THE R.J. MARSHALL COMPANY

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Fire Retardants and Smoke Suppressants

Flame Defense Series

- Antimony Trioxide (AO)
- AO Replacements

Smoke Defense Series

- Ammonium Octamolybdate (AOM)
- AOM Replacements

Flame & Smoke Defense Series

- Zinc Borates
- Zinc Stannate
- Zinc Stannate Replacement
- Zinc Hydroxy Stannate
- Zinc Hydroxy Stannate Replacement

Metal Hydrate Series

- Alumina Trihydrate (ATH)
- Huntite / Hydromagnesite
- Magnesium Hydroxide (MDH)

Marshall Additive TECHNOLOGIES

DIVISION OF THE R.J. MARSHALL COMPANY

Marshall Additive Technologies (MAT), a division of The R.J. Marshall Company, is a leading supplier of innovative and cost attractive inorganic flame retardant and smoke suppressant technologies for the plastics and rubber industries.

Backed by a customer focused Applications and R&D team, MAT is focused on developing and offering reactive combinations of inorganic flame retardant and smoke suppressant products with the aim of enhancing performance and/or reducing cost of the final compound.

Flame Defense Series

Antimony Trioxide and our AO replacement synergists enhance the flame retardancy of chlorine and bromine based chemicals and polymers. The mechanism works in the vapor phase by capturing the free radicals generated by the combustion process.

FD335 A reactive synergist blend specially formulated to provide the maximum flame retardant performance when used as an Antimony Trioxide replacement. This product is applicable to PVC, CPE, and a wide range of polymer systems where the flame retardant is bromine or chlorine based. Depending on the specific formulation, it is typically possible to *replace between 50 and 100%* of Antimony Trioxide.

FD409 A reactive synergist blend specially formulated to provide a good balance of flame retardant performance and reduced cost when used as a partial Antimony Trioxide replacement. This product is applicable to PVC, CPE, and a wide range of polymer systems where the flame retardant is bromine or chlorine based. Depending on the specific formulation, it is typically possible to *replace between 30 and 50%* of Antimony Trioxide.

FD440 An antimony free inorganic synergist for halogenated flame retardant systems. FD440 can allow the formulator to significantly reduce the antimony trioxide level in a formula while providing equivalent performance at a reduced cost. This product is applicable to PVC, CPE, and a wide range of polymer systems where the flame retardant is bromine or chlorine based.

Flammability Performance Summary				
Formulation Ingredient	**Control**	**FD335**	**FD409**	**FD440**
PVC Resin	100	100	100	100
DINP	45	45	45	45
Ca-Zn stabilizer	6	6	6	6
Stearic Acid	0.3	0.3	0.3	0.3
ATH	60	60	60	60
Antimony Trioxide Synergist	5	2.5	2.5	2.2
FD Synergist	**0**	**2.5**	**2.5**	**2.8**
Limiting Oxygen Index %	35	36.5	36	35
Peak Heat Release Rate (kW/m^2)	182.8 ± 17.3	63.8 ± 71.4	182.3 ± 13.5	154.2 ± 6.4
Total Heat Release (MJ/m^2)	31.8 ± 9.5	22.5 ± 9.6	36.3 ± 8.0	33.7 ± 6.5
Ignited Y/N	Y	N/Y	Y	Y

Flame Defense Series continued...

FDVW1 Specifically optimized for the crosslinked low voltage XLPE and EPDM wire & cable market. A segment of products in this application are flame retarded to meet the demanding VW1 flame test requirement. To achieve this performance, it is common to formulate with Brominated flame retardants and Antimony Trioxide synergists.

Leveraging The R.J. Marshall's long history with Antimony Trioxide replacement products for PVC applications, a research program was undertaken to design a specific product for the VW1 application and similar systems where Brominated flame retardants are used. FDVW1 is the result of those efforts.

To demonstrate the basic efficacy of the product, a typical polyethylene recipe was constructed, compounded, press-molded and finally crosslinked using electron beam irradiation for convenience. After confirming crosslink density, UL94 sample bars were cut (0.03 inches thick) and laminated to a thin copper sheet (0.02 inches thick) to provide the heat sink effect and structural stability similar to that encountered in an extruded wire.

The laminated UL94 samples were then tested using the basic UL94 protocol but adapted to simulate the VW1 test. Specifically, the flame was applied at a 20 degree from the vertical angle for 15 seconds for a total of 5 applications. The recipes evaluated and result obtained are shown below.

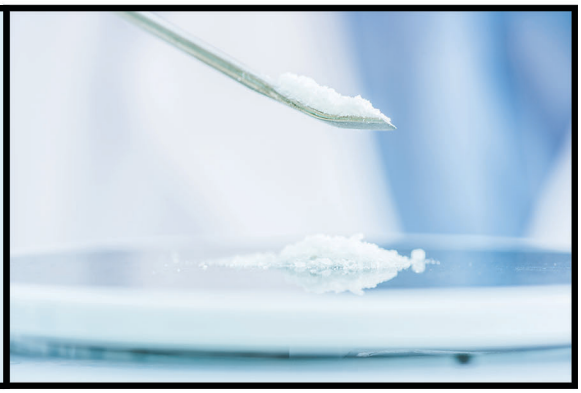
Formulation Ingredient	Control ATO	FDVW1
XLPE	59	59
SAYTEX 8010	26.7	26.7
Antioxidant	0.5	0.5
Antimony Trioxide Synergist	13.8	4.6
FDVW1	**0**	**9.2**
Afterflame time 1 (s)	0 	0 
Afterflame time 2 (s)	0	0
Afterflame time 3 (s)	0	0
Afterflame time 4 (s)	0	1
Afterflame time 5 (s)	0	3
Cotton Ignited?	No	No

Note: Images taken after fifth flame application.

FDAO 100% antimony trioxide synergist for halogenated flame retardant systems.

Other FD products are available on request for specific applications.

The MAT division is constantly researching and working on new products. If you have a formulation problem you are trying to solve, or a cost reduction target, please feel free to contact us at matsolutions@rjmarshall.com
We may be able to help with one of our existing products or partner with you to develop a custom solution.



Smoke Defense Series

Ammonium Octamolybdate (AOM) is a well known additive for smoke suppression in plasticized PVC. Based on this technology, MAT has developed a high performance, low cost, reactive blend that can improve upon the performance of AOM alone.

SD890 A reactive smoke suppressant blend specially formulated to provide the maximum reduction in smoke generation at the lowest possible cost when replacing molybdate based additives in PVC compounds. Specifically, work has been done which shows that it is possible to replace 100% of Ammonium Octamolybdate while achieving a further improvement in smoke suppression of a typical PVC plenum jacketing formulation and small gain in flame retardancy.

PVC Wire & Cable Jacket Example		
Formulation Ingredient	**Control**	**SD890**
PVC Resin	100	100
DINP	50	50
Ca-Zn stabilizer	5	5
Stearic Acid	0.2	0.2
ATH	70	70
Ammonium Octamolybdate (AOM)	15	0
SD890	**0**	**15**
Limiting Oxygen Index %	30.5	32
Smoke Density ASTM E662 Flaming Ds 1.5 min	53.4 ± 16.0	23.3 ± 5.8
Smoke Density ASTM E662 Flaming Ds 4.0 min	114.6 ± 8.3	88.7 ± 13.7

SDZAM A reactive smoke suppressant blend that has been specifically formulated to provide a more cost effective alternative to Zinc Molybdate coated Talc (ZMT) products in the market for application in PVC compounds. Our experimental work has shown that SDZAM can be used as a 1:1 replacement for "ZMT" type products and deliver similar smoke suppression performance together with a gain in the Limiting Oxygen Index of the PVC compound.

PVC Wire & Cable Jacket Example		
Formulation Ingredient	**Zinc Molybdate coated Talc**	**SDZAM**
PVC Resin	100	100
DINP	50	50
Ca-Zn stabilizer	5	5
Stearic Acid	0.2	0.2
ATH	70	70
Zinc Molybdate coated Talc	15	0
SDZAM	**0**	**15**
Limiting Oxygen Index %	32.5	33.5
Smoke Density ASTM E662 Flaming Ds 1.5 min	33.1 ± 3.4	39.0 ± 2.7
Smoke Density ASTM E662 Flaming Ds 4.0 min	94.3 ± 17.4	80.8 ± 16.1
Ignition Time	Ignited after 4s Burned for 829s	Ignited after 9s Burned for 637s

SDAOM 100% Ammonium Octamolybdate smoke suppressant.

Other SD products are available on request for specific applications.

Fire & Smoke Defense Series

Where a combination of smoke suppression and flame retardance is required in one product, MAT offers a range of single chemical zinc based products as well as an emerging family of propritary reactive blends of zinc chemicals and other ingredients.

FSD479 is an antimony free proprietary inorganic blend flame retardant synergist for use with halogen based flame retardant polymer compounds where Zinc Hydroxy Stannate (ZHS) is used as the primary synergist. It allows the formulator to reduce the amount of the expensive Zinc Hydroxy Stannate while retaining flammability performance and hence provide an overall cost saving. This product is applicable to PVC, CPE, and a wide range of polymer systems where the flame retardant is bromine or chlorine based.

FSD485 is an antimony free proprietary inorganic blend flame retardant synergist for use with halogen based flame retardant compounds, where Zinc Stannate (ZST) is used as the primary synergist. It allows the formulator to reduce the amount of the expensive Zinc Stannate while retaining flammability performance and hence providing an overall cost saving. This product is applicable to PVC, CPE and a wide range of polymer systems where the flame retardant is bromine or chlorine based.

PVC Wire & Cable Jacket Example				
Formulation Ingredient	**Control w/ZHS**	**FSD479**	**Control w/ZST**	**FSD485**
PVC Resin	100	100	100	100
DINP	45	45	45	45
Ca-Zn stabilizer	6	6	6	6
Stearic Acid	0.3	0.3	0.3	0.3
ATH	60	60	60	60
Control Chemical	5	0	5	0
FSD Synergist	**0**	**5**	**0**	**5**
Limiting Oxygen Index %	32	33.5	31.5	32

The use of cost effective FSD products to replace zinc hydroxy stannate and zinc stannate can reduce your synergist cost.

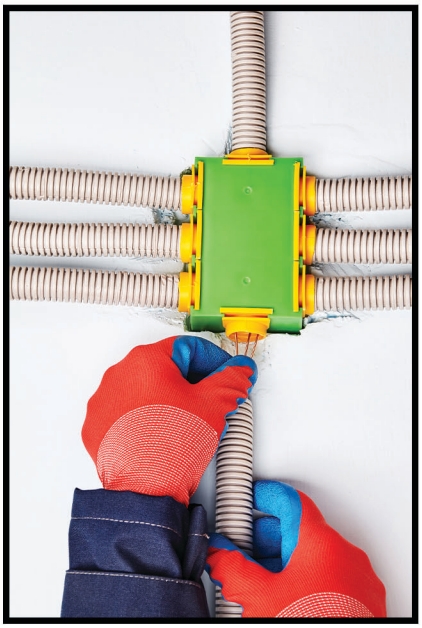
CTZB400 Zinc Borate is typically used as a formulating additive to increase char strength, reduce smoke, and to provide afterglow suppression.

CTZST Zinc Stannate combines smoke suppression and flame retardant synergy with halogenated flame retardants where antimony trioxide is not desired or permitted. It is suitable for formulations that are processed above 200°C.

CTZHS Zinc Hydroxy Stannate combines smoke suppression and synergism with halogenated flame retardants where antimony trioxide is not desired or permitted. It is suitable for formulations that are processed below 200°C.

Metal Hydrate Series

MAT offers a broad line of metal hydrate FR products. These include alumina trihydrate (ATH), a huntite / hydromagnesite blend, and magnesium hydroxide (MDH).



These products are typically selected for halogen free applications and work according to two modes. Release of water and endothermic decomposition. The water release reduces the temperature in the combustion zone, excludes oxygen and combines with soot particles to reduce smoke. The endothermic nature of the decomposition removes heat energy from the combustion process.

An important property in selecting a metal hydrate is:

Decomposition Temperature	
Alumina Trihydrate	~220°C
Huntite / Hydromagesite blend	~250°C
Magnesium Hydroxide	~330°C

Alumina Trihydrate

Alumina Trihydrate is the most widely used flame retardant in the world due to its versatility and low cost. Available in different particle sizes, it can be used in a wide range of polymers at processing temperatures below 220°C. ATH is non-toxic, halogen-free, chemically inert, and has low abrasiveness. Additional benefits are arc and track resistance in plastics exposed to electrical arcing, acid resistance, and smoke suppression. The non-toxic, zero halogen alumina trihydrate (ATH) is offered by MAT from a precipitated and fine grinding process.

HT900	Precipitated 0.9 micron d_{50}
HT1000	Precipitated 1.4 micron d_{50}
A202	Ground 2 micron d_{50}
A204	Ground 4 micron d_{50}

Median particle size by sedigraph using Micromeritics model 5125

Additional grades of ATH are available. Please see our separate ATH literature or contact us for more information.

Commitment to Quality

The R.J. Marshall Company strives to achieve total customer satisfaction by assuring that each product delivered or service provided consistently meets or exceeds our established standards.

Metal Hydrate Series continued...

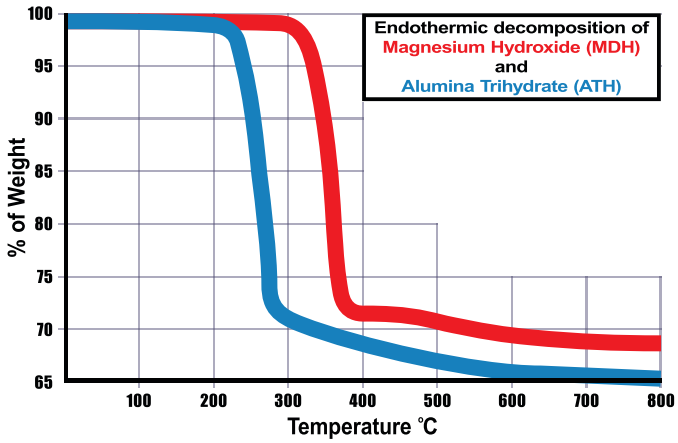
Huntite / Hydromagnesite Blend

HTMC9 is a white finely-divided combination of magnesium calcium carbonate (huntite) and hydrated magnesium carbonate. With thermal stability above that of ATH and low cost, it can be used as a replacement for magnesium hydroxide and can be used in halogenated systems as well. It can offer a cost/performance advantage over magnesium hydroxide and can allow higher processing temperature than ATH.

Magnesium Hydroxide

The Magnapur series of products are suitable for a wide range of demanding flame-retardant polymeric applications. Endothermic decomposition begins at about 330°C releasing water, which produces a cooling effect, reduces oxygen availability and suppresses smoke evolution. The resulting Magnesium Oxide ash provides a char layer, which further reduces the combustion rate of the system. These combined mechanisms result in an overall powerful flame retardant performance which allows polymer formulators to design products to meet the most demanding specifications in wire & cable insulation and jacketing, sheet, film, and profile applications.

The relatively high decomposition temperature compared to other zero halogen fillers, such as Alumina Trihydrate, allows for a significantly higher processing temperature without the concern of developing porosity in the finished part.



While Magnapur has good dispersibility in many resin systems, further improvements can be gained by using one of our coated grades. These coatings are selected for excellent compatibility in a wide range of resins and to provide the opportunity for chemical coupling with the polymer matrix. This can result in significant increases in physical properties, extrusion smoothness and resistance to moisture.

MGP-N2 is a magnesium hydroxide of natural origin (brucite). This 2.0 µm magnesium hydroxide is suitable as a flame retardant in a wide range of applications including wire & cable bedding and jacketing, foams, hoses, roofing, sheet, and profile.

MGP-N2SC is a stearic acid coated, magnesium hydroxide of natural origin (brucite). This 2.0 µm coated magnesium hydroxide is suitable as a flame retardant in in a wide range of applications including wire & cable bedding and jacketing, foams, hoses, roofing, sheet, and profile.

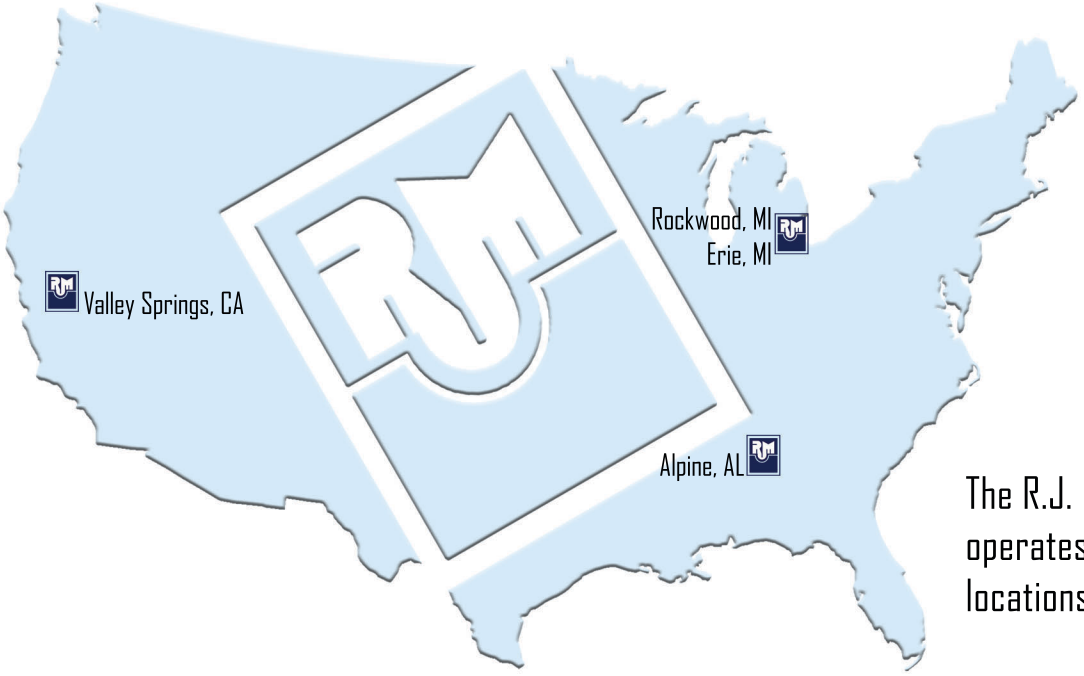
MGP-N4 is a magnesium hydroxide of natural origin (brucite). This 4.0 µm magnesium hydroxide is suitable as a flame retardant in in a wide range of applications including wire & cable bedding and jacketing, foams, hoses, roofing, sheet, and profile.

MGP-N4SC is a stearic acid coated, magnesium hydroxide of natural origin (brucite). This 4.0 µm coated magnesium hydroxide is suitable as a flame retardant in a wide range of applications including wire & cable bedding and jacketing, foams, hoses, roofing, sheet, and profile.

The R.J. Marshall Company Mission

At the R.J. Marshall Company, we seek to make our customers successful by supplying innovative, quality-focused products and services. We serve our customer's needs with perseverance and we continuously strive to create an environment where our customers, employees and suppliers are highly valued. Our core values include the following business principles:

Integrity – to maintain the highest ethical standards
Honesty – to be honorable and trustworthy, to always do the right thing
Respect – to show regard for worth, honor and esteem for our employees, customers and suppliers
Perseverance – to have a passion for excellence and a resolve for continuous improvement
Knowledge – to be lifetime learners and provide a continual learning environment which empowers our employees to solve problems
Forgiveness – to create an environment of trust where people are allowed to fail
Fairness – to treat all people in a just and equitable manner
Teamwork – to work together with mutual respect and courtesy realizing we can achieve more by working together
Competence – to do it right the first time by making smart, quick, common sense decisions
Family – to recognize and support the family and maintain a family atmosphere



The R.J. Marshall Company operates 4 manufacturing locations in the United States.

To discuss your specific requirements or to place sample orders or commercial orders, we encourage you to contact us at:

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