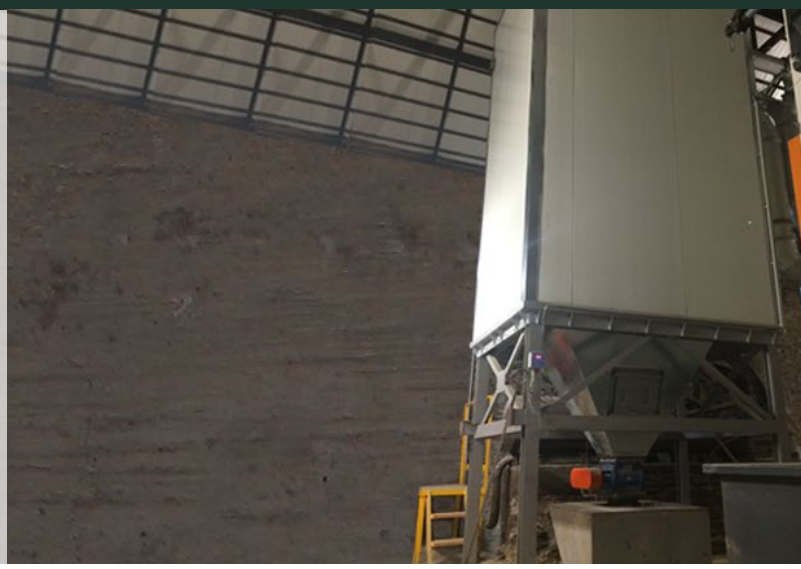
Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

SCIÉRIE DE MIREMONT | NORD DU PÉRIGORD VERT, FRANCE | 2014

Hurricane MK System *to Reduce Particulate Matter from a Wood Bark and Forestry Waste Boiler Under 30mg/Nm³*



FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System, type MK, for **Sciérie de Miremont**, a French company located in the Nord of Périgord Vert, working in the forest exploitation sector and forestry waste.

ACS was contacted to reduce Particulate Matter (PM) emissions from a biomass boiler burning wood bark and forest waste under 30mg/Nm³ (Fig. 1).

This level of emission insures the co-financing of the dedusting system by ADEME - the french agency for the environment and efficient energy use. The alternative for the client was the installation of an ESP.

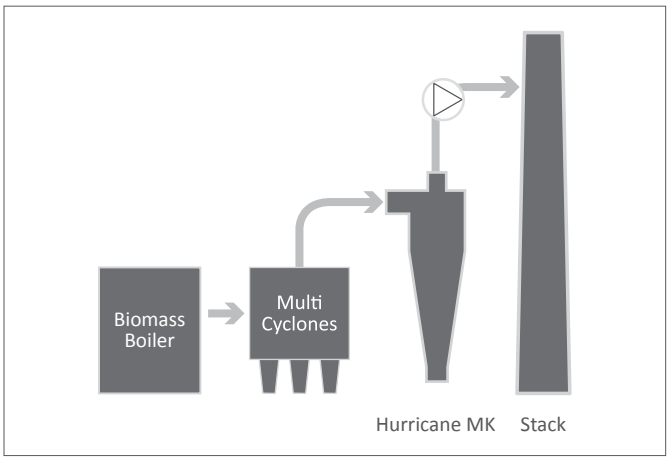


Fig. 1 – Process diagram

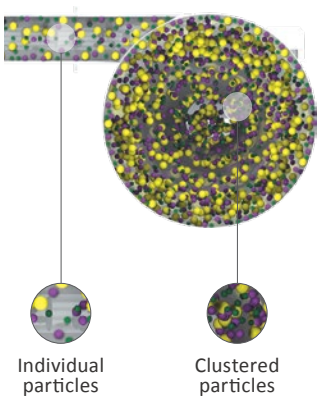
IDENTIFYING THE PROBLEM AND SOLUTION

The use of biomass in heating systems is beneficial because it uses biological material derived from living, or recently living, organisms with less effect on the environment than fossil fuels. However, its combustion produces significant amount of inhalable PM, which must be collected before being released to the atmosphere, thereby ensuring the air quality for the people living nearby. Taking the advantage of being located in a forest area, Miremont burns forestry waste with more than 50% moisture in order to produce steam, thus providing energy for several processes.

The boiler manufacturer designed the boiler with gas flow rate at the stack with about 3 200m³/h at 190ºC and expected emissions of particulates after the multicyclone of 150mg/Nm³ at 6% O_2. The goal of Miremont was to decrease it to under 30mg/Nm³, therefore complying with the emission limits imposed by ADEME.

In order to design the most efficient system for this case, ACS made use of its extensive particle size distribution (PSD) database collected from very different industrial dusts analyzed in ACS´ pilot systems. After choosing the most appropriate PSD (Fig.3), ACS designed a system comprising 6 Hurricane MK numerically optimized cyclones with ø600mm, operating in parallel and disposed in 1 battery. The system is capable of guaranteeing emissions under 30mg/Nm³ at 6% O_2 (expected under 15mg/Nm³) at a pressure drop of 1.2kPa.

THE 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 30 mg/Nm³ for many industrial processes.

For more information, visit our website: **www.acystems.pt**

Fig. 2 – Agglomerator Cyclone

DESIGN BASIS

- Fuel **[Bark and forest waste]**
- Particle size distribution **[Fig.3]**
- Gas flow temperature (ºC) **[190]**
- Actual flow rate (m^3/h) **[3 200]**
- Normalized flow rate (Nm^3/h_{dry}) **[1 792]**
- Inlet concentration (mg/m^3) **[150]**

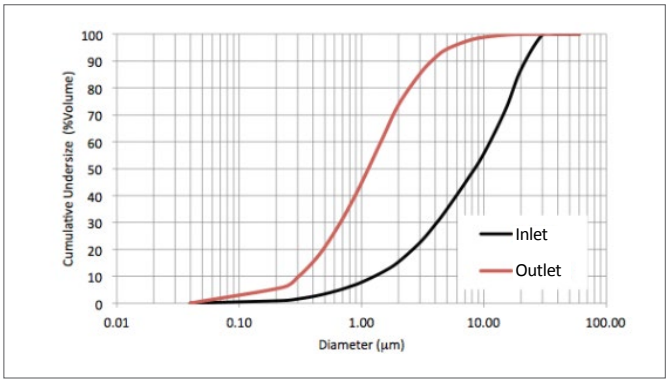


Fig. 3 - Particle size distribution used in simulation

SYSTEM SPECIFICATIONS | EMISSIONS

- Guaranteed maximum emissions 11% O_2 (mg/Nm^3) **[30]**
- Expected emissions 11% O_2 (mg/Nm^3) **[15]**
- Expected total pressure drop for the usual air flow (KPa) **[1.2]**

CONCLUSIONS

After running the installation, results confirm the Hurricane MK efficiency, achieving PM emissions under 30mg/Nm³, thus confirming the achievement of the imposed emission standards with an equipment with significantly lower investment costs, when compared with ESPs (approximately 50% lower), and lower maintenance and operating costs, when compared to Bag Filters (from 70% to 90% lower).

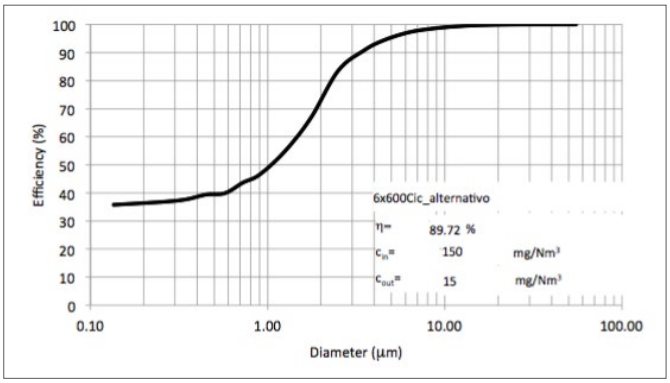


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

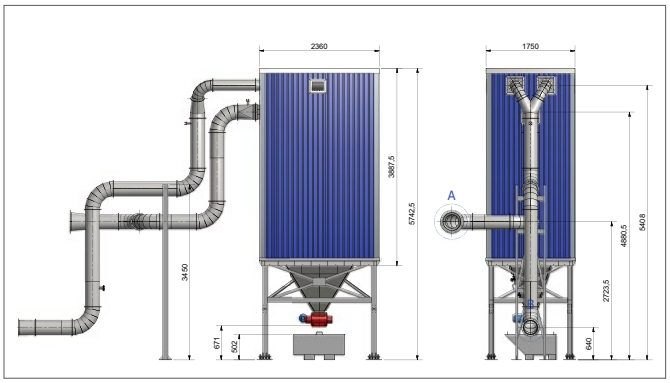


Fig.5 – General arrangement of the Hurricane cyclone system

Fig. 6 – Look of the stack at normal boiler operation