

## Over a Century of Advancing Technology

Huber Engineered Materials is part of J.M. Huber Corporation, one of the largest family-owned companies in the United States. With revenues in excess of \$2 billion, J.M. Huber Corporation is a broadly diversified multinational company providing innovative products and services in three major sectors: Engineered Materials, Natural Resources and Technology-based Services. Huber Engineered Materials develops engineered specialty ingredients that enhance the performance, appeal and processing of a broad range of products used in industrial and consumer-based applications.

## Fire Retardant Applications

Huber ATH and MDH Products are used in:

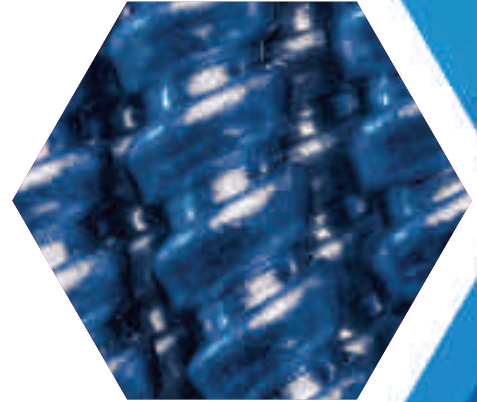
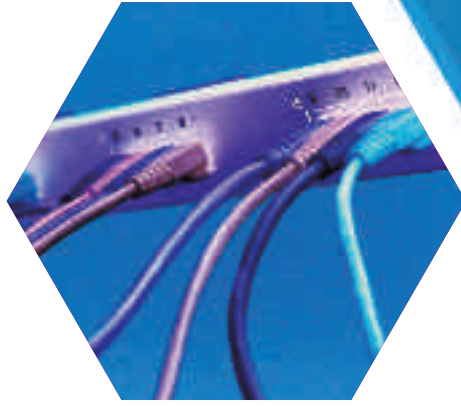
Building Wire  
Power/Utility Cable and Accessories  
Electrical and Electronic Cable and Components  
Security Cable  
Transit/Transportation Cable  
Mining Cable  
Communications/Data Cable  
Automotive Wire  
Appliance Cable

## Wire and Cable Capabilities

Huber's technical and commercial expertise is the foundation to developing innovative products that meet the exacting performance requirements for each application. Huber Engineered Materials is a supplier of metal hydroxide products (ATH and MDH) used for fire retardant material applications. Huber specializes in the design, manufacture and marketing of a comprehensive product portfolio based on ATH and MDH.

## Fire Testing Capabilities

- ASTM E1354: Cone Calorimeter
- ASTM E662: NBS Smoke Chamber
- ASTM D3806: Two-Foot Tunnel
- ASTM D2863: Limiting Oxygen Index
- UL 94: Horizontal and Vertical Burn Tests
- ASTM E648: Radiant Panel



## Technical Papers

Huber has published a number of technical papers that may be used as guidelines for ATH or MDH product selection for formulating a range of wire and cable compounds. The following papers are available upon request:

### New Magnesium Hydroxides Enabling Low-Smoke Cable Compounds

56th International Wire and Cable Symposium, 2007

### Low-Smoke Flexible PVC Compounds via Metal Hydroxide as Flame Retardants

SPE Vinyltec, 2006

### Synergistic Benefits of Metal Hydroxides and Zinc Borate in Flame Retardant Wire and Cable Performance Compounds

54th International Wire and Cable Symposium, 2005

### Effects of Morphological and Surface Characteristics of Magnesium Hydroxide on Performance of Flame Retardant Wire and Cable Compounds

53rd International Wire and Cable Symposium, 2004

### Comparison of Ground vs. Precipitated Fine Aluminum Trihydrate for Flame Retardant Wire and Cable Applications

52nd International Wire and Cable Symposium, 2003

### The Characteristics of a Non-Halogen Flame Retardant Compound Using Advanced Thermoplastic Plastomer

51st International Wire and Cable Symposium, 2002

## FOR MORE INFORMATION

For more information about Huber products, please call us at: **1-866-JMHUBER (1-866-564-8237)** or visit us at: [www.hubermaterials.com](http://www.hubermaterials.com) or email us at: [hubermaterials@huber.com](mailto:hubermaterials@huber.com)

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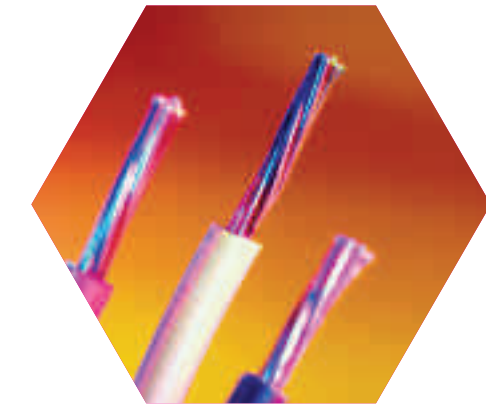
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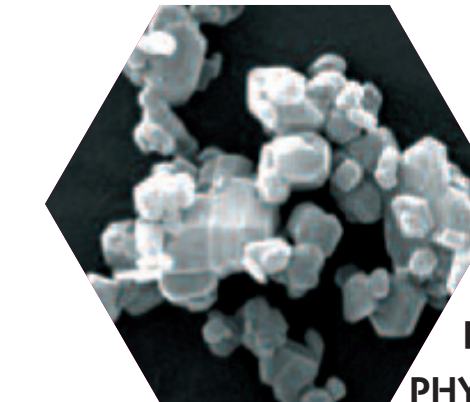
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Vertex® is a registered trademark of J.M. Huber Corporation for magnesium hydroxide.  
ZeroGen® is a registered trademark of J.M. Huber Corporation for mineral flame retardants.  
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HUBER ENGINEERED MATERIALS



## PERFORMANCE ADDITIVES FOR WIRE AND CABLE



Alumina Trihydrate (ATH) Crystal

FLAME RETARDANCE  
SMOKE SUPPRESSION  
ELECTRICAL PERFORMANCE  
PHYSICAL PROPERTY ENHANCEMENT

WHY GO  
ANYWHERE?  
ELSE?

## Huber ATH and MDH Solutions: Meeting the Requirements of Wire and Cable Compounders and Producers

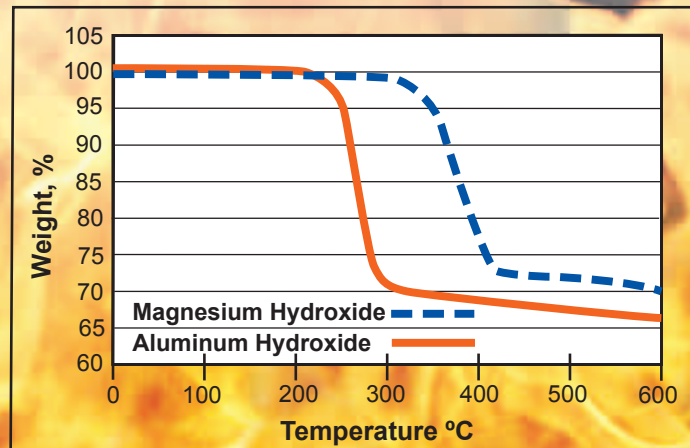
Huber offers a broad family of products to satisfy the needs of Wire and Cable compounders and producers. The following are the primary brands of Huber products that meet the demanding requirements of our customers:

- Micral® Alumina Trihydrate
- Hymod® Treated Alumina Trihydrate
- Zerogen® Magnesium Hydroxide
- Vertex® Magnesium Hydroxide

Alumina trihydrate (ATH) and magnesium hydroxide (MDH) are widely used to make low-smoke and/or non-halogen flame retardant wire and cable compounds for a range of insulation and jacketing applications. ATH and MDH serve to retard both flame and smoke via an endothermic reaction that releases water when heated to decomposition. The metal oxide by-product from decomposed ATH and MDH, Al<sub>2</sub>O<sub>3</sub> and MgO respectively, also helps form a char on the polymer, thus insulating the polymer from heat and oxygen.

The chart below compares the decomposition characteristics of ATH and MDH. ATH decomposes at about 220°C while MDH decomposes at about 330°C thus having a higher thermal stability offering a wider window for compounding processing.

### Thermal Stability Comparison of Al(OH)<sub>3</sub> and Mg(OH)<sub>2</sub>



Decomposition temperature of alumina trihydrate and magnesium hydroxide measured by TGA.

ATH is suitable to use in PVC- and polyolefin-based wire and cable compounds where compounding processing temperatures are typically below 220°C. MDH is preferred for formulating the compounds that need to be processed at temperatures near or above the ATH decomposition temperature such as polypropylene and engineering thermoplastics. Use of MDH also enables processing of PVC or polyolefin compounds at higher temperatures not permissible for ATH, thus enhancing the compounding efficiency or extrusion throughput.

Key material parameters considered when selecting an ATH or MDH product for flame retardant wire and cable applications are particle size, particle size distribution, surface area, particle shape or morphology, chemical cleanliness and sometimes color. These particle properties will directly affect compounding performance and compound properties. Other common considerations in material selection and compound formulation may include the type and level of surface treatment for a specific type of the polymer to be used and a given set of compound performance requirements.

### Physical Property Comparison of Alumina Trihydrate and Magnesium Hydroxide

Property	Alumina Trihydrate Al(OH) <sub>3</sub>	Magnesium Hydroxide Mg(OH) <sub>2</sub>
Physical Form	Powder	Powder
Particle Morphology	Hexagonal Platelet	Hexagonal Platelet
Color	White	White
Specific Gravity, g/cm <sup>3</sup>	2.42	2.36
pH Value	9-10	10-11
Hardness, Mohs	2.5-3.5	2.0-3.0
Refractive Index	1.57	1.58
Temperature of Decomposition	220°C/428°F	330°C/626°F
Heat of Decomposition, cal/g	280	328
Theoretical Loss on Ignition, %	34.6	31.0

## Huber Base ATH and MDH Products

Huber offers a broad family of products, including the following base materials. **Numerous other grades are available within each product category.** Huber also offers state-of-the-art **Surface Treatments** to enhance the performance of the base materials.

### Huber ATH and MDH Products

Product	Average Particle Size (microns)	Product Characteristics
Alumina Trihydrate		
Micral® 9400D	1	Ultrafine Particle Size, Precipitated ATH With Low Electrolytes
OE 805	2.5	Color Controlled, Intermediate Particle Size, Ground ATH
SB 805	2.5	Intermediate Particle Size, Ground ATH
Micral 632	3.5	Intermediate Particle Size, Ground ATH
Magnesium Hydroxide		
Zerogen® 50	1	Untreated, Fine Particle Size Magnesium Hydroxide With Low Electrolytes
Zerogen 100*	2	Fine Particle Size Magnesium Hydroxide With Low Electrolytes
Vertex® 60	2.8	Fine Particle Size, Broad Particle Size Distribution Magnesium Hydroxide
Vertex 90	1.5	Untreated, Ultrafine Particle Size, Uniform Particle Size Distribution Magnesium Hydroxide
Vertex 100	1.5	Untreated, Ultrafine Particle Size, Uniform Particle Size Distribution Magnesium Hydroxide
Vertex 200*	1.0	Uniform Particle Size Distribution, Enhanced Mechanicals

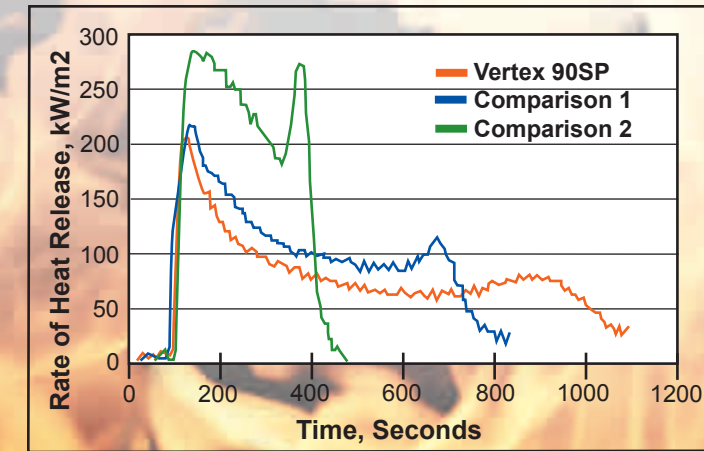
\*Huber developmental products.

## Introducing Vertex® 90 to Deliver Superior MDH Performance

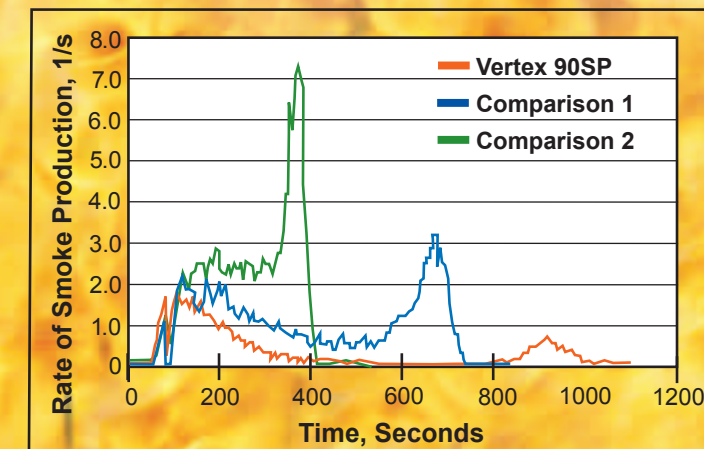
Huber recently introduced a fine sized MDH product line called Vertex® 90 via particle engineering. The Vertex 90 products, available in untreated and variously treated forms, offer improved mechanical and fire performance, and can be used for substituting or replacing those premium MDH grades for certain compound applications such as jacketing, resulting in a material cost savings benefit while still meeting performance requirements. As shown by the testing below, Vertex 90SP outperforms comparative products in reducing and delaying both heat release and smoke production.

Easy incorporation and uniform dispersion of ATH or MDH into the chosen polymer are critical to achieving desired processing rheology and compound performance such as mechanical properties. Unlike halogen-based fire retardants, metal hydroxides are generally used at higher loading levels in order to achieve certain fire performance. The high ATH or MDH loadings can reduce compound mechanical properties as well as compounding performance.

### Rate of Heat Release Vertex 90SP vs. Competitive MDH-Filled EVA Compound



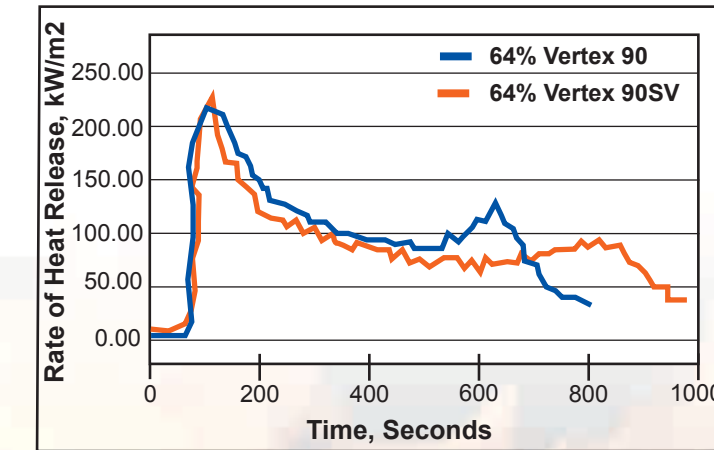
### Rate of Smoke Production Vertex 90SP vs. Competitive MDH-Filled EVA Compound



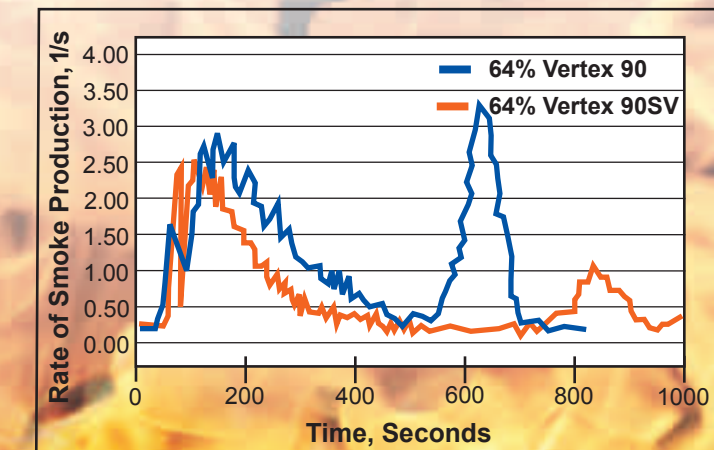
## Huber's Innovative SV Treatment

One of Huber's newly developed chemical treatments, called the SV treatment, enables lowering of MDH loading levels for use in polar polyolefins such as EVA, while providing adequate fire performance. The reduction of MDH loading via Vertex® 90SV makes it possible to improve mechanical property and processing rheological performance.

### Rate of Heat Release Vertex 90 vs. Vertex 90SV-Filled EVA Compound



### Rate of Smoke Production Vertex 90 vs. Vertex 90SV-Filled EVA Compound



### Benefits of Vertex® 90SV

Vertex 90SV enables reduced MDH loading for maximized overall FR-EVA compound performance while retaining adequate FR characteristics.

MDH Type	MDH Loading, %	LOI, %	Tensile Strength, psi	Elongation at Break, %	Brittleness Temperature °C	Processing Viscosity Reduction*
Vertex 90	64	38	1581	100	- 11	-
Vertex 90SV	64	44	1105	134	- 10.5	-23%
Vertex 90SV	60	41	1183	322	- 16.5	-32%
Vertex 90SV	56	40	1372	444	- 21.0	-38%

\* Compounding torque reduction vs. untreated Vertex 90

## Huber Offers State-of-the-Art Surface Treatments

Chemical modification of the ATH or MDH particle surface can improve incorporation and dispersion thus resulting in improved mechanical properties and compounding or extrusion performance. Using proper surface-treatment chemistry also enables enhanced cable material fire and electrical performance. Huber focuses on developing new surface treatment chemistries and provides users with a versatile set of tools to meet specific application requirements.

### Surface-Treated Vertex Grades

Product	Polymer Type	Performance Benefits
Vertex 90ST1	Polyolefins, PVC	Processability, Dispersion
Vertex 90SA	Polyamids, Polyolefins	Low Temperature Properties, FR
Vertex 90SP	Polyolefins, Elastomers	Mechanical Properties, FR
Vertex 90PK	Polyolefins	Mechanical Properties, FR (LOI)
Vertex 90SK	Polyolefins	Mechanical Properties, Color
Vertex 90SN	Polyolefins, PVC	Mechanical Properties, FR (Smoke)
Vertex 90SI	Polyolefins	Processability, Mechanical Properties
Vertex 90SV	Polyolefins (EVA)	FR (Lower Smoke, Higher LOI)