 400 psi.
- **Injection Volume: Short shot by the targeted amount of materials reduction (i.e. short shot by 10% for 10% lighter parts). Short shot by 3–5% relative for sink/warp reduction.**
 - **Example: If adding 1% into a 1000g part, and wanting to reduce to a 900g part, the 1000g. (Approx.) shot becomes 900g, (or correlating cu.in, cm3, etc.).**
- **Again, inject rapidly, use a quick, strong pack, then drop the hold pressure to foam from within.**

PACK/HOLD PRESSURE: VERY IMPORTANT!

- **Inject as fast as safely possible**
 - May need to reduce shot volumes, when increasing injection rates, to control flashing.
 - *This hardens the skin without blemishes or splay, and allows the CFA to fill from the inside. The gas expansion cools the melt, further shortening cooling times.*
- **Cushion: Almost None.** Approx. 0.15 cu. in. (or 0.5 cm³) if must use to fill.
 - **Come close to bottoming out the screw.** Maintaining a cushion hinders the expansion/pressure drop needed to foam.
- **Hydraulic Shut-off Nozzle (optional):**
 - Great for keeping the gas in the polymer solution between shots.
 - Reduces nozzle drool with CFA's.
 - Allows greater consistency.
- **Cycle Times:**

The increased speed of the injection rate, the shorter pack/hold time, the reduced polymer amount, and the reduced cooling time from the expansion of the gas (from the CFA) in the final part will shorten the total cycle time by 15-25%, versus the same part, made without Reedy's CFA's.

 - Note: Try reducing the cooling time settings by 5% relative, with each shot, to determine the shortest cool cycle possible, when optimizing Reedy's CFA's for density/weight reduction.