Advanced Cyclone Systems

POWDER RECOVERY

CASE STUDY

NESTLÉ | AZORES, PORTUGAL | MAY 2012



Hurricane HR Cyclones To Reduce Particulate Matter (PM) Emissions Under 75mg/Nm³ From A Drying Tower Of Powder Milk

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System for **Nestlé**, the world's leading nutrition, health and wellness company.

Nestlé which is based in Linda-a-Velha (Oeiras, Portugal), has 4 production plants and 25 distribution centers spread across the country. ACS's system was installed in the production plant of Azores, in the beautiful island of S. Miguel.

ACS was contacted with the objective of reducing particulate matter (PM) emissions under 75mg/Nm³ from a Drying Tower of Powder Milk (Fig. 1).

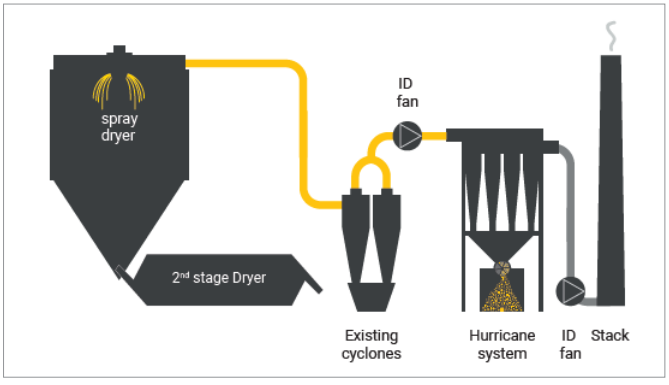


Fig. 1 – Process scheme

IDENTIFYING THE PROBLEM AND SOLUTION

The existing cyclones installed after the Spray Dryer at Néstle's plant had emissions around 170mg/Nm³, besides being above the emissions limits this valuable product was being lost to the atmosphere.

In order to design the most effient system for this case, an isokinetic dust sample was collected at the stack and measured by ACS in a laser sizer to obtain the Particle Size Distribution (PSD).

After stack tests confirmed the PSD (Fig.3), ACS designed a Hurricane system comprising 8 Hurricane HR numerically optimized cyclones with ø850 mm, disposed in 2 batteries, operating in parallel. The system is capable of guaranteeing emissions under 75mg/Nm³ (expected under 50 mg/Nm³) at a pressure drop of 1.7 kPa.

ABOUT HURRICANE CYCLONES

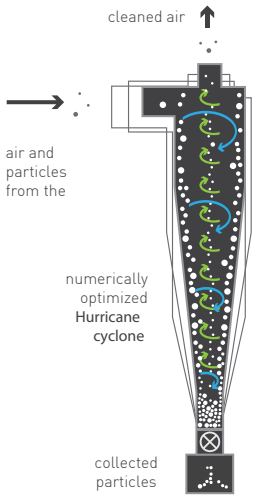


Fig. 2 – Hurricane system scheme

Understanding How Cyclones Work

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

- Powder **[Milk powder]**
- Particle size distribution **[Fig. 3]**
- Gas flow temperature (ºC) **[70-80]**
- Effective flow rate (Nm^3/h) **[31 100]**
- Normalized flow rate (Nm^3/h_{dry}) **[21 150]**
- Inlet concentration (mg/Nm^3) **[245]**

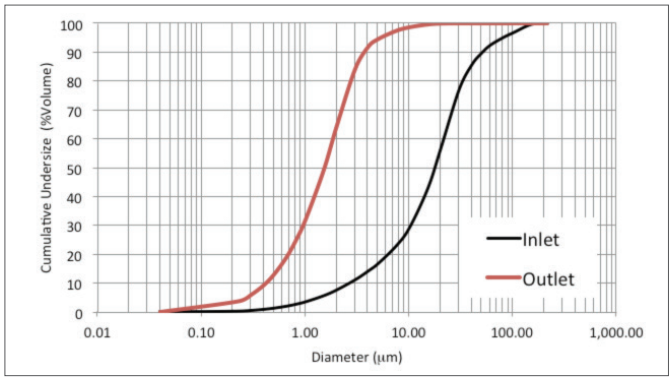


Fig. 3 - Particle size distributions used in simulations (Coulter)

SYSTEM SPECIFICATIONS | PARTICLE EMISSIONS

- Guaranteed maximum emissions (mg/Nm^3) **[75]**
- Expected maximum emissions (mg/Nm^3) **[<50]**
- Expected total pressure drop (kPa) **[1.7]**
- Verified Emissions (mg/Nm^3) **[25]**

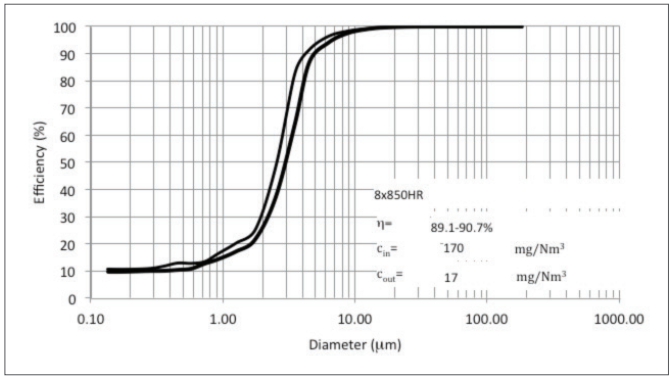
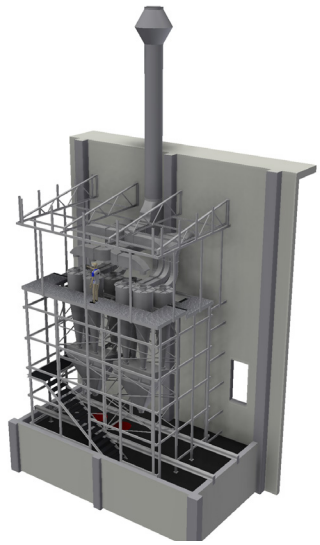


Fig. 4 - Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

GENERAL ARRANGEMENT



CONCLUSIONS

Results confirm the Hurricane Cyclone System, achieving PM emissions under 50 mg/Nm^3, thus assuring future imposed emission standards with an equipment which has lower investment costs, BFs, and lower maintenance and operating costs, when compared to Bag Filters.