

Masterbatches

Lighten Up
**HYDROCEROL[®] Chemical Foaming
and Nucleating Agents**



Exactly your chemistry.



HYDROCEROL®

Additive Masterbatches for Plastics



Clariant Masterbatches is recognized worldwide as the leader in color and additive solutions for the plastics industry. The family of HYDROCEROL chemical foaming and nucleating agents is a key component of Clariant's comprehensive product line.

HYDROCEROL concentrates are specified worldwide to reduce weight, improve performance, and optimize costs in products ranging from business machine housings, food and medical packaging to material handling systems, automotive parts and window profiles. HYDROCEROL masterbatches also add special visual effects and rigidity, and they allow the design of more functional, complex parts. Aesthetics and processability are also enhanced.

With superior technology, global presence and customer commitment second to none, Clariant is your partner in achieving leadership in your market.

Weight reduction and raw materials savings are only the first of many key advantages of foaming with HYDROCEROL chemical foaming agents (CFAs). Others include thermal and acoustic insulation, increased stiffness-to-weight ratio, improved surface texture and elimination of warpage and sink marks, together with more efficient processing.

HYDROCEROL chemical foaming agents produce foam by decomposing at processing temperatures, liberating gases into the polymer melt. The decomposition of the CFA can be either of an endothermic



or an exothermic character. In contrast, physical blowing agents are gases or low-boiling-point liquids that are injected directly into the melt to produce foam.

Exothermic CFAs release energy during decomposition. Once decomposition has started, it continues spontaneously after the energy supply has been stopped. Exothermic CFAs include hydrazines and azo compounds that are characteristically yellow in color and should be handled with care to avoid skin irritation.

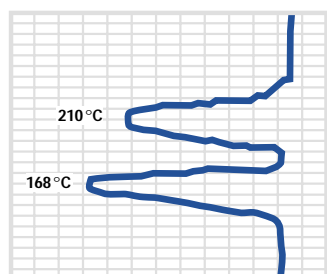
Endothermic CFAs consume energy during decomposition, requiring continuous energy input during the full reaction time. Endothermic CFAs are based on bicarbonate and citric acid, derivatives that are also used as food additives.

Available in various sizes of granules and as powders, HYDROCEROL foaming and nucleating agents can be used for foaming almost all commonly used thermoplastic resins and blends, such as the following:

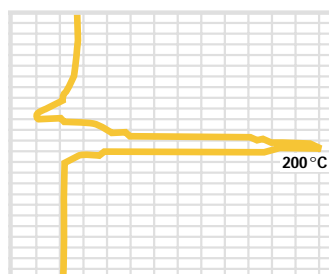
- PP, HDPE, LDPE, LLDPE
- PET, PETG
- TPE, TPU, TPR
- PVC
- PS, ABS
- PC, PC/ABS
- PA

The carrier systems of the masterbatches and additive combinations are specially developed for a wide variety of processes and applications, including the following:

- Foam extrusion, used in the manufacture of film, sheet, profile and pipes. The wide variety of applications for foamed extrusion products ranges from thermoformed packaging and profiles to foam core pipes.



DSC endothermic decomposition



DSC exothermic decomposition

- Foam injection molding, used in the manufacture of lightweight structural parts. HYDROCEROL CFAs produce a uniform, fine cell structure and smooth part surface, with reduced cycle times.
- Direct-gas extrusion, used in the manufacture of physically blown film and sheet. The addition of HYDROCEROL active nucleating agents produces more uniform, fine-celled foam structures.

Foam Extrusion

In the extrusion of chemically foamed products, the foaming agent masterbatch (or powder) is either pre-mixed with the resin or fed separately into the extruder. During processing, the temperature of the polymer melt activates the decomposition reaction of the CFA.

Gaseous components are generated and dissolved in the polymer melt by the extrusion pressure. The pressure gradient between the extrusion pressure and the ambient pressure as the polymer exits the die causes a cellular structure to form within the extrudate in much the same way uncorking a bottle of champagne causes the wine to foam. This cellular structure results in density reductions of 15 to 30% in films and sheets and 20 to 40% in pipes, profiles and boards.

Foam extrusion is used for the manufacture of cast film, blown film, sheet, profile and piping. The wide variety of applications for extruded foam products ranges from decorative ribbons to thermoformed food trays or cups to profiles for picture frames and foam core pipes.



HYDROCEROL PEX Series

The HYDROCEROL PEX Series is specially designed for Packaging EXtrusion applications where the thermoforming characteristics of the finished film are a key issue. PEX Series foaming agents produce an especially fine-celled foam structure, enabling thermoforming without surface defects. Density reductions between 15 to 30% are usual in standard monolayer as well as in co-extruded (e.g., A-B-A) applications. HYDROCEROL PEX formulations are available for most common packaging resins, such as PP, PE, PS and PET.



Foam Injection Molding



When used in the structural foam molding process, chemical foaming agents generate a cellular foam structure in the part interior. This technology delivers many advantages, including the following:

- Reduced part weights
- Reduced cycle times
- Reduced warping and sink marks
- Improved melt flow
- Improved dimensional stability
- Enhanced specific mechanical properties

In foam injection molding, the foaming agent masterbatch (or powder) is either mixed or fed together with the polymer. The reaction of the CFA and the compression of the gaseous components are comparable to those in the extrusion process.

The cavity is only partially filled with polymer melt during the injection phase, then expansion of the blowing gas completes the fill. No holding pressure or cushion is required during either cell growth or subsequent cooling. The foam injection process can be compared to co-injection technology, where component A is the used polymer and component B the gas from the CFA.

Density reductions ranging from 5 to 30% are possible with foam injection molding, depending on the ratio of foaming agent to injected resin. In special cases where polymer choice, part geometry and all other relevant process parameters are optimized, weight reductions as high as 50% are possible.



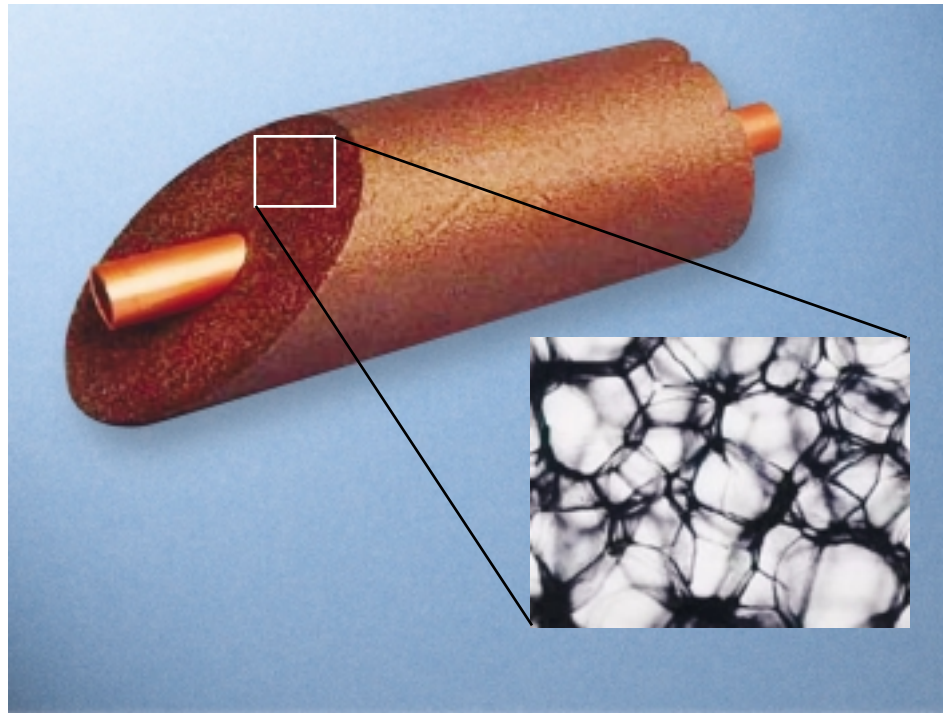
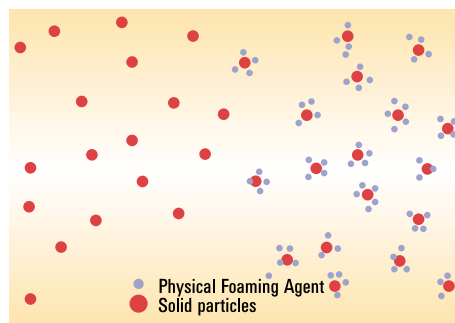
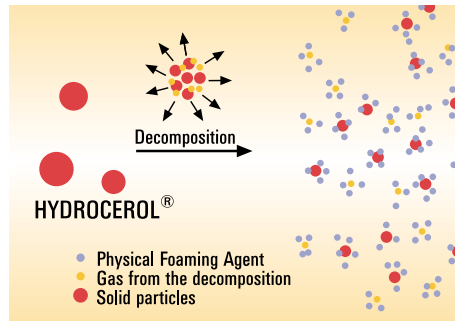
HYDROCEROL ITP Series

The HYDROCEROL ITP Series is designed for use in thin-wall parts requiring the elimination or reduction of sink marks and warpage. Typical examples are injection molded automotive and electronic parts, as well as appliance housings. ITP Series foaming agents will produce a micro-cellular foam with no adverse influence on surface appearance. The use of these products may lead to density reductions of 5 to 10% and lowers resin consumption.



Foam Nucleation

Direct-gassed extrusion of resins produces a rather coarse foam structure. Achieving a fine and uniform cell structure requires the addition of a nucleating agent. The nucleating agent creates nucleating sites where the physical foaming agent will come out of solution during foam expansion, providing a starting point from which the foam cells start to grow. If a nucleating agent can provide a high number of nucleating sites, more cells will be formed and the average cell size will be smaller.



There are basically two types of nucleating agents: passive (or inactive) and active nucleators.

Passive nucleators include solid materials with fine particle size. Talc would be a typical example. The efficiency of these materials is affected by the shape and size of the particles.

Chemical foaming agents, materials that generate gas upon decomposition, also act as nucleating agents. Mixtures based on sodium bicarbonate and citric acid powders or ready-to-use masterbatches are widely used as active nucleating agents.

The nucleation of direct-gassed systems with chemical foaming agents is called "active nucleation." Active nucleators are four to six times more efficient and provide smaller and more uniform cells than passive nucleators.

Foam extrusion with chemical foaming agents can achieve foam densities as low as 500 kg/m³. Lighter weight thermoplastic foams with densities as low as 15 kg/m³ can be produced only with physical foaming agents in a direct-gassed extrusion process. Using HYDROCEROL active nucleating agents produces a more uniform, fine-celled foam structure.

HYDROCEROL NUC Series

The HYDROCEROL NUC Series is designed to provide process-relevant nucleation solutions to specific application requirements. They are available as either active foam nucleators or as chemically inactive nucleating masterbatches, such as talc. NUC grades are typically supplied as PE- or PS-based masterbatches, corresponding with the resins most commonly used in physical foaming.

HYDROCEROL NUC grades are also available as blends of active and passive nucleating agents, combining the advantages of both types. These special products are supplied either as powders or as masterbatches.





HYDROCEROL For Special Raw Materials



Special base resin formulations often require special CFA solutions. These are provided by two additional HYDROCEROL Series, PLC for Plastic Lumber Composites and ESC for Elastomers and Soft Compounds.

HYDROCEROL PLC Series

Plastic lumber composites or wood composites are hybrid materials that maximize the performance and cost attributes of both wood and thermoplastics. Applications for these composites are mainly for outdoor use in the construction industry and in certain automotive applications.

Unfortunately, extruded wood composites do not provide the mechanical performance and workability of natural wood. However, these properties can be significantly improved by using CFAs to produce a foam structure within the profile. The cell structure enhances the sawing, gluing and painting performance of finished products, while also reducing their weight and resin consumption. The result is better performance at lower cost.

The HYDROCEROL PLC Series is specifically designed to meet the requirements of wood composites. Different grades are tailored for use with a variety of wood/resin grades in a wide range of applications. HYDROCEROL PLC grades are available as powders and as masterbatches, to complement multiple production technologies.

HYDROCEROL ESC Series

Thermoplastic elastomers or soft compounds are frequently specified to replace rubber today. As resins like TPE and TPU are used more widely, there is also an increasing need for suitable foaming agent solutions. The HYDROCEROL ESC Series meets this need, combining several different foaming techniques to fit the processing window of a variety of thermoplastic elastomers. When combined with optimal polymer selection, density reductions of 30% or even 50% are possible. Typical applications for the HYDROCEROL ESC Series include TPU shoe soles and artificial wine corks.

HYDROCEROL Additive Masterbatches

Product Line

Clariant provides a diverse and comprehensive range of chemical foaming and nucleating agents. The products listed in the chart below represent only a sampling of the comprehensive line of

HYDROCEROL additive masterbatches. In addition, Clariant can custom-formulate additive masterbatches to meet the most stringent and demanding application requirements.

HYDROCEROL Grade		Extrusion	Injection Molding	Direct Gassing	PE	PP	PVC	PS/ABS	Engineering Plastics
Endothermic Foaming Agents									
BIF	Powder	▲	▲		▲	◆	▲	◆	
BIH	Powder	▲	▲		▲	◆	▲	◆	
BIH 20	PE	▲	▲	▲	▲	▲	◆	◆	TPE, POM
BIH 40	PE	▲	▲		▲	◆	◆	◆	TPE, POM
BIH 70	PE	▲	▲		▲	◆	◆	◆	TPE
BM 40	PE	▲	▲		▲	◆	◆	◆	TPE
BM 70	PE	▲	▲		▲	◆	◆	◆	TPE
CF	Powder	▲	▲	▲	▲	▲		▲	TPE, POM
CF 5 E	PE		▲	▲	▲	◆		◆	
CF 20 E	PE	▲	▲	▲	▲	▲		◆	TPE, POM
CF 20 P	PE-Copo	▲	▲		▲	▲			
CF 40 E	PE	▲	▲	▲	▲	▲		▲	TPE, POM
CF 40 S (Mod.)	PS	▲	▲	▲				▲	
CF 70	PE	▲	▲	▲	▲	▲		◆	
CLM 70	PE	▲	▲	▲	▲	▲		▲	
Compound	Powder	▲	▲	▲	▲	▲		◆	
HK 40 B	HDPE	▲	◆		▲	◆			PET, PC
HK 5 S	PS		▲					▲	PC/ABS
583	PS	▲	▲	◆				▲	PC/ABS
HK 70	PE	▲	▲		▲	◆			PA
HP 5 E	PE		▲		▲	◆		◆	PA, PC
HP 20 P	PE-Copo	▲	▲		◆	▲			PA, PC
HP 30 E	PE	▲	▲		▲	▲		◆	TPE
HP 40 P	PE-Copo	▲	▲		◆	▲			PA, PC
Exothermic Foaming Agents									
AB 40 E	PE	▲	▲		▲	▲			TPE
232	Powder	▲	▲		◆	◆	▲	◆	TPE
397	Acrylate	▲			◆	◆	▲		
529	Acrylate	▲					▲		

▲ Suggested ◆ May be used after testing

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A Partner in Innovation

A global color technology leader, Clariant offers the industry's broadest range of high-performance masterbatches for plastics, including HYDROCEROL® chemical foaming and nucleating agents; RENOL® masterbatches for engineering resins, styrenics and PVC; CESA® additive masterbatches; REMAFIN® masterbatches for polyolefins; OMNICOLOR® universal color masterbatches; and ENIGMA™ special effects. These products are widely specified in the packaging, automotive, durable goods, housewares, office automation, electrical, and other major industries.

Clariant's in-depth market knowledge, formulation expertise and customer commitment are recognized worldwide. A global network of ISO 9000 facilities

incorporates the most demanding manufacturing standards to ensure the quality and consistency of Clariant masterbatches wherever they are used.

Clariant also continues to drive new dimensions in color creativity. At its global ColorWorks™ Design and Technology Centers, inspiration and technology meld together, helping customers strengthen brand recognition, enhance new product development and accelerate speed to market.

Additional information about Clariant products and technical support is available from all our global facilities. Start a dialog with the experts at the Clariant location nearest you.



Exactly your chemistry.

www.clariant.masterbatches.com

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