THE R.J. MARSHALL COMPANY

Non-Halogen Fire Retardants and Smoke Suppressants

Aluminum Trihydroxide (ATH)

Magnesium Hydroxide

Antimony Oxide

Antimony Oxide Replacements

Ammonium Octamolybdate (AOM)

AOM Replacements

Zinc Borates

Zinc Stannates

Marshall Additive TECHNOLOGIES
DIVISION OF THE R.J. MARSHALL COMPANY

"We seek to make our customers successful"

Marshall Additive Technologies (MAT) is a wholly owned division of **The R.J. Marshall Company**. The R.J. Marshall Company was founded by Richard J. and Joan E. Marshall in May of 1978. The R.J. Marshall Company quickly grew into a reliable supplier of quality products currently sourced from five manufacturing plants in North America.

MAT offers a full line of non-halogen flame retardants, flame retardant synergists, and smoke suppressant products from our Erie, Michigan plant.

METAL HYDRATE PRODUCTS

MAT offers a full line of metal hydrate FR products. These include ATH, magnesium hydroxide, and huntite-hydromagnesite. These products are offered under the H-TEC™ trade name and the A200 series of products. An important property in selecting a metal hydrate is decomposition temperature.

Decomposition Information

MAT Product	Decomposition Temperature
ATH	~ 190°C
Huntite-Hydromagnesite	~ 220°C
Magnesium Hydroxide	~ 330°C

ATH

Aluminum Trihydroxide (ATH), also called alumina trihydrate, is offered by MAT from a precipitated and fine grinding process. Particle sizes are measured by Sedigraph.

*Aluminum Trihydroxide (ATH) Products***

	Microns*	Product Description
H-TEC™ HT1000	1	Precipitated high grade fine particle ATH
ATH A202	2	Fine ground ATH
ATH A204	4	Fine ground ATH

* Median particle size by sedigraph using Micromeritics model 5120
** Listed products produced in Erie, MI and Alpine, AL.

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

MAGNESIUM HYDROXIDE

Magnesium hydroxide is a ground natural magnesium hydroxide available in two particle sizes to meet various application requirements. In halogen-containing plastics such as PVC, it favors low smoke as well as flame retardancy.

Natural Magnesium Hydroxide Products

	Microns*	Product Description
H-TEC™ HTMB2**	2	Natural magnesium hydroxide
H-TEC™ HTMB4**	4	Natural magnesium hydroxide

* Median particle size by sedigraph using Micromeritics model 5120
** Stearic acid coated version available

HUNTITE-HYDROMAGNESITE

This product 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.

Huntite-Hydromagnesite

	Product Description
H-TEC™ HTMC9	Very fine plate shaped particles helps to improve mechanical properties of compounds.

APPLICATION EXAMPLES

MAT Magnesium Hydroxide and ATH A204 PVC Formulations

Formulation Component	ATH A204	H-TEC™ HTMB2
PVC	100 parts	100 parts
DINP	45 phr	40 phr
Brominated DOP	8 phr	-
Stabilizer	4 phr	5 phr
ATH A204	70 phr	-
H-TEC™ HTMB2	-	50 phr
Oxygen Index	***31.4***	***28.0***

FLAME RETARDANT SYNERGISTS

Non-Halogen Flame Retardant Synergists for Halogen FR Systems

	Product Description
C-TEC™ CTFRZ8S	Low Cost Antimony Oxide Replacement
C-TEC™ CTFRZ20S	Antimony Oxide Replacement
C-TEC™ CTFRZ30S	Antimony Oxide Replacement
C-TEC™ CTFRINT3	High Efficiency Antimony Oxide Replacement
C-TEC™ CTAO	Antimony Oxide

These MAT FR synergists are used primarily in PVC wire and cable formulations and function as synergists with the halogen contained in the PVC polymer. These FR compounds are antimony oxide replacements which result in lower cost formulations.

APPLICATION EXAMPLES

Below are some typical formulations showing Oxygen Index results for MAT products in comparison with typical FR formulation results in select applications.

PVC Riser Formulation

Formulation Component	Antimony Oxide	C-TEC™ CTFRZ20S
PVC	100 parts	100 parts
Plasticizer	45 phr	45 phr
Stabilizer	5 phr	5 phr
Calcium Carbonate	35 phr	35 phr
Antimony Oxide	6 phr	~
C-TEC™ CTFRZ20S	~	6 phr
Oxygen Index	***31.5***	***33.5***

Cost savings of up to 50%, for the flame retardant component, can be achieved with the above formulation by replacing antimony oxide with C-TEC™ CTFRZ20S. C-TEC™ CTFRZ8S may meet the application flammability requirements when they are not as severe as those required for riser cable.

Conversely, C-TEC™ CTFRZ30S and C-TEC™ CTFRINT3 can provide, in certain formulations, FR performance that is even superior to antimony oxide. It is always best to discuss your specific needs with MAT directly to determine the best product for your process.

ZINC BORATES & ZINC STANNATES

MAT offers a variety of zinc containing products which function as flame retardant synergists and smoke suppressants in halogenated and in some non-halogenated systems, and in PVC. These products improve the efficiency of and sometimes lower loadings of non-halogen metal hydrate FR systems. They also act as partial antimony oxide replacements. See the table below for details.

Non-Halogen Flame Retardant Synergists for Halogen FR Systems

	Microns*	Product Description
C-TEC™ CTZB200	2-3	Zinc metaborate FR synergist
C-TEC™ CTZB400	2-3	Zinc borate FR synergist
C-TEC™ CTZB800	7	Zinc borate FR synergist
C-TEC™ CTZST	2-3	Zinc Stannate for smoke suppressant (SS) replacement in PVC
C-TEC™ CTZHS	2-3	Zinc Hydroxy Stannate for SS replacement in PVC

* Median particle size by Cilas 1190L

APPLICATION EXAMPLES

In many parts of the world, users are demanding the exclusion of antimony oxide from polymer formulations for health and safety reasons while still demanding comparable or lower smoke performance in these non-antimony formulations.

Below is an application example using C-TEC™ CTZHS and antimony oxide in the same unfilled PVC formulation. This particular application is for flexible PVC sheet and film.

Flexible PVC Formulations with Zinc Hydroxy Stannate Synergist

Formulation Component	Antimony Oxide	C-TEC™ CTZHS
PVC	100 parts	100 parts
DOP Plasticizer	50 phr	50 phr
Stabilizer	4 phr	4 phr
Process Aid	1 phr	1 phr
Antimony Oxide	5 phr	~
C-TEC™ CTZHS	~	5 phr
ASTM E1354 Cone Calorimeter Peak Rate of Heat Release	***286 kW/m²***	***209 kW/m²***
Smoke Parameter	***277***	***179***

The next example shows Oxygen Index comparisons for a total of three formulations using MAT antimony oxide and C-TEC™ CTZHS at different loadings.

This application is a filled PVC formulation.

ATH Filled PVC Formulation

Formulation Component	Antimony Oxide	C-TEC™ CTZHS 9 phr	C-TEC™ CTZHS 6 phr
PVC	100 parts	100 parts	100 parts
DOP Plasticizer	45 phr	45 phr	45 phr
Stabilizer	5 phr	5 phr	5 phr
Process Aid	1 phr	1 phr	1 phr
ATH A204	60 phr	60 phr	60 phr
C-TEC™ CTAO	9 phr	-	-
C-TEC™ CTZHS	-	9 phr	6 phr
Oxygen Index	***38.5***	***38.2***	***36.0***

Here we see that Oxygen Index for the MAT C-TEC™ CTAO (antimony oxide) formulation is quite comparable to the Oxygen Index for C-TEC™ CTZHS (zinc hydroxy stannate) formulation at equivalent 9 phr loading levels. A reduction of 30% of the C-TEC™ CTZHS loading level to 6 phr gives an ever so slightly reduced but still very good Oxygen Index of 36.0.

Below is another PVC formulation this time using calcium carbonate as a filler.

Calcium Carbonate Filled PVC Formulation

Formulation Component	Antimony Oxide	C-TEC™ CTZHS 9 phr
PVC	100 parts	100 parts
DOP Plasticizer	45 phr	45 phr
Stabilizer	5 phr	5 phr
Process Aid	1 phr	1 phr
Calcium Carbonate	60 phr	60 phr
C-TEC™ CTAO	9 phr	-
C-TEC™ CTZHS	-	9 phr
Oxygen Index	***29.0***	***30.5***

Here we see the C-TEC™ CTZHS performing a little better than antimony oxide in this calcium carbonate filled PVC formulation. Added benefits when using the C-TEC™ CTZHS formulation include lower smoke and lower cost.

PVC SMOKE SUPPRESSANTS

MAT offers a full line of proven smoke suppressants (SS) for all PVC applications where smoke reduction is required. These products have provided smoke suppressant effectiveness to the high performance PVC market for over twenty years.

Smoke Suppressant Products for PVC

	Product Description
C-TEC™ CTLSZ4AF	Low cost PVC smoke suppressant
C-TEC™ CTLSZ8A	PVC smoke suppressant
C-TEC™ CTLSZ20A	High efficiency PVC smoke suppressant
C-TEC™ CTLS20A	PVC smoke suppressant
C-TEC™ CTAOM	Ammonium Octamolybdate smoke suppressant
C-TEC™ CTSD200	PVC smoke suppressant plus fire retardant

APPLICATION EXAMPLES

PVC Jacket Formulations

Formulation Component	Antimony Oxide	C-TEC™ CTLSZ4AF	C-TEC™ CTAOM
PVC	100 parts	100 parts	100 parts
Plasticizer	50 phr	50 phr	50 phr
Stabilizer	5 phr	5 phr	5 phr
ATH A204	70 phr	70 phr	70 phr
Antimony Oxide	15 phr	-	-
C-TEC™ CTLSZ4AF	-	15 phr	-
C-TEC™ CTAOM	-	-	15 phr
ASTM E662 Smoke	***650+***	***271***	***261***

A key comparison here in addition to the improved ASTM E662 smoke performance is the lower cost when the C-TEC™ CTLS series products are substituted for C-TEC™ CTAOM. Cost savings can be up to 80% on the smoke suppressant formulation component.

Simplicity is one of the many benefits of working with MAT FR and SS products. Your formulation process can be made much easier as MAT can be your ***"one-stop"*** shopping source of so many different products. You can improve formulation performance and reduce your costs or both.

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

Care of Creation

The R.J. Marshall Company is devoted to maintaining the highest environmental standards by unwavering compliance with state and federal regulations, waste prevention measures, and consistent monitoring of our manufacturing processes.

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. As part of our dedication to quality,
The R.J. Marshall Company will...
Develop and nurture an environment conducive to the highest standards of quality, commitment and continue improvement.
Partner with and monitor our vendors and suppliers to obtain the most consistent and highest quality materials and service.
Use statistical methods to understand and manage the actions of our total organization.
Dedicate ourselves to continuous improvement in all activities of our business.
Continually strive to develop our employees though training and education.
Quality will be achieved though prevention of defects rather than detection.

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

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