











Helping to create Safer Environments





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Product and Company Profile

Hidromag Ly is a 99% purity Synthetic Magnesium Hydroxide, produced by Química del Rey which is one of the leading manufacturers of Magnesium Products in the world and is part of the Industrias Peñoles Metallurgical-Chemical Group.

Química del Rey was established in 1964, developing the major chemical plant within Peñoles group. Peñoles's shares have trated on Mexican Stock Exchange since 1968 under the ticker PE&OLES.

As a primary raw Material, the production of Hidromag requires a purified Magnesium Chloride brine, obtained from the geological genesis of an underground salted lake, in the Coahuila desert formed some 65 million years ago. The deposit consists of a solid mineral phase and a liquid phase. As a secondary feedstock for the precipitation of the MDH, Peñoles uses high purity Dolomite, extracted from its Esmeralda Mine, at projected production rates. The proved reserves of the deposit, allow us to continue production beyond the next 400 years.

Quimica del Rey is manufacturing flame retardant MDH in a specifically designed state-of-the-art plant, which started first operations mid of the year 2008. Latest equipment and a well-trained staff ensure the supply of a product with premium standard and high consistency.

The particular dedication to the control of the precipitation process leads to a high purity product with a TAPPI-brightness of 97 and a purity of above 99 %. Multiple purification steps remove impurities from the crystal surface. Most of the remaining constituents are part of the crystal lattice and immobile in a plastic compound.



Peñoles seeks to:

Provide our shareholders with the best long-term investment option, with growth and profitability.

Form strategic partnerships with our clients, offering integral solutions and inspiring trust to conduct business over the long term.

Become a strategic link in the value chain, establishing long-term and mutually beneficial relations with suppliers.

Create a workplace that engenders pride and dignity, because it offers opportunities for development, respect and recognition to our employees, in a safe environment and teamwork.

Be a socially responsible company, respectful of the natural environment while promoting selfdevelopment in the communities where we operate.



Magnesium Hydroxide is a mineral filler used in the manufacturing of halogenfree thermoplastic and thermostable compounds in order to obtain flameresistant properties and low emission of smoke, while also obtaining a reduction in the toxicity of gases given off during combustion.

Generally, to reach the flame retardant level in these types of compounds, it is necessary to have a high mineral filler content and, as a result, problems may arise during the manufacturing of the compounds and during the subsequent transformation processes. Likewise, the mechanical, physical, and electrical properties of the end products could also be affected.

The Current industrial installations demand products which are easy to handle in large amounts during unloading, transport, and feeding systems – thus calling for a production process that is efficient, robust, and stable in order to ensure the quality in the end product.

New Magnesium Hydroxide Series: HIDROMAG LYO - HIDROMAG LY1 - HIDROMAG LY2



Quimica del Rey has developed a new generation of Precipitated Magnesium Hydroxide that offers improvements in terms of flowability and greater stability during the manufacturing stages; likewise, there are other advantages such as a decrease in the compound's viscosity, improved surface finishing for the end product, and a notable improvement in final characteristics.

This improvement was possible because Quimica del Rey is the owner of its raw materials and to the flexibility of the particular design of the production process, that allows modify the product according to customer needs. Our philosophy is to build up a close partnership to our customers, supporting them to develop innovative products to stand out on the markets.

Hidromag Ly is offered in various grades with different particle sizes distributions (PSD), and coatings.



New Generation of MDH



Typical values

| | UNITS | Hidromag Ly2 | Hidromag Ly1 | Hidromag Ly0 |
|---|-------------------|--------------|--------------|--------------|
| Mg (OH) $_2$ - content | % | >99 | >99 | >99 |
| Moisture (105° C) | % | <0.3 | <0.3 | <0.3 |
| Median Particle Size, d ₅₀ Horiba Laser Diffraction | μm | 2.20 | 1.50 | 0.65 |
| Specific Surface Area (BET) | m²/g | 9 | 10 | 11 |
| Density | g/cm ³ | 2.36 | 2.36 | 2.36 |
| Bulk Density | Kg/m ³ | >320 | >320 | >300 |
| Electrical Conductivity (10% susp. in deionized water) | µS/cm | <300 | <300 | <300 |
| Color (White grade) ASTM E-1347 | | >96 | >96 | >96 |
| Mohs Hardness | | 2.5 | 2.5 | 2.5 |

LyO Particle Size d₅₀ 0.50 - 0.80 (µm)

Applications demanding a high level of electrical insulation and fireproof performance:

- Compounds, which require a demanding electrical insulation, good mechanical properties and surface finish.
- Extrusion and injected components requiring excellent surface finish.

Ly1 Particle Size d₅₀ 1.3 - 1.7 (μm)

Applications demanding a medium level of electrical insulation and fireproof performance:

- Electrical grade material, recommended for compounds that need good electrical insulation.
- Compounds with high-performance properties.

Ly2 Particle Size d₅₀ 2.0 - 2.4 (µm)

General-purpose applications with high flame retardancy:

- Cable application recommended for jackets compounds.
- "Halogen Free Compounds" for general-applications.

These products are available also with surface treatments:

- V vinyl silane
- S fatty acids
- A aminosilane
- P silicone
- X propietary



Improved Performance

• Improvement in powder flowability for easy handling in transport and feeding system.

• Better rheological behavior of critical parameters of powder flowability as, flow index, friction-angle, etc that are very important to accurate a handling in the industrial plants. As it is well known, interaction between particles can cause problems in terms of deficiencies arising in feeding systems, as well as during powder transport over production lines.

• The effects of improved performance in the fluidity of magnesium hydroxide in powder form can also be observed in the stability and operational continuity that presents the load on the machine, into the compounding line. As shown in the graph Amperage, the operation of the machine is regular and continuous, because they reduce overloads caused by the lack of continuity in the feed hopper, which translates into stability and improvements in the quality of the final compound.

• Another benefit observed with the new MDH grades, is an improvement in mineral filler dispersion within the polymer matrix. Cohesion of space is increased on the interface level and thus in this way, interaction between mineral filler and polymer is improved and a higher dispersion is achieved.

• Regular feeding and improved dispersion of mineral filler in the polymer generate more efficient production processes and, as a result, a notable improvement in the quality of the compounds.

• Lastly, the high degree of homogeneity in compounds with Hidromag Ly gives a notable improvements in the surface appearance of the end products, as well as improvements in mechanical and electrical characteristics.

COMPARATIVE FIGURES OF PROCESS CONTROLS

Composite Manufacturing with Hidromag HQ



Compound manufactured in Kneader Line Compunding Line EVA/PE compound filled with 55 wt.-% of MDH





Halogen Free Compounds Application in Cable Formulations

One of the biggest uses of MDH is in compounds which are known as "Halogen Free," whose final use is mainly in the electric cable manufacturing sector. The formulations to be used, polymers and additives depend on the design of the end product.

Mechanical Properties of using different grades of Hidromag Ly



Cable Guiding Test Compound

The following Standard EVA formulation has been used to generate comparative results

| COMPONENT | Wt % |
|----------------------------------|--------|
| EVA (MFI=3; VA=28) | 27.7 |
| LLDPE (MFI=1) | 8.0 |
| LDPEgMAh | 4.0 |
| Processing Aid | 0.4 |
| Antioxidant | 0.9 |
| MDH HYDROMAG (Ly0 / Ly1 / Ly2) |) 59.0 |

The compounds were manufactured in a Compounder co-rotating twin-screw extruder.

| Characteristics | Standard | MDH Ly0 | MDH Ly1 | MDH Ly2 |
|---------------------------------|-------------|------------|------------|------------|
| Tensile Strength at break (Mpa) | IEC 60811 | 20.8 | 12.5 | 11.4 |
| Elongation at break (%) | IEC 60811 | 260 | 220 | 170 |
| MFI 190°C; 21.6 Kg; 10min | ISO-133 | 5.6 | 8.5 | 9.2 |
| Oxygen index LOI (%O) | ASTM D 2863 | 36 | 35 | 35 |

Higher Surface Area increases tensile strength.

- Higher d₅₀ Particle Size reduces elongation at break.
- Higher Surface Area reduces MFI value.
- Higher Surface Area increases LOI

The formulations of halogen-free flame retardant compounds contain large quantities of mineral filler, this fact causes compounds has a tendency absorb water that could affect the physical and electrical properties of final product as electric cable.

The graphics show comparative results of the effect of aging in water on compound properties.

The results show that for the same composition, the behavior of each one of the compounds may vary depending on the type of Hydromag Ly used; therefore the Hydromag grade to be used must be selected according to final application.









Halogen Free Flame Retardant

"Fire Performance" describes as material's ability to contribute to the development and spread of fire and it's used to define non-flammable materials subject to action of fire.

"Halogen-Free" materials is a "Fire Performance" property required by electric cables sector. They are materials nonflammable, low heat release, low smoke emission and low emission of corrosive fumes. There are standard tests to be able to evaluate a material's behavior when faced with fire. Some of most used are, the Oxygen Index (ASTM D 2863), Release of Heat in Cone Calorimeter (ISO 5660-1) and Opaque Smoke Emission during Combustion (ASTM E-662). The metal hydroxides (Magnesium Hydroxide (MDH) and Aluminum Hydroxide (ATH)), are commonly used in the manufacturing of compounds to obtain non-flammable products, with low emission of opaque smoke and corrosive fumes.

Both hydroxides act as flame-retardants, react with heat releasing water and absorbing heat through an endothermic reaction. The reactions are similar but Magnesium Hydroxide has better properties in terms of behavior when faced fire, because Heat release and opaque smoke emission are released to a lesser extent.

| Cone Calorimeter Fire Performance Evaluation ISO 5660 | Composition ATH | Composition MDH Hidromag Ly |
|---|--------------------|--------------------------------|
| Inflamation time | 94 | 112 |
| Maximum heat emission (kW/m²) | 135 | 124 |
| MARHE (kW/m²) | 85 | 78 |
| SA,1 + SA,2 | 520 | 414 |



Effective reduction of Opaque Smoke Emission according to ASTM E662

In the Smoke Emission Test according to ASTM E 662, the specific optical density (Dm) is determined for smoke released by materials when a sample is vertically exposed to a radiant heat source in a closed chamber with and without flame.

The compounds with the different MDH grades generate less opaque smoke than the sample manufactured with ATH.











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