Chemical Foaming Agents Injection Molding Guide

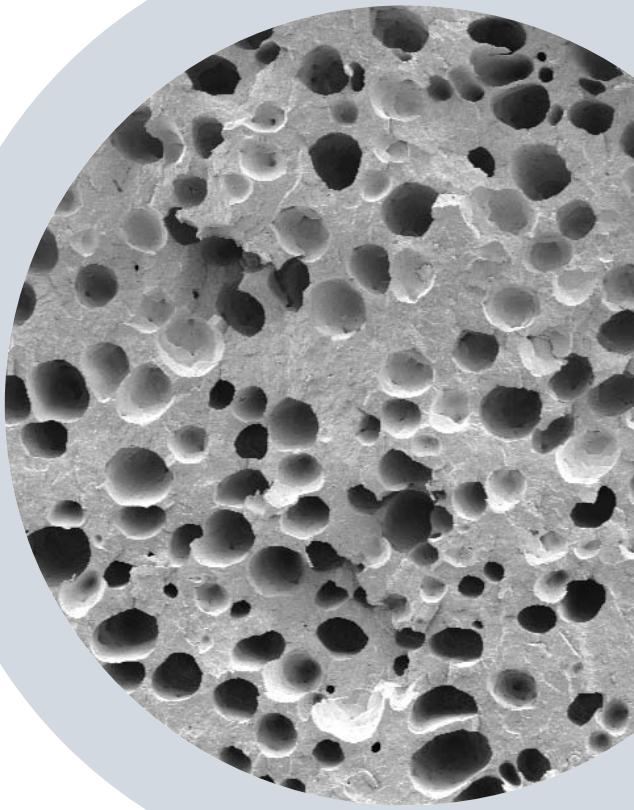
TecoCell

TecoCell® is a new generation of chemical foaming agents developed for injection molding to improve part qualities and process economics.TecoCell products offer many processing advantages for molders looking to lightweight plastic parts while maintaining their structural integrity.

Processing advantages using TecoCell chemical foaming agents include:

- Lighter parts
- Faster cycle times
- Better dimensional stability
- Elimination of sink marks
- Better surface finish
- Elimination of voids in thick sections
- Lower melt viscosity
- Lower clamping pressures
- Lower molded-in stress

TecoCell's unique, patented chemistry is easy to incorporate into your existing injection molding equipment without significant equipment changes.



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Trexel – A Better Way to Foam

Frequently Asked Questions

Q: Are samples available for trials?

A:Yes they are! We encourage trying the TecoCell product in your equipment with your process. Contact us at TecoCell@trexel.com to request a trial sample.

Q: What are the typical weight saving achieved when using TecoCell?

A:In general, a 10% reduction can be achieved with a 2% level of TecoCell H1 and process conditions in the range of 440 - 480°F with a nominal wall of 2.5 to 3.0 mm. However, the percentage of weight reduction will vary because it is a function of the level of TecoCell added, the part geometry, the process conditions and the gate location. Higher density reductions can be achieved using core back or for parts with short flow length and and for parts with a thicker wall such as floats.

Q: Do I need to reduce the shot weight to account for material expansion from the foaming action?

A:You will need to reduce shot weight to allow for gas expansion otherwise the solid shot size will cause the cell structure to compress.

Q: Does the mold need special venting to release some of the gas pressure generated inside the mold?

A:The TecoCell does not create added pressure in the mold cavity and in fact reduces the overall cavity pressure as the expansion of the CO2 replaces the traditional pack and hold pressure. Additional venting is recommended for maximum process optimization as trapped gas can inhibit the foaming process. For trial purposes, you may be able to improve venting by reducing clamp tonnage. Gas trap conditions in the mold will become worse with foaming due to the lack of pack pressure. Gas traps and back flow conditions will need to be vented or corrected through flow promoter.

Q: What effect does TecoCell have on impact resistance of the molded part?

A:Typically, foaming agents decrease the elongation at break of a material which is directly related to ductility. Impact resistance may vary based on the testing method used. Testing method like notched charpy or notched izod impact, in case of HDPE, do not show any change in impact resistance.

Q: What kind of shrink reduction could we estimate on PP and HDPE?

A:While foaming agents eliminate sink marks, you will actually see an increase in shrinkage. Shrinkage is a function of cavity pressure. As cavity pressure increases, shrinkage decreases. Foaming agents result in a much lower cavity pressure which lowers clamp tonnage requirements but also increases shrinkage. We expect about an 8% to 10% increase in the shrinkage of PP or HDPE. So if you design for 0.022 in/in of shrinkage, you can expect something closer to 0.024 to 0.025 in/in.

Q: How do I learn more about TecoCell?

A:Contact us at TecoCell@trexel.com for additional information.

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New Performance in Chemical Foaming

Trexel – A better way to foam.

Trexel Inc., widely known as the company that developed the MuCell physical foaming process applies its unsrpassed expertise to chemical foaming with the introduction of TecoCell. TecoCell is a new generation of chemical foaming agents utilizing patented chemistry for premium performance. Trexel is the first to offer both chemical and physical foaming solutions and the only resource with the knowledge base to apply the optimal foaming process to maximize results on each unique application.

TecoCell® chemical foaming agents

- Cleaner chemistry. No damage to the mold.
- Longer shelf-life due to use of hydrophobic coating
- Single reaction temperature leads to greater process control and reproducibility
- Patented nanoscale grind size which results in uniformly distributed microcellular structure for achieving greater dimensional stability and highest quality surface appearance

Competitive chemical foaming agents

- Many CFAs in the market give corrosive reaction byproducts detrimental to the environment and harsh on the mold surface
- Leading endothermic CFAs entail hygroscopic component which decreases shelf-life and product reproducibility
- Leading endothermic CFAs utilize two activation temperature which makes it harder to control the morphology and decreases reproducibility
- Broad distribution of cell size leading to localized non-uniformities in the molded part and surface appearance imperfections

TecoCell Chemical Foaming Agents' Advantages

TecoCell chemical foaming agents' unique, patented chemistry produces the smallest cell sizes achievable with a chemical foaming agent (50 – 200 microns). TecoCell technology uses uniform, nano-sized (≥0.08 micron) particles of $CaCO_3$ to release CO_2 and create microcellular structures in the polymer melt. The TecoCell chemistry produces more uniform dispersion throughout the part than is achieved by other chemical foaming agents (CFAs). Uniform cell structure throughout the part makes for better performance and greater dimensional integrity of the part.

Foaming with TecoCell products generally produces a 5 – 10% weight savings in an injection molded part. The amount of savings will be controlled by factors in the part and mold design. The wall thickness, flow length, vent placement, gate placement and other design features will be factors in the amount of foaming action that occurs in the injection molded part. Trexel engineers can advise on these parameters.

TecoCell chemical foaming agents act as nucleating agents eliminating the need for additional inorganic nucleating agents that could change the performance characteristics of the polymer.

The nucleation takes place at the interface between the TecoCell nanoparticles and the polymer. This heterogeneous nucleation increases polymer crystallization rates that reduce cycle time.

Caps and Closures

Automotive

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White Goods

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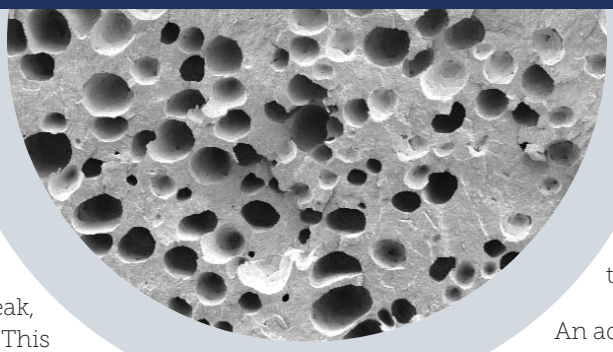

In general, the goal with foaming is to achieve the smallest cell structure possible to maintain mechanical properties, such as impact strength, tensile strength and elongation-at-break, all while reducing part density. This preferred small, closed cell structure produced with TecoCell products is crucial in keeping mechanical properties and part characteristics.

Exothermic vs. Endothermic CFAs

Many popular CFAs release nitrogen in an exothermic ("energy releasing") reaction. Exothermic reactions can release more energy during thermal decomposition than is needed for the reaction. Once thermal decomposition begins, it can continue spontaneously, even after stopping the external energy supply. To compensate for this excess energy, parts foamed with these CFAs must be cooled intensely for a longer period to avoid post-expansion. This extended cooling lengthens cycle time and requires additional energy. Exothermic CFAs (nitrogen-releasing) also liberate more gas per gram than endothermic CFAs (CO_2-releasing), and at higher gas pressures, thus producing larger cells.

Other issues with exothermic CFAs, for example, azodicarbonamide, include the production of hazardous reaction by-products that can corrode molds and are environmentally harmful. Exothermic CFAs can also have more than one decomposition temperature making it more difficult to control and reproduce consistent foaming.

Concerns about environmental hazards and corrosive by-products have led injection molders to move to endothermic CFAs.

Cleaner, Greener, Easy to Use

TecoCell products are endothermic ("energy absorbing") chemical foaming agents that outperform other CFAs without any of the accompanying hazardous reaction by-products. All ingredients in the TecoCell formulations and their reaction products are environmentally friendly. These materials are listed as "Generally Recognized as Safe" (GRAS) by the F.D.A. and are approved for food contact applications.

Because the TecoCell thermal decomposition reaction is endothermic (absorbs heat), it requires less energy and less time to cool the mold, reducing cycle time.

An added advantage of endothermic CFAs is that they must be thermally activated (heated) to initiate and maintain decomposition. Gas release stops quickly after termination of the heat supply. This feature gives the operator greater control over the part's thermal expansion.

TecoCell products have only one activation temperature going straight to CO_2, water and citric salts - all inert and benign. By comparison, many endothermic foaming agents have an intermediate reaction product of soda ash, causing plate out and mold corrosion. TecoCell chemistry provides a cleaner process and a more consistent conversion to CO_2.

The TecoCell formulations are stoichiometrically balanced so that all starting materials are consumed when the thermal decomposition reaction runs to completion. The TecoCell reaction products all have a neutral pH - so they won't eat up molds. (This is an added advantage in blow molding applications where TecoCell products have been used successfully in re-worked material.)

TecoCell formulations have been shown to reduce carbon footprint by up to 25% vs. the non-foamed part. Thus, your process becomes very lean with less material consumption, lower energy requirements and higher material throughput.

If you have tried chemical foaming agents in the past and have had dissatisfying results, then you should try TecoCell products. TecoCell products use an entirely different reaction chemistry!

- Smallest cell sizes achievable with a chemical foaming agent
- Cleaner, environmentally friendly reaction products
- More reproducible reaction conditions
- Highest quality surface appearance

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Usage Instructions in Injection Molding

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Trexel – A better way to foam.

Equipment:

Although TecoCell can be run on a typical injection molding machine if the nozzle is adjusted to a lower temperature, it is recommended to use a shut off nozzle and a tool with either a cold runner system or a valve gate to prevent drool.

Processing Parameters:

All TecoCell products have a single activation temperature of 393°F (200°C). The activation process must take place in the higher compression area or metering section of the screw. This will prevent the CO_2 gas from escaping through the material feed throat.

Preferred Melt Temperature should be as mentioned in the table below. Mold Temperature is generally cooler than the typical settings.

Injection Speed should be set as fast as possible to achieve maximum foaming agent expansion

Shot Size should be reduced by about the amount desired for the weight reduction of the part, generally up to 10%. Thinner walls and longer flow length give lower weight reduction.

Back Pressure should be set high enough for proper mixing of the concentrate and to prevent back flow of CO_2 gas.

Hold Pressure should not be used as it will interfere with the foaming system. The elimination of this step in the molding process will reduce cycle times.

Venting must be located at the end of the fill and generous to prevent short shots in the part.

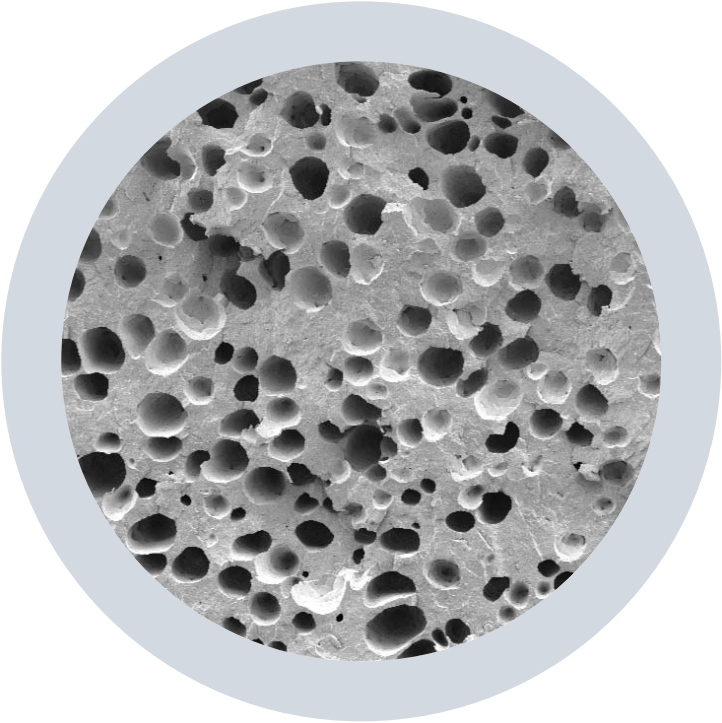
Clamping Pressure should be decreased to at least 1/2 the force used with the typical process. This will assist in the venting of the tool and prevent wear at the parting line.

Blending in Concentrate should be done with a typical volumetric or gravimetric feeder and should be used at 1-2.5%. Lower levels will not be effective and higher levels could cause excessive gassing on the surface of the part.

	Texel Microcelluar Foaming Products		
Recommended Conditions	**TecoCell® chemical foaming agents**		**MuCell® physical foaming systems**
Product	TecoCell H1	TecoCell GT	All systems
Foaming Agent	Carbon dioxide (CO_2)		Nitrogen gas (N_2)
Wall Thickness	~>2 mm		~<3 mm
Parts Production Volume	Low		High
Process Temperature	220°C – 260°C 430°F – 500°F	250°C – 290°C 480°F – 550°F	No restrictions
Materials	Polyolefins, Polystyrene, and for nucleation of these polymers when foamed with a physical blowing agent (MuCell)	PET, PETg, Nylon, PLA and other high temperature processing polymers	Virtually all polymers*
Filled/Unfilled	Unfilled		Filled
Water-Sensitive Polymers	+		++
Weight Reduction	+		++
Surface Appearance	++		+
Surface Flatness	+		++
Re-Grind/Re-Use?	Yes		Yes
Reduced Carbon Footprint vs. Solid Molding	Yes		Yes

*The MuCell process is not recommended with Liquid Crystal Polymers (LCP) due to a very limited solubility and the low viscosity of the material.

Trexel Inc., widely known as the company that developed and commercialized the MuCell® Process for the production of microcellular foamed parts in injection molding and blow molding, expands its foaming portfolio with the introduction of TecoCell® chemical foaming agents.



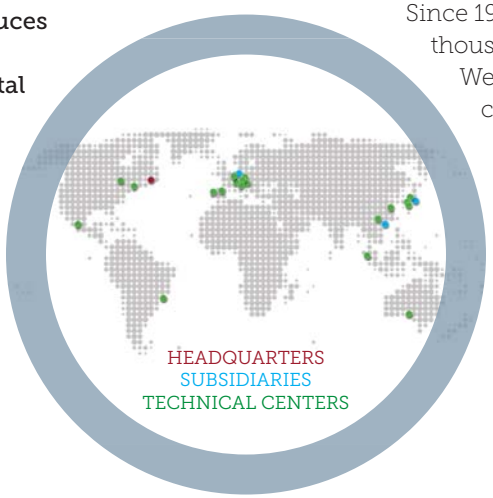
Trexel adds the TecoCell products to complement its MuCell product line for those applications where a chemical foaming agent offers cost and processing advantages.

From the global headquarters outside of Boston, MA, Trexel operates a state of the art plastics processing development laboratory, supporting plastics processors with the definition and implementation of leading and differentiating plastic molding technologies.

In support of a global client base, Trexel operates subsidiaries in Europe, Japan and Southeast Asia with competent plastics processing engineering capabilities. Trexel's worldwide subsidiaries are augmented by a network of competent independent representatives and distributors.

About Trexel

Trexel is in the business of providing technology which places tiny cells of gas in plastic parts, and our passion is manifested in the broader benefits that these micro bubbles can deliver. Our microcellular foaming technology **reduces production cost** while **increasing environmental sustainability.**



Our technology enables **lighter, more dimensionally stable products** which can be **produced faster** on **smaller, more energy efficient equipment.**

Since 1995 we have been applying our technology to thousands of applications in dozens of industries. We have developed unsurpassed know-how, continuously improved our technology and enhanced our services, growing into the **global leader in microcellular foaming technology** we are today.

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