

# Mineral Additives for Rigid PVC Applications



**Specialty**  
**MINERALS**

# Mineral's Functionality in Rigid PVC Applications

PVC is a versatile polymer which is used in a variety of applications and processes. The majority of the PVC produced is used in the building and construction industry. Typical rigid PVC applications are vinyl siding, window & door profiles, decking, fence & railing, pipe & fittings, shutters & blinds, gutters & downspouts, and electrical housings. PVC is also used to produce extruded and calendared sheet, foamed products, extruded compounds, and injection molded parts.

A PVC compound contains a number of ingredients. The selection of ingredients, and their use levels, will determine the physical properties of a PVC compound and the products made from it. Compounds are designed to provide the proper balance of properties. Impact strength, stiffness, cost, processability and appearance are among the properties that need to be considered.

Generally, minerals are utilized in PVC formulations as fillers. The properties of the mineral used will influence the performance of the PVC product. Calcium carbonates can be used as fillers to extend resins or as a functional additive to replace impact modifiers. Talc can be used to increase the flexural modulus. The relationship between a mineral's properties and the PVC compound's properties are important to understand in order to select the appropriate mineral product which will meet the requirements of the end use application.

Calcium carbonate's particle size and distribution influence the mechanical properties and appearance of the PVC compound. Chart 1 shows how impact strength, gloss, appearance, powder flow and dispersion are affected by the mineral's particle size.

**Chart 1**

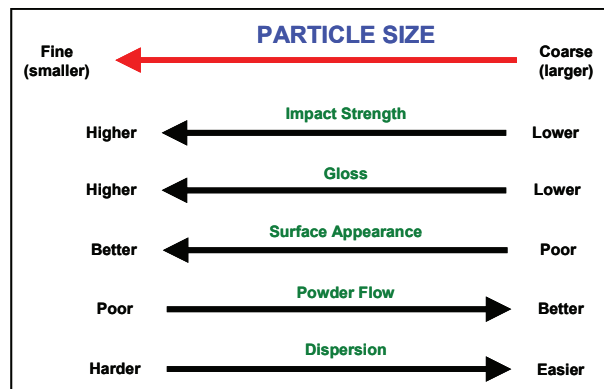
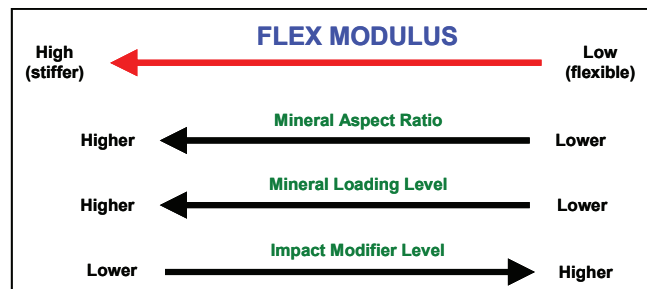


Chart 2 shows how the flexural modulus (stiffness) is affected by the mineral's aspect ratio, mineral loading level and impact modifier.

**Chart 2**



## Product Range

Calcium carbonate can be used as a filler or as a functional additive to reduce impact modifier. Specialty Minerals' ULTRA-PFLEX<sup>®</sup> PCC, TUFFGARD<sup>®</sup> PCC, and SUPER-PFLEX<sup>®</sup> PCC, are coated, precipitated calcium carbonate (PCC) products with controlled particle size distribution for PVC applications. A few basic things to consider when selecting a calcium carbonate products for use in rigid PVC.

### **Sub-micron PCC**

In formulations containing more than three parts of impact modifier, finer calcium carbonate products, such as ULTRA-PFLEX<sup>®</sup> PCC and TUFFGARD<sup>®</sup> PCC, are recommended because they will allow a reduction of impact modifier level. This will result in a lower total formulation cost. In addition, they will produce a smoother, higher gloss surface. Switching to a finer calcium carbonate is a more cost effective way to increase impact strength than the addition of impact modifier.

These products should be used at levels where impact performance is optimized. Chart 3, on the next page, shows that ULTRA-PFLEX<sup>®</sup> PCC and TUFFGARD<sup>®</sup> PCC provide maximum performance when used at levels of 15-20 parts per hundred resin (values include any TiO<sub>2</sub> used in the formulation).

ULTRA-PFLEX<sup>®</sup> is also recommended when sub-zero (°C) impact performance is required.

### **1-micron PCC**

If formulations contain little or no impact modifier, SUPER-PFLEX<sup>®</sup> PCC is recommended because higher loading levels can be used without detracting from performance. SUPER-PFLEX<sup>®</sup> PCC is a product with a finer top size and narrower particle size distribution than ground calcium carbonates (GCC). Chart 3 shows better impact performance of SUPER-PFLEX<sup>®</sup> PCC at higher loading levels than GCC. Since higher loading levels lowers the formulation cost, SUPER-PFLEX<sup>®</sup> PCC provides exceptional value vs. GCC.

### **PCC Value**

Chart 4, on the next page, summarizes the relative performance advantages of PCC products (ULTRA-PFLEX<sup>®</sup> PCC, TUFFGARD<sup>®</sup> PCC, SUPER-PFLEX<sup>®</sup> PCC) vs GCC rigid in PVC applications. In general, ULTRA-PFLEX<sup>®</sup> PCC and TUFFGARD<sup>®</sup> PCC provide the best impact strength with lower levels of impact modifier. SUPER-PFLEX<sup>®</sup> PCC provides higher filler loading capability.

### **Talc**

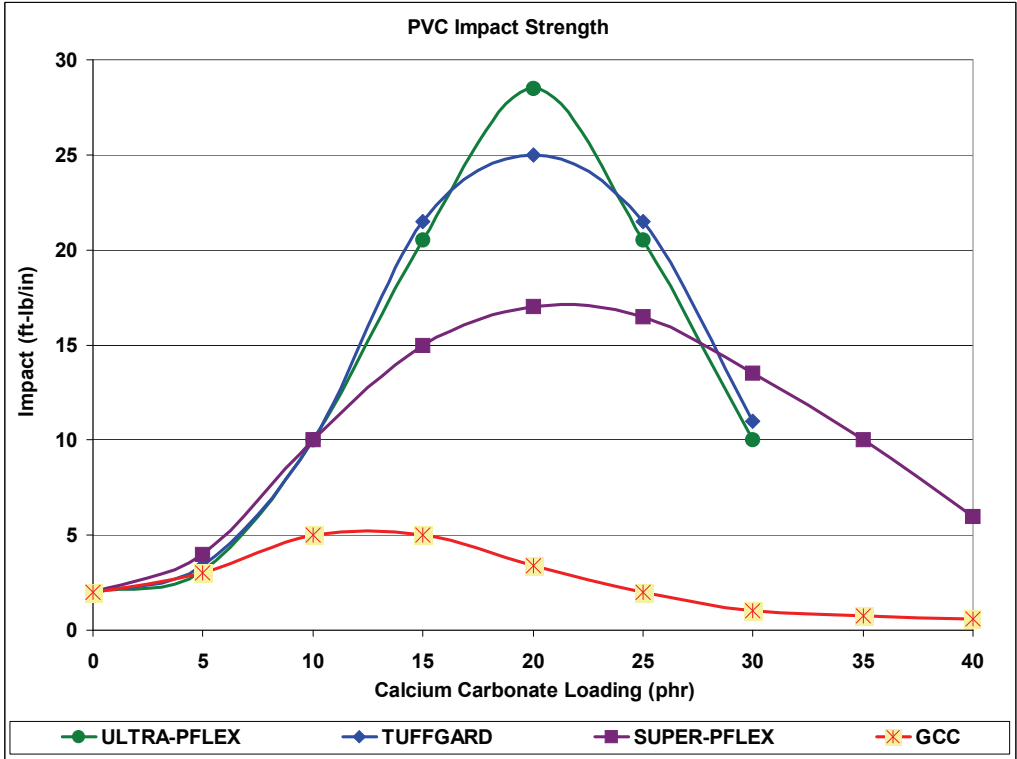
Flexural modulus or stiffness, is primarily a function of filler loading level and aspect ratio. Because most calcium carbonates have similar aspect ratios there will be little difference in stiffness. Talc is much more effective at increasing stiffness than calcium carbonate. Using AG 609 talc can provide an increase in stiffness. When talc is used there is a trade-off between stiffness and impact strength. This trade-off can be minimized by using AG 609 talc with increased levels of impact modifier.

### **Specialty Minerals Advantage**

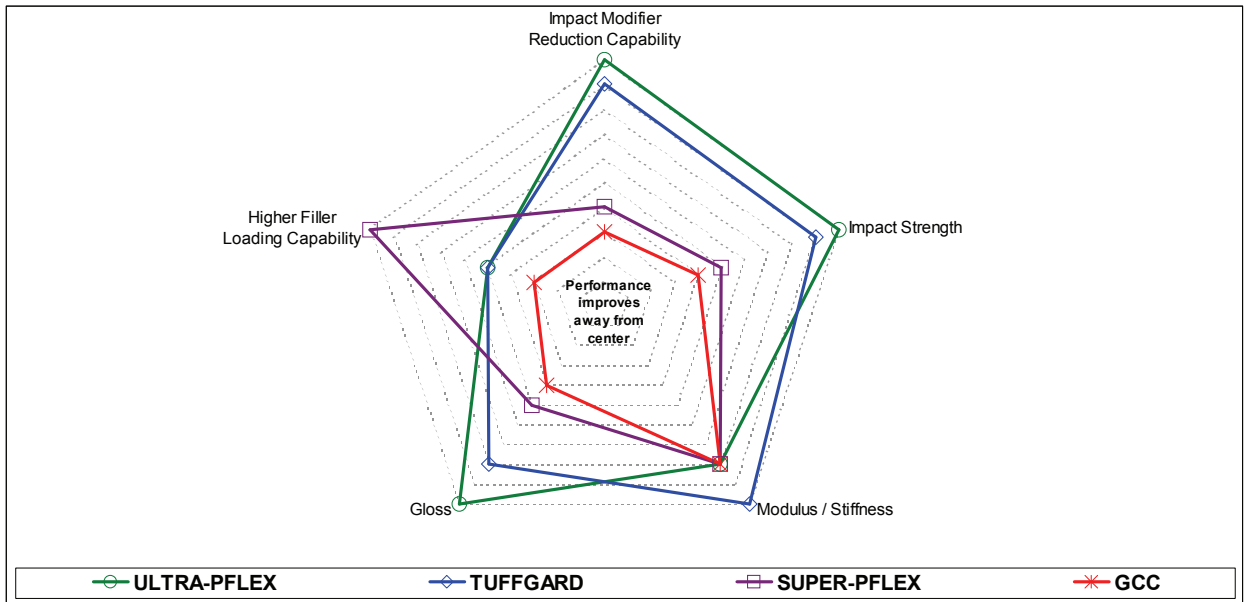
Depending on your performance criteria and applications requirements, Specialty Minerals has the products and knowledge to provide solutions for your PVC applications. The product selector, on page 5, will help you narrow the product options for your application needs.

# Product Performance

**Chart 3**






**Chart 4**



# Product Selector

	CALOFORT® S*	ULTRA-PFLEX®	TUFFGARD®	SUPER-PFLEX®	SUPER-PFLEX® MS	AG 609	1 micron	1+ micron
	Precipitated Calcium Carbonate					Talc	Ground Limestone	
Average Particle Size (microns)	0.07	0.07	0.3	0.7	1.1	0.9	~ 1	> 1
<b>PROVIDING IMPACT STRENGTH</b>								
impact modifier extension	✓	✓	✓			✗		✗
maximum low temp. impact	✓	✓	△			✗		✗
impact strength at high loadings				✓	△	✗		✗
<b>IMPROVING STIFFNESS</b>								
by increasing loading level				△	△	✓	△	
by taking out impact modifier	✓	✓	✓					
by using talc + impact modifier						✓		
<b>IMPROVING APPEARANCE</b>								
higher gloss	✓	✓	✓	△				
whiter, brighter	✓	✗				✗		✗
<b>Typical Applications</b>								
molding compounds	✓	✓	✓	△	△		△	
window profiles	△	△	✓	✓			△	
siding			✓	✓			△	
fence & rail			✓	△	△		△	
pipe					△		△	△
pipe fittings			△	△	△		△	
extruded sheet	△	△	✓	△	△		△	
calendered sheet			△	✓	△		△	
foamed products			△	✓	△		△	△

\* Sourced from England

	Highly Recommended
	Can be used
	Not Recommended

## Technical Capabilities and Support

Specialty Minerals believes in technology as a path to success. This philosophy allows Specialty Minerals to continually invest in technical capabilities for product development and customer support.

The Specialty Minerals' Plastics Applications Laboratory in Bethlehem, Pennsylvania plays a crucial role in the development and testing of products for use in PVC. The lab has the ability to blend, compound, extrude, mold, and test a broad range of thermoplastics. These capabilities allow Specialty Minerals to fine tune our products and processes, to optimize their performance and value in customers' formulations. A partial list of the lab's equipment includes:

### **BLENDING**

High Intensity Mixers; Ribbon Blender; Drum Tumbler

### **COMPOUNDING**

Single & Twin Screw Extruder; Banbury Mixer; Two Roll Mill

### **FABRICATING**

Injection Molder; Extruded Strip; Heated Press

### **PHYSICAL TESTING**

Tensile Properties; Flexural Properties; Heat Deflection

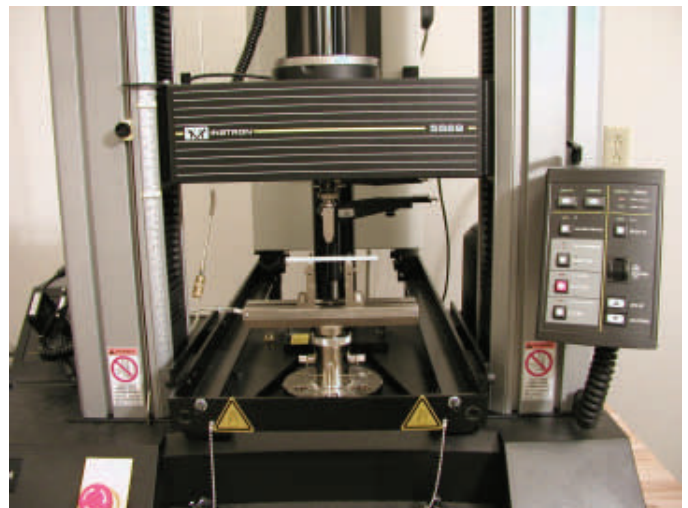
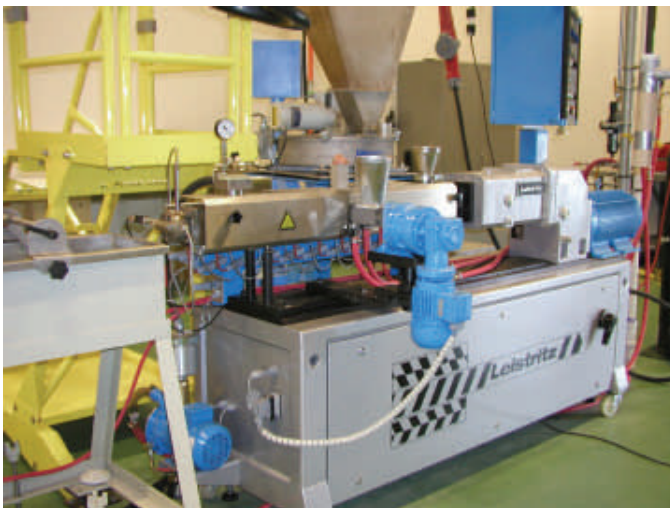
### **IMPACT TESTING**

Izod & Charpy; Falling Weight; VHIT (Gardner)

### **RHEOLOGICAL**

Plasticorder; Capillary Rheometer; Melt Index

Specialty Minerals' Research Center and Analytical Laboratories provide additional support. Their detailed analysis and imaging techniques can gather important information about the composition and structure of materials. These tools and our experienced scientists provide customers with excellent technical service. We can assist with problem solving, formulation development, production trials, process optimization, and product testing.



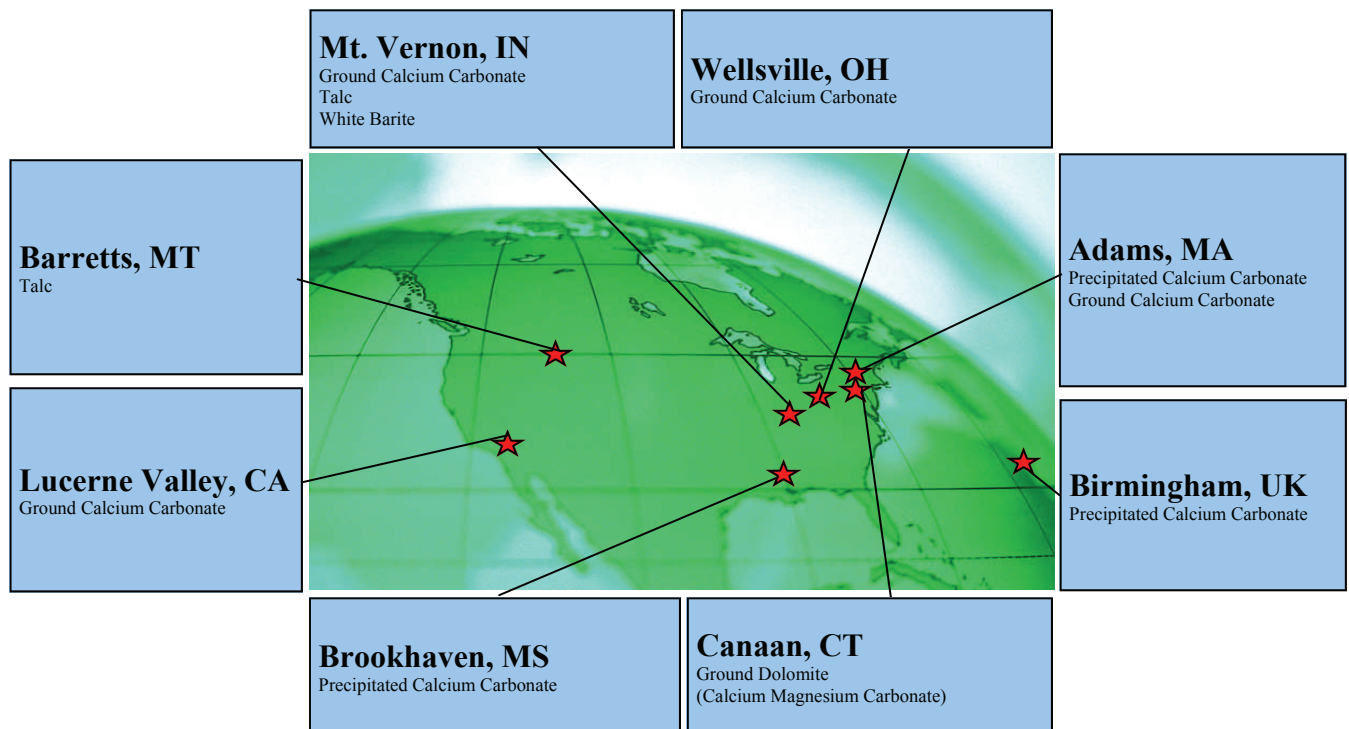
## About Specialty Minerals

Specialty Minerals Inc. (SMI) is a wholly owned subsidiary of Minerals Technologies Inc. (MTI). Specialty Minerals, headquartered in Bethlehem, PA is a leading manufacturer of high performance industrial minerals; precipitated calcium carbonate (PCC), ground calcium carbonate (GCC), lime, talc, dolomite and barite.

Specialty Minerals has global manufacturing locations which provide raw materials for a wide variety of industries, including; building and construction, plastics, adhesives and sealants, paints and coatings, inks, packaging and films, automotive, ceramics, pharmaceuticals, food and nutritional supplements, personal and healthcare, agriculture and paper.

Emphasis on research and development has enabled Minerals Technologies to meet industry and customer requirements through product and application innovations. The company utilizes its expertise in inorganic chemistry, crystallography and structural analysis, and fine particle technology to deliver solutions to customers.

## Performance Minerals Operations





# **Specialty** **MINERALS**

**Specialty Minerals Inc.  
35 Highland Avenue  
Bethlehem, PA 18017-9482  
USA  
1-610-997-8394  
1-800-801-1031  
[www.specialtyminerals.com](http://www.specialtyminerals.com)**

**Specialty Minerals Inc.  
Lifford Lane  
Kings Norton  
Birmingham B30 3JW  
United Kingdom  
+44-1212-524500  
[www.specialtyminerals.com](http://www.specialtyminerals.com)**

The recommendations made herein are based upon our research and are believed to be accurate, but no guarantee, either expressed or implied, is made with respect thereto or with respect to the infringement of any patent. SMI MAKES NO WARRANTY OF MERCHANTABILITY OR SUITABILITY FOR ANY PARTICULAR PURPOSE IN CONNECTION WITH ANY SALE OF THE PRODUCTS DESCRIBED HEREIN. Inconsistent terms and conditions contained in Buyer's purchase order shall not be binding on SMI/BMI unless reflected in writing signed by SMI/BMI's representative. The information contained herein is not to be copied or otherwise used in any publication in whole or in part without written permission from Specialty Minerals Inc./Barretts Minerals Inc. ULTRA-PFLEX®, SUPER-PFLEX®, TUFFGARD®, and CALOFORT® are registered trademarks of Minerals Technologies Inc or its subsidiaries.

© Specialty Minerals Inc. 2007