

## Hurricane MK System for sulfanilic acid powder recovery and emission control of fluid bed dryer (from 6 700 m<sup>3</sup>/h at 107°C up to 12 000m<sup>3</sup>/h at 115 °C)



### FOREWORD

**Advanced Cyclone Systems, S.A. (ACS)** designed and supplied a Hurricane MK cyclone system for sulfanilic acid powder recovery and emission control from a fluid bed dryer. Sulfanilic acid (4-aminobenzenesulfonic acid, with chemical formula C<sub>6</sub>H<sub>7</sub>NO<sub>3</sub>S) has four primary end uses: it is used as an intermediate in the production of yellow food dye, specific pharmaceutical applications, optical brighteners for white paper and as a concrete additive. The system was installed at Bondalti, in Estarreja, Portugal. Bondalti is the largest Portuguese producer of organic-derived chemicals - aniline and derivatives – and of inorganic chemicals - chlor-alkali products. Its production is mainly destined for exportation. Bondalti group has also an industrial facility with innovative technology focused on the production of nano-structured ceramic materials.

### IDENTIFYING THE PROBLEM AND SOLUTION

The fluid bed dryer of the sulfanilic acid plant at Bondalti had originally a process cyclone to return the product to the dryer and downstream, a bag filter for emission control. The bag filter had operational problems due to high moisture content of the exhaust stream. Back in 2001, this installation was retrofitted and the bag filter was replaced by ACS's ReCyclone MH both due to the higher collection efficiency and due to the absence of maintenance costs over a period of 5 years (these results can be analyzed in detail in "Pilot and Industrial-Scale Experimental Investigation of Numerically Optimized Cyclones" Particle Agglomeration in Cyclones (PACyc) model - (Chemical Engineering Journal 162 (2010) 861–876)). ReCyclone MH solved the operational issues while complying with Emission Limit Value by that time (ELV) of 150mg/Nm<sup>3</sup>.

In 2016 Bondalti approached ACS to design a new solution for stricter ELV. After installation of the Hurricane MK system model 6 MK 900 with the new developed agglomerator cyclones, ACS was able to design a cyclone system without recirculation, but sufficiently efficient to reduce emissions under 50mg/Nm<sup>3</sup>, cutting previous power losses in more than 70%.

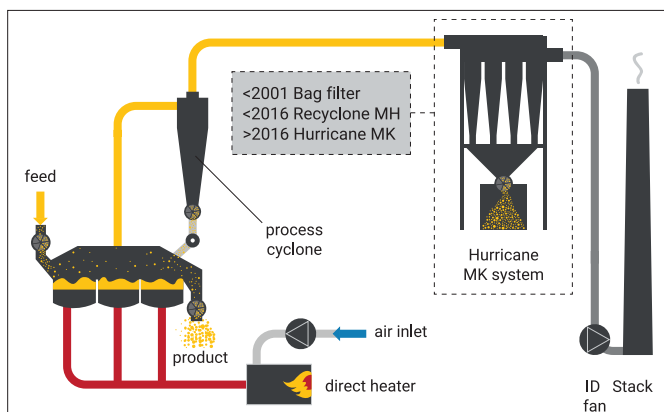


Fig. 1 – Process flow diagram from new installation

**ABOUT HURRICANE CYCLONES**

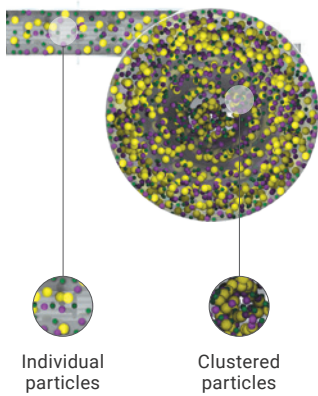


Fig. 2 – Agglomerator Cyclone

**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. 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.

In 2014, a better understanding of agglomeration has allowed ACS to develop a completely new line of cyclone geometries, different from any other in the world: the **Hurricane MK**. It was obtained by combining stochastic numerical optimization with ACS (Particle Agglomeration in Cyclones (PACyc) model - (Chemical Engineering Journal 162 (2010) 861–876).

Emissions of these cyclones can be as low as 30mg/Nm<sup>3</sup> for many industrial processes.

For more information, visit our website: [www.advancedcyclonesystems.com](http://www.advancedcyclonesystems.com)

**DESIGN BASIS**

- Powder **[Sulfanilic Acid Fines]**
- Particle size distribution **[Fig.3]**
- Temperature (°C) **[107 to 115]**
- Actual flow rate (m<sup>3</sup>/h) **[6 700 to 12 000]**
- Moisture content (% v) **[3.8 to 5.1]**
- Absolute pressure (Pa) **[101 178 to 101 700]**
- Powder concentration at inlet (mg/Nm<sup>3</sup>) **[31 567]**
- Site location **[Indoors]**

**SYSTEM SPECIFICATIONS | EMISSIONS**

- Guaranteed maximum emissions (mg/Nm<sup>3</sup>) **[100]**
- Expected separation efficiency (%) **[99.86-99.92, fig. 4]**
- Expected emissions (mg/Nm<sup>3</sup>) **[24-45, fig. 4]**
- Verified emissions (mg/Nm<sup>3</sup>) **[34.5-44.7\*]**
- Expected pressure drop (KPa) **[1.2 to 2.2\*\*]**

\*From official reports

\*\*Depending of the actual flowrate, which is variable.

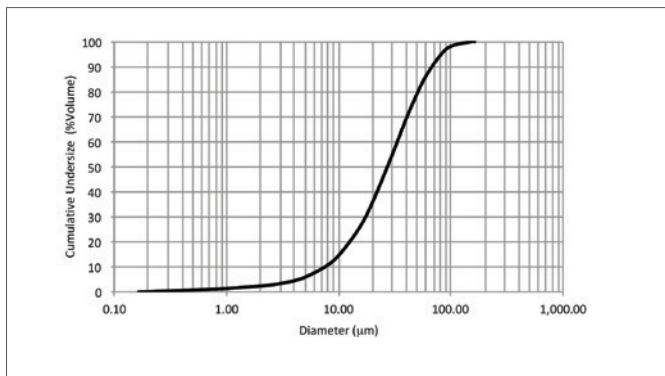


Fig. 3 – Particle size distribution used in simulation

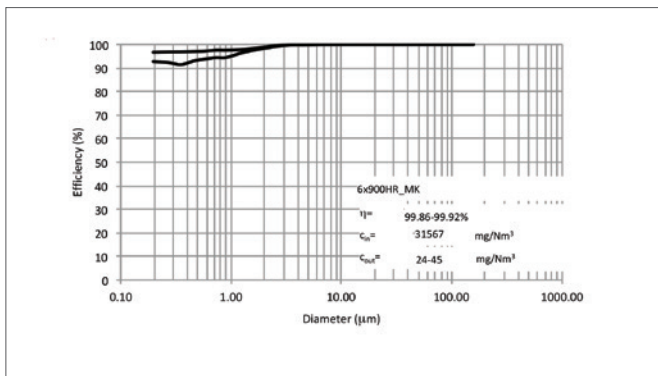


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

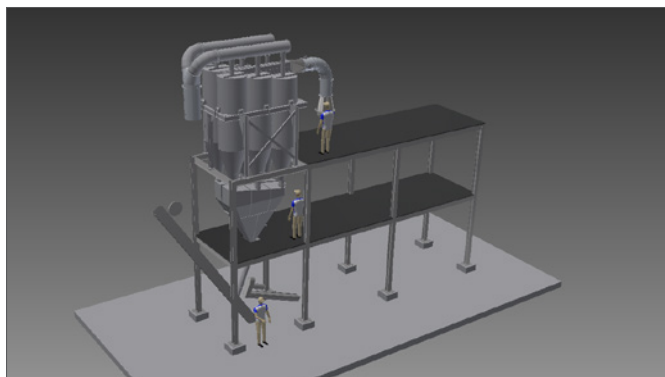


Fig.5 – ACS solution: 6 Hurricane MK ø900mm installed in parallel, with a common hopper, rotary valve for air lock and inspection doors. All equipment was manufactured in stainless steel AISI 304 with chemical grade finishing. Heat tracing and thermal insulation was installed in some parts of the equipment to avoid condensations.

**CONCLUSIONS**

This installation was a complete success and client is satisfied for several reasons. Besides general cleanliness, and low maintenance, the hurricane MK system allows recovering the fine product that escapes the process cyclone, which is incorporated in the end product, while complying with stricter emission limits. Verified results confirmed emissions consistently under 40mg/Nm<sup>3</sup>. This represents a cut-off in previous powder losses in more than 70%, with a system which is easier to clean and has less maintenance due to absence of recirculation.