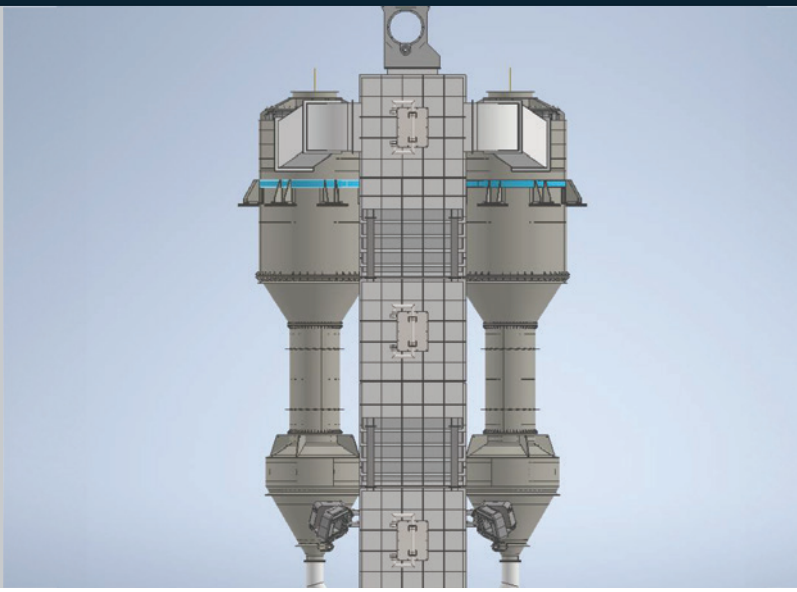
Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

MAGNESIUM DO BRASIL | Ceará, Brazil | 2022

Hurricane AT System to pre-separate Magnesium Oxide (MgO) (104 493m³/h at 325°C | 61 502acfm at 617°F)



FOREWORD

ACS designed and supplied a **Hurricane AT Cyclone System** for product recovery from the exhaust from the pre-heater of a calcination kiln for Magnesium do Brasil (Groupe Roullier) Magnesium facility in Ceará, Brazil.

Magnesium do Brasil specializes in the mining of magnesium deposits, the production of magnesite, a mineral composed of magnesium carbonate ($MgCO_3$), and Magnesium Oxide (MgO).

Magnesite is a crucial raw material in various industries, including refractories, agriculture, construction, and environmental applications. Depending on the heat treatment applied, different Magnesium forms can be produced. Sintered or Dead Burned Magnesite is essential in the steel sector as a refractory, or Caustic Calcinated Magnesite, a reactive form of Magnesium Oxide, used in agriculture, livestock farming, the environment, and other industrial and chemical technologies.

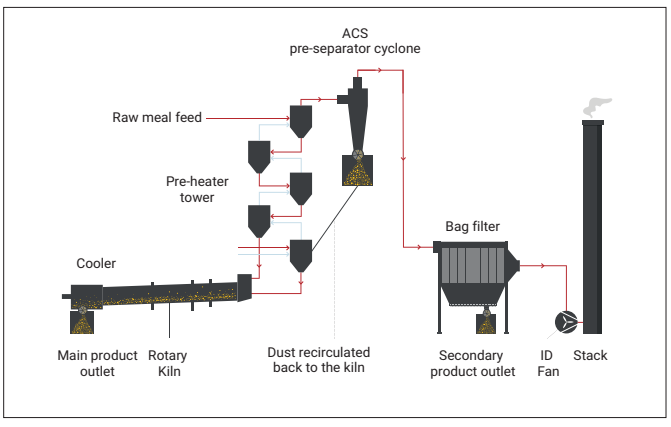


Fig. 1 – Process flow diagram from existing installation

IDENTIFYING THE PROBLEM AND SOLUTION

ACS was approached by Groupe Roullier to design a cyclone system for the expansion project and new Rotary Kiln of Magnesium do Brasil plant in Ceará, Brazil. The primary objective was to optimize product recovery at the outlet of the pre-heater, and with it, improving overall production efficiency and extending the service life of the end-stage baghouse.

The process involves high-temperature gases and highly abrasive particulate matter, which pose a significant risk of accelerated wear to downstream equipment. To address this, ACS engineered a dual cyclone system consisting of two 2 300mm (7.5ft) diameter Hurricane cyclones. The system was specifically designed to achieve over 99% separation efficiency, focusing on capturing the most abrasive particle size fraction while withstanding a high inlet particle load. To ensure durability under such demanding conditions, the interior of the cyclones was lined with a corundum-based abrasion protection cement.

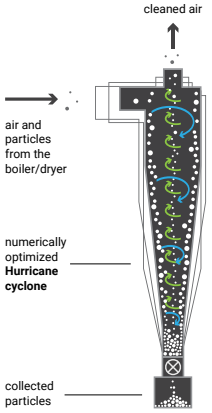


Fig. 2 – Hurricane cyclone

ABOUT HURRICANE CYCLONES

Hurricane cyclones are patented numerically optimized cyclones. **Hurricane** geometries maximize powder collection for each different application, while minimizing reentrainment and keeping pressure drop at reasonable levels. Hurricane cyclones demonstrate impressive efficiencies in capturing very fine powders with a Volume Median Diameter (VMD) of less than 5µm.

These cyclones are the output of nonconvex nonlinear problems formulated and solved after years of work in partnership with the Faculty of Engineering of Porto and incorporate the most recent findings of the impact of agglomeration in the cyclone collection efficiency (Chemical Engineering Journal 162 (2010) 861–876).

A single Hurricane is more efficient than any other known cyclone available in the market for the same pressure drop.

DESIGN BASIS

- Type of particles **[Magnesium Oxide]**
- Particle size distribution **[Fig.3]**
- Temperature (°C | °F) **[325 | 617]**
- Actual flow rate (m^3/h | acfm) **[104 500 | 61 500]**
- Normalized flow rate (Nm^3/h_{dry} | dscfm) **[45 000 | 26 486]**
- Inlet concentration (mg/Nm³dry | gr/dscf) **[410 000 | 180]**

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected separation efficiency (%) **[>99.5]**
- Expected emissions (mg/Nm^3_{dry} | gr/dscfm) **[<2 100 | 0.92]**
- Guaranteed emissions (mg/Nm^3_{dry} | gr/dscf) **[2 200 | 0.96]**
- Total pressure drop (kPa) **[1.3 | 5.3]**

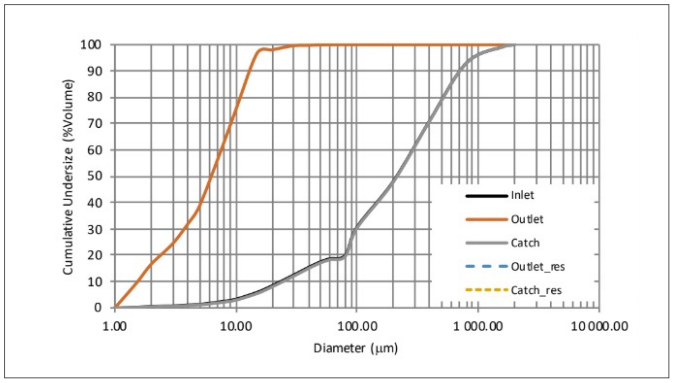


Fig. 3 – Particle size distribution used in simulation

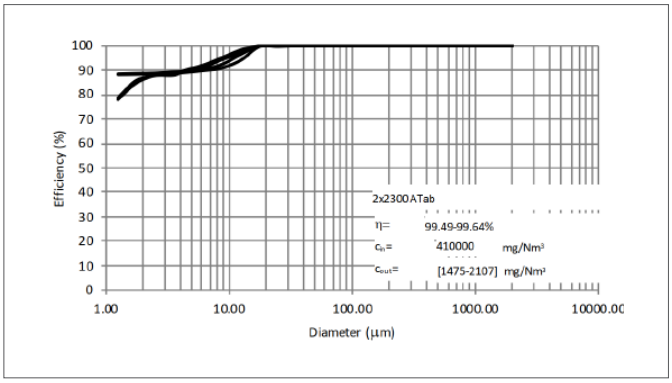


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

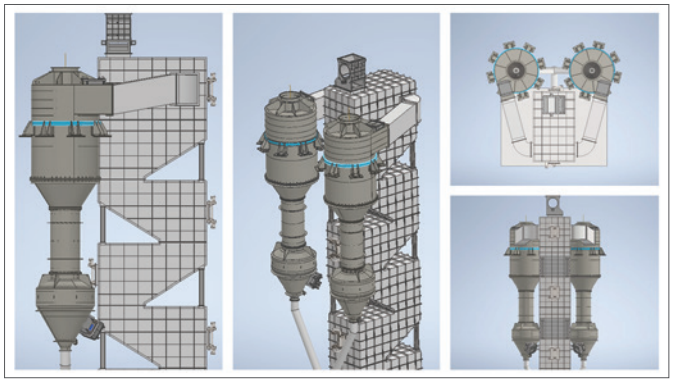


Fig.5 – ACS solution [2 AT ø2 300 | 7.5ft]

CONCLUSIONS

ACS solution increased the kiln efficiency and significantly reduced particulate carryover to the baghouse, minimizing maintenance needs and unplanned downtime. By effectively capturing the most abrasive particles, the system also reduced wear on downstream equipment.

Additionally, the corundum-based abrasion-resistant lining ensures long-term durability of the cyclones themselves, making the overall operation more stable, efficient, and cost-effective.