# PRCO AMERICA


# RAW MATERIALS AND MINERALS

# PN-MH Series High Purity Caustic Calcined Magnesia

The manufacturing process of PN-LBM series High Purity Caustic Calcined Magnesia involves mining, beneficiation, crushing, calcining, cooling and crushing on High Purity Microcrystalline Magnesite.

At present, PRCO has an annual production capacity of 300,000 tons of High Purity Caustic Calcined Magnesia by rotary kiln. The whole production line is computerized and controlled automatically.

It's characterized by high purity, low $SiO_2$, low $Fe_2O_3$, and no harmful impurity elements such as $B_2O_3$ and chlorine. It has superior quality advantages versus Seawater Caustic Calcined Magnesia and Brine Caustic Calcined Magnesia.

PN-LBM is ideal high-quality raw materials for refractory materials, building materials, feed, rubber, and other industries. It is used to produce Electrofused Large Crystal Magnesia, High Purity Dead Burned Magnesia, Sintered Spinel, refractory additives, rubber, and plastic additives.

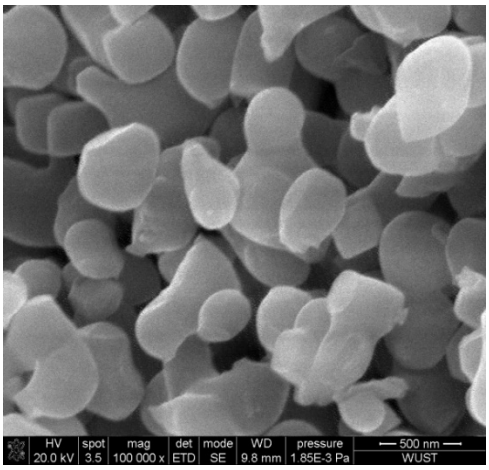
Date Sheet of High Purity Caustic Calcined Magnesia

| Brand / Item | PN-MH001 | PN-MH002 | PN-MH003 | PN-MH004 | PN-MH005 |
|---|---|---|---|---|---|
| MgO% | ≥97 | ≥93.0 | ≥95 | ≥94.5 | ≥97 |
| CaO% | ≤1.2 | ≤1.5 | ≤1.2 | ≤1.5 | ≤2 |
| $SiO_2$ % | ≤0.5 | ≤0.4 | ≤0.2 | ≤0.3 | ≤0.1 |
| $Al_2O_3$% | ≤0.02 | - | - | - | ≤0.2 |
| $Fe_2O_3$% | ≤0.3 | - | ≤0.02 | - | ≤0.3 |
| Mn% | - | - | ≤0.02 | - | - |
| Chloride (Cl) % | ≤0.02 | - | ≤0.02 | ≤0.1 | ≤0.2 |
| Sulfate ($SO_4$) % | - | - | ≤0.2 | - | ≤0.2 |
| Loss of Ignition% | - | ≤5 | ≤3.5 | ≤3 | ≤3 |
| Bulk Density, g/ml Bulk Density | 1.0-1.4 | - | ≤0.5 | - | ≥0.4 |

# MAGNESIUM OXIDE FOR REFRACTORIES

| | | | | | |
|---|---|---|---|---|---|
| Particle Size | Customized | Customized | Customized | Customized | Screen Size, passing 325 mesh, 95% （wet） |
| Activity Index (25℃) | ≥15min | ≤80s | ≤80s | ≤80s | ≤35s |
| Avg Particle Size | - | - | - | - | ≤20μm |
| Surface Area | - | - | - | - | ≥25 $m^2/g$ |

CCM Produced by Rotary Kiln




Microstructure of PRCO CCM

The crystal grain of High Purity Caustic Calcined Magnesia is basically uniform, rounded granular morphology. Most of the crystal grain sizes are 40 - 200 nm.

PRCO High Purity Caustic Calcined Magnesia

PRCO Warehouse of High Purity Caustic

PRCO AMERICA

# Electrofused Magnesia

PRCO's Electrofused Magnesia is obtained from crushing and melting, cooling, and crystallization on High Purity Microcrystalline Magnesite in high-voltage arc furnaces. It is then graded and sorted to get different grade products. The product features high purity, low $SiO_2$, and low $Fe_2O_3$, and no harmful impurity elements such as $B_2O_3$ and chlorine. PRCO Electrofused Magnesia is ideal for refractory applications such as ladle bricks, converter bricks, EAF bricks, ramming materials, castables, etc.

Data Sheet of Electrofused Magnesia

| Brand | MgO, ≥ | CaO, ≤ | $SiO_2$, ≤ | $Fe_2O_3$, ≤ | Bulk Density ≥ | Apparent Porosity ≤ |
|---|---|---|---|---|---|---|
| PN-FM990 | 99.0 | 0.5 | 0.2 | 0.1 | 3.50 | 1.5 |
| PN-FM985 | 98.5 | 1.0 | 0.3 | 0.2 | 3.45 | 2.0 |
| PN-FM980 | 98.0 | 1.5 | 0.5 | 0.2 | 3.45 | 2.0 |
| PN-FM975 | 97.5 | 2.0 | 0.8 | 0.3 | 3.40 | 3.0 |
| PN-FM970 | 97.0 | 2.0 | 1.5 | 0.5 | 3.40 | 3.0 |
| PN-FMS | 97.0 | 2.5 | 1.5 | 0.5 | 2.60 | 25.0 |

# MAGNESIUM OXIDE FOR REFRACTORIES

PN-FM990 Fused Magnesia

PN-FM985 Fused Magnesia

PN-FM98 Fused Magnesia

PN-FM975 Fused Magnesia

PRCO AMERICA

# High Purity Dead Burned Magnesia

The process of manufacturing High Purity Dead Burned Magnesia involves crushing, grinding, briquetting and sintering of High Purity Caustic Calcined Magnesia in ultra-high temperature shaft kilns. The main features of PRCO High Purity Dead Burned Magnesia are high purity and high density, low $SiO_2$ and low $Fe_2O_3$ and no harmful impurity elements such as $B_2O_3$ and chlorine.

High Purity Dead Burned Magnesia is ideal for refractory solutions used in:

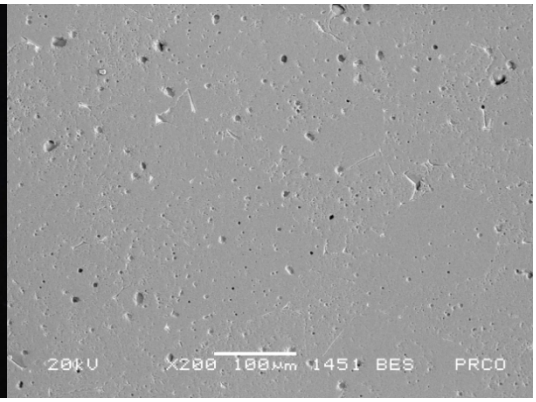
1. Steel industry refractories, such as steel ladle bricks, converter bricks, EAF bricks, ramming materials, and castables.
2. Non-ferrous metallurgical furnaces and smelters.
3. Cement rotary kilns, such as the burning zone brick.
4. Melt zone brick for glass kilns.
5. Other industries, such as glass ceramics, hydrotalcite, & acetate.

PRCO has a production line of 2 High Purity Dead Burned Magnesia furnaces with an annual production capacity of 120,000 tons.

Data Sheet of High Purity Dead Burned Magnesia

| Brand | MgO, ≥ | CaO, ≤ | $SiO_2$, ≤ | $Fe_2O_3$, ≤ | Bulk Density ≥ | Apparent Porosity ≤ |
|---|---|---|---|---|---|---|
| PN-DBM98A | 98.0 | 1.5 | 0.3 | 0.2 | 3.40 | 30 |
| PN-DBM98B | 98.0 | 1.5 | 0.3 | 0.2 | 3.30 | 5.0 |
| PN-DBM98B | 97.8 | 1.5 | 0.3 | 0.2 | 3.28 | 5.0 |

High Purity Dead Burned Magnesia Ball




Microstructure of High Purity Dead Burned Magnesia, grain size 40-200µm

# Large Crystal Electrofused Magnesia

The process of manufacturing Large Crystal Electrofused Magnesia involves melting, cooling, and crystallization on High Purity Caustic Calcined Magnesia in high-voltage arc furnaces. The main features of Large Crystal Electrofused Magnesia are high purity, low $SiO_2$, and low $Fe_2O_3$, without harmful impurity elements such as $B_2O_3$ and chlorine.

Large Crystal Electrofused Magnesia is not only the ideal high-quality raw material for magnesia-carbon bricks applied in key parts of converters, EAF and ladle linings, but also suitable for ramming mix, castables, acetate industries, etc.

PRCO has 6 production lines for Large Crystal Electrofused Magnesia with an annual production capacity of 60,000 tons.

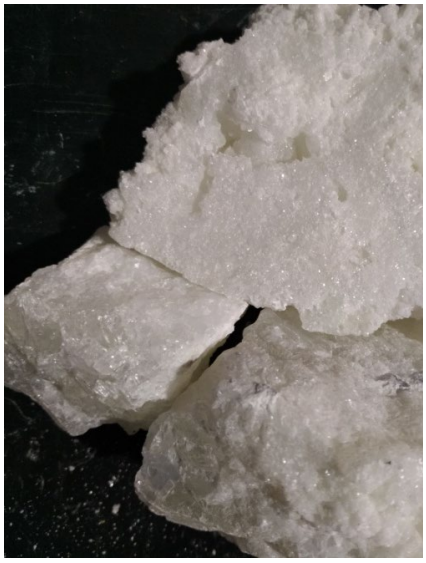
Data sheet of Large Crystal Electrofused Magnesia

| Brand | MgO, ≥ | CaO, ≤ | $SiO_2$, ≤ | $Fe_2O_3$, ≤ | Bulk Density ≥ | Apparent Porosity ≤ |
|---|---|---|---|---|---|---|
| PN-LFM985 | 98.5 | 1.0 | 0.3 | 0.2 | 3.45 | 2.0 |
| PN-LFM980 | 98.0 | 1.5 | 0.3 | 0.2 | 3.45 | 2.0 |
| PN-LFM975 | 97.5 | 2.0 | 0.8 | 0.3 | 3.40 | 3.0 |
| PN-LFM970 | 97.0 | 2.0 | 1.5 | 0.3 | 3.40 | 3.0 |
| PN-LFMS | 97.0 | 2.5 | 1.5 | 0.5 | 2.60 | 25.0 |

PN-LFM985 Large Crystal Electrofused Magnesia

PN-LFM980 Large Crystal Electrofused Magnesia

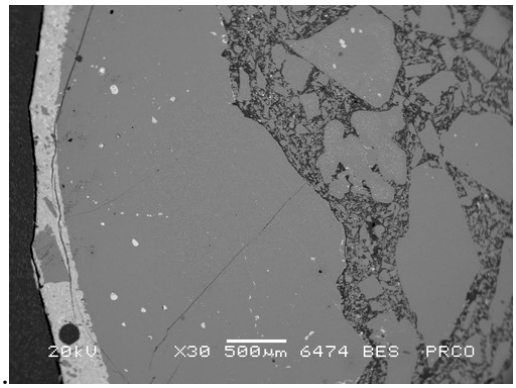
PN-LFM975 Large Crystal Electrofused Magnesia



PN-LFM970 Large Crystal Electrofused Magnesia

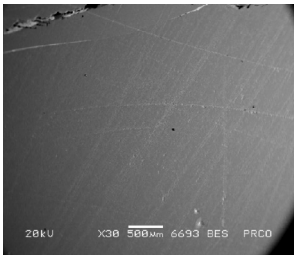
PRCO has adopted PN-LFM985 Large Crystal Electrofused Magnesia for Low Carbon Magnesia Carbon Brick by replacing the conventional Chinese produced 98.5% grade Large Crystal Electrofused Magnesia.

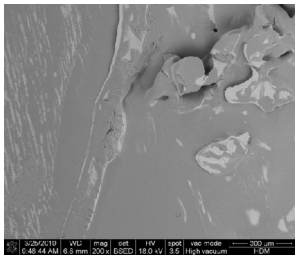
The new Low Carbon Magnesia Carbon Brick developed by PRCO has achieved good results in the VOD ladle slag line. Compared with similar products using the conventional Chinese 98.5% grade Large Crystal Electrofused Magnesia, the service life was increased by 30%, which is equivalent to the service life of Magnesia Chrome Brick.




(Microstructure of the new Low Carbon Magnesia Carbon Brick)

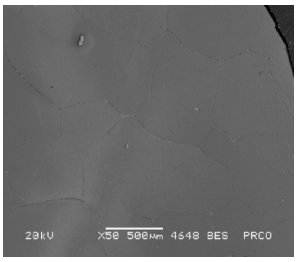


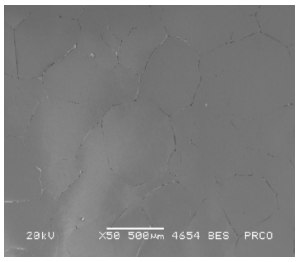




98% large grain Magnesite








98%, 98.5% Magnesite

| Large Grain Size Magnesite Origin | MgO | CaO | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | $CaO/SiO_2$ |
|---|---|---|---|---|---|---|
| Other | 97.72 | 0.90 | 0.51 | 0.55 | 0.15 | 1.76 |
| PRCO ore mine | 97.50 | 1.40 | 0.35 | 0.15 | 0.10 | 4.00 |

PRCO AMERICA

# MAGNESIUM OXIDE FOR GLASS

Puyang Refractories Group Co., Ltd. (PRCO) owns a high-grade magnesite mine with independent property rights in west China. The verified reserves exploitable are above 48 million metric tons.

PN-MH011/MH004 is a magnesium oxide product specifically developed for the glass industry. In glass production, the hardening speed and crystallization performance of the glass liquid can be effectively controlled to improve the high-temperature physical properties of the glass, while also improving the melting performance of the glass.

- It can meet the demand of the high-speed molding by controlling the hardening speed (i.e., making the glass harden by increasing the viscosity in a short time).
- Also helps to prevent the glass liquid from crystallizing during cooling or bursting during annealing.
- This contributes to improving the refractive performance of glass by transforming dazzling light into relatively soft light, which is very important for safety in aircraft and automotive applications.

**Product features:** Low iron, low sulfur, chlorine free, and boron free.
**Application fields:** Optoelectronic glass, mobile phone touch screens, displays, automotive glass, etc.
**Advantages:**

1. High purity. MgO≥97.8%.
2. Low ferrous. This doesn't affect the transparency or color of the glass.
3. Halogens-free and sulfate ions free. Neither has an adverse effect on glass during service, nor corrodes or affects metal equipment and the lining materials of glass furnaces.
4. High-cost performance. Simple processing techniques, short productive processes and no impurities introduced.

**References:**

This product has been successfully launched on the market and has achieved excellent performance in South Korea, and China branches (Taiwan, Hefei, Wuhan, Beijing, and Guangzhou) of an American company. Current supply quantity is approx. 5000 tons per year.

**Size fraction:** 20mesh (750micron) ~ 200 mesh (75micron) .

**Packing:** 25kg woven bags / 1000kg jumbo bags / customized.

# MAGNESIUM OXIDE FOR HYDROMETALLURGY

Puyang Refractories Group Co., Ltd. (PRCO) owns a high-grade magnesite mine with independent property rights in west China. The verified reserves exploitable are above 48 million metric tons. Magnesium oxide for hydrometallurgy is manufactured through mining, beneficiation, crushing, calcination, cooling, crushing, grinding, and packaging. Microcrystalline magnesite is used as a raw material, and an energy-saving rotary kiln is utilized for calcination, with the whole manufacturing process automatically controlled by a computer.

**Product features:**

- High purity
- low silicon
- low iron
- no harmful elements such as chlorine and boron
- quality advantages unmatched by seawater light-burned magnesium oxide and brine light-burned magnesium oxide.

**Application fields:** Wet cobalt precipitation and Wet nickel precipitation.

**Advantages:**

1. High cobalt and nickel precipitation rates.
2. High cobalt and nickel content in hydroxides.
3. Low consumption of magnesium oxide used for cobalt and nickel precipitation.
4. High cost-effectiveness.

Fig.1 Magnesium Oxide For Hydrometallurgy

# MAGNESIUM OXIDE FOR HYDROMETALLURGY

| Product | Brand Code | Chemical Analysis (Calcined Basis), % | | | | | | Physical Analysis | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Property | MgO | CaO | $SiO_2$ | $Fe_2O_3$ | LOI | Loose Bulk Density ($g/cm^3$) | Activity CAA (s) | Percentage pass through 325 mesh screen |
| Magnesium Oxide For wet cobalt precipitation | PN-MH006-7 | Guarantee | ≥95.0 | ≤4.0 | ≤0.5 | ≤0.1 | ≤3.0 | ≤0.5 | ≤45 | ≥99.0 |
| | | Typical | 95.96 | 3.29 | 0.29 | 0.06 | 2.16 | 0.38 | 28 | 99.5 |
| | PN-MH006-7C | Guarantee | ≥95.0 | ≤4.0 | ≤0.5 | ≤0.1 | ≤3.0 | ≤0.5 | ≤40 | ≥99.5 |
| | | Typical | 95.85 | 3.61 | 0.25 | 0.05 | 2.57 | 0.30 | 25 | 100 |
| Magnesium Oxide For wet nickel precipitation | PN-MH006-7A | Guarantee | ≥95.0 | ≤4.0 | ≤0.5 | ≤0.1 | ≤3.0 | ≤0.5 | ≤45 | ≥99.0 |
| | | Typical | 95.88 | 3.29 | 0.29 | 0.06 | 2.16 | 0.38 | 38 | 99.5 |
| | PN-MH006-7B | Guarantee | ≥95.0 | ≤4.0 | ≤0.5 | ≤0.1 | ≤3.0 | ≤0.5 | ≤40 | ≥99.5 |
| | | Typical | 95.79 | 3.29 | 0.29 | 0.06 | 2.71 | 0.31 | 32 | 100 |

Table 1: Chemical and physical properties of Magnesium Oxide For Hydrometallurgy

| Brand Code | Solution after iron removal | Solution after cobalt precipitation | Cobalt precipitation rate | Metal content in cobalt hydroxide | | | Unit consumption of Magnesium Oxide |
|---|---|---|---|---|---|---|---|
| | Co2+/g·L-1 | Co2+/g·L-1 | % | Co | Mg | Mn | /T·(T·Co)-1 |
| PN-MH006-7 (1#) | 10.70 | 2.49 | 76.08 | 45.55 | 3.83 | 0.94 | 0.75 |
| PN-MH006-7 (2#) | 10.70 | 2.46 | 76.37 | 45.72 | 3.99 | 1.02 | 0.74 |
| Average | 10.70 | 2.48 | 76.22 | 45.64 | 3.91 | 0.98 | 0.74 |

Table 2: Third-party evaluation report

**Conclusion on third-party evaluation report:**

The performance test results of PN-MH006-7 magnesium oxide cobalt precipitation show that: for solutions with high cobalt content (Co 10.70 g/L), under the condition that the amount of magnesium oxide added is 0.8 times the theoretical amount of cobalt precipitation, the Co and Mg contents in the cobalt hydroxide slag obtained by cobalt precipitation are 45.64% and 3.91%, respectively, and the liquid Co precipitation rate is 76.22%. The consumption of magnesium oxide is 747.67 kg/tCo. Compared with the current operating parameters in the cobalt extraction industry (magnesium oxide consumption~1.1 t/tCo),

the unit consumption of the tested magnesium is much lower. The Mg content in the crude cobalt hydroxide obtained by precipitation is lower than the secondary product requirement (Mg≤ 6%) in the industry standard (YS/T1152-2016 crude cobalt hydroxide). This magnesium oxide sample can be used as a precipitant for wet cobalt extraction from copper cobalt ore.

| Brand Code | Solution after iron removal | Solution after cobalt precipitation | Cobalt precipitation rate | Metal content in cobalt hydroxide | | | | | Unit consumption of Magnesium Oxide |
|---|---|---|---|---|---|---|---|---|---|
| | $Co^{2+}/g{\cdot}L^{-1}$ | $Co^{2+}/g{\cdot}L^{-1}$ | % | Co | Mg | Mn | Ca | Fe | $T{\cdot}(T{\cdot}Co)^{-1}$ |
| Product from Australia | 8.20 | 0.60 | 92.68 | 37.44 | 6.18 | 2.23 | 0.18 | 0.11 | 1.01 |
| PN-MH006-7 | 8.20 | 0.22 | 97.32 | 38.16 | 4.48 | 2.50 | 0.21 | 0.11 | 0.95 |

Table 3: Application case one

| Brand Code | Solution after iron removal | Solution after cobalt precipitation | Cobalt precipitation rate | Metal content in cobalt hydroxide | | | | | Unit consumption of Magnesium Oxide |
|---|---|---|---|---|---|---|---|---|---|
| | $Co^{2+}/g{\cdot}L^{-1}$ | $Co^{2+}/g{\cdot}L^{-1}$ | % | Co | Mg | Mn | Ca | Fe | $T{\cdot}(T{\cdot}Co)^{-1}$ |
| Product from Australia | 11.75 | 0.69 | 94.13 | 40.12 | 4.36 | 1.72 | 0.18 | 0.01 | 0.84 |
| PN-MH006-7 | 11.75 | 0.35 | 97.02 | 40.48 | 4.11 | 2.28 | 0.18 | 0.11 | 0.79 |

Table 4: Application case two

| Brand Code | Solution after iron removal | Solution after cobalt precipitation | Cobalt precipitation rate | Metal content in cobalt hydroxide | | | | | Unit consumption of Magnesium Oxide |
|---|---|---|---|---|---|---|---|---|---|
| | $Co^{2+}/g{\cdot}L^{-1}$ | $Co^{2+}/g{\cdot}L^{-1}$ | % | Co | Mg | Mn | Ca | Fe | $T{\cdot}(T{\cdot}Co)^{-1}$ |
| Product from Australia | 1.41 | 0.40 | 71.60 | 26.48 | 3.61 | 8.67 | 1.14 | 0.01 | 0.84 |
| PN-MH006-7C | 1.41 | 0.35 | 75.20 | 26.32 | 2.48 | 10.32 | 0.99 | 0.11 | 0.79 |

Table 5: Application case three

# TABULAR ALUMINA

Puyang Refractories Group Co., Ltd. (PRCO) high density and high purity tabular Alumina is produced by rapid sintering on calcined alumina without the use of sintering aids at a high temperature close to the melting point of aluminum oxide (approx. 2040°C).

The product has high chemical purity (Tab.1). The corundum crystals are completely developed and tightly bonded (Fig.1), with a certain amount of closed micro pores wrapped inside and between crystals. Therefore, it has excellent chemical stability, high refractoriness, high hardness, good toughness, good thermal shock resistance, and high mechanical strength. It's widely used to produce high-quality refractory materials for multiple industries in metallurgy, foundry, ceramics, petrochemical, and cement.

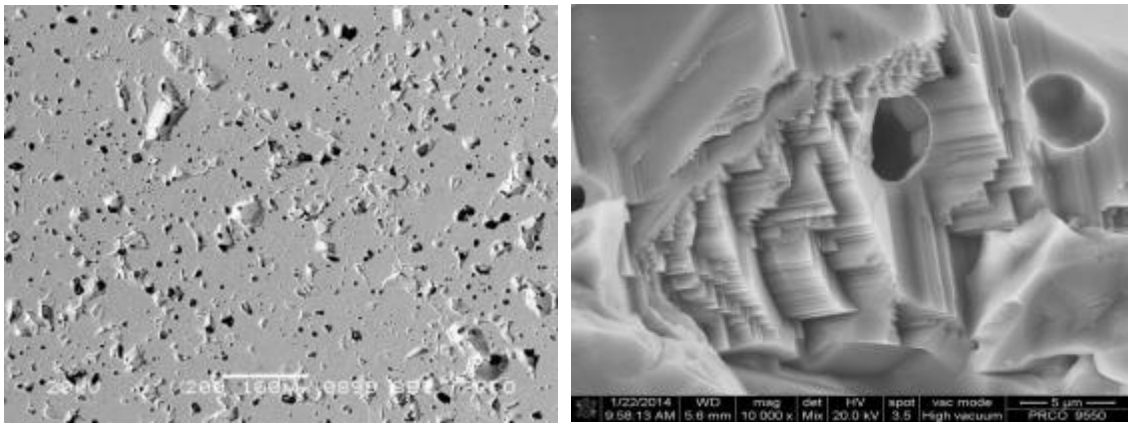


**Fig.1 Microstructure of tabular alumina**

| Items | | Granular | | Powder | |
|---|---|---|---|---|---|
| | | Guarantee | Typical | Guarantee | Typical |
| Chemical analysis, % | $Al_2O_3$ | ≥99.30 | 99.45 | ≥99.30 | 99.40 |
| | $SiO_2$ | ≤0.12 | 0.05 | ≤0.12 | 0.05 |
| | $R_2O$ | ≤0.40 | 0.29 | ≤0.40 | 0.35 |
| | $Fe_2O_3$ | ≤0.15 | 0.05 | ≤0.15 | 0.05 |
| | Fe Magnetic | ≤0.02 | 0.01 | ≤0.02 | 0.01 |
| Bulk density, $g/cm^3$ | | ≥3.50 | 3.55 | | |
| Apparent porosity, % | | ≤5 | 4.0 | | |
| Water absorption，% | | ≤1.5 | 1.3 | | |

**Tab.1 Physical and chemical properties of tabular alumina**

Size fraction: Granular: 6-15mm, 6-10mm, 3-6mm, 1-3mm, 1-2mm, 0-1mm, 0.5-1mm and 0-0.5mm; Powder: 200 mesh (75micron) and 325 mesh (45micron).

Packing: 25kg woven bags / 1000kg jumbo bags / customized.

PRCO AMERICA

## For more information:

minerals@prco-america.com

(270) 277-1985, option 9

PRCO AMERICA

**Corporate:**
P.O. Box 30
Glenshaw, PA 15116
(412) 837-2798

**Plant:**
150 Hickory Road
Hickory, KY 42051
(270) 277-1985

**www.prco-america.com**