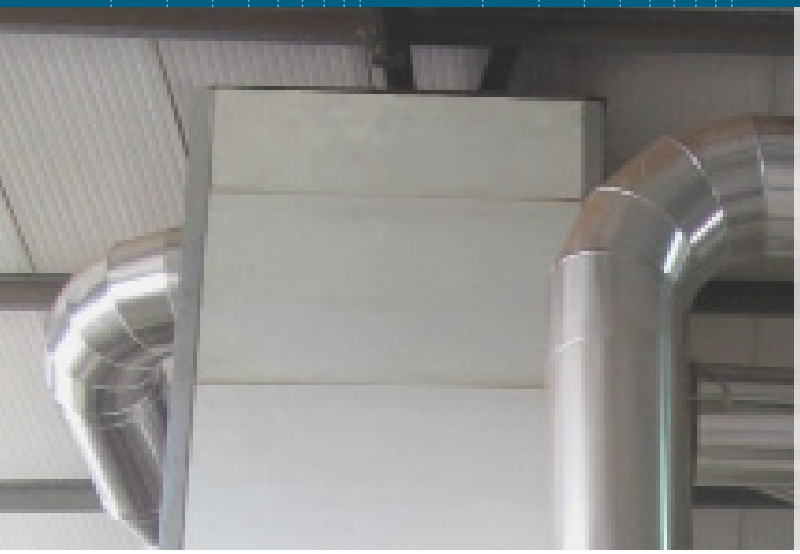
Advanced Cyclone Systems

CASE STUDY



hurricane for PM Emission Reduction from Dryer Off Gases on a Wood Pellet Production Line

8074 m³/h @ 110 ºC

FOREWORD

Advanced Cyclone Systems, S. A. (ACS) designed a settling chamber, followed by a *Hurricane* system with the double purpose of dust recovery and Particulate Matter (PM) emission reduction, from a sawdust rotary dryer in an industrial wood pellets production plant with 2 ton/h capacity (VIMASOL).

High quality pellets are manufactured from sawdust coming from nearby sawmilling plants (mainly pine wood), after being dried with VIMASOL's own drying facility. A furnace burning forestry waste delivers the hot air for the dryer.

Pellets production involves several phases, from the collection of raw material, drying, grinding or milling, granulation and packaging. Learn more about Vimasol Pellets at: http://pellets.vimasol.pt/.

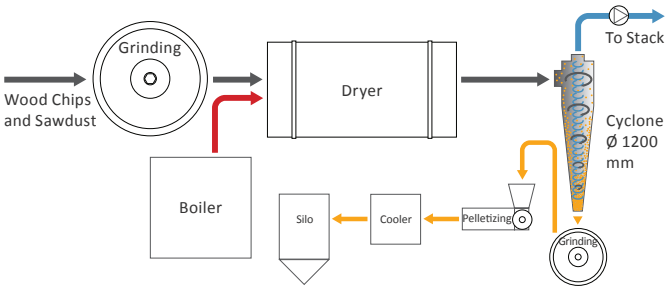


Fig. 1 – Process Scheme

IDENTIFYING THE PROBLEM AND SOLUTION

The existing cyclone after the dryer was not efficient enough to meet the Portuguese emission limit (150 mg/Nm³). Measured emissions at the stack reached 1,625 mg/Nm³ of total suspended particles (mass flow of 9 kg/h). The objective of the client was to meet the legal standards without investing in a Wet Electrostatic Precipitator (WESP) and contacted ACS to present a solution based on cyclones.

In order to design the most appropriate system for this case, a dust sample was collected through an isokinetic sampling at the stack and subsequently measured in a Coulter LS230 analyzer. With the information of the recovery rate of the existing cyclones and the current emissions of these cyclones, ACS easily perfectly reconstruct the particle size distribution and solids concentration (g/Nm³) at the exit of the dryer.

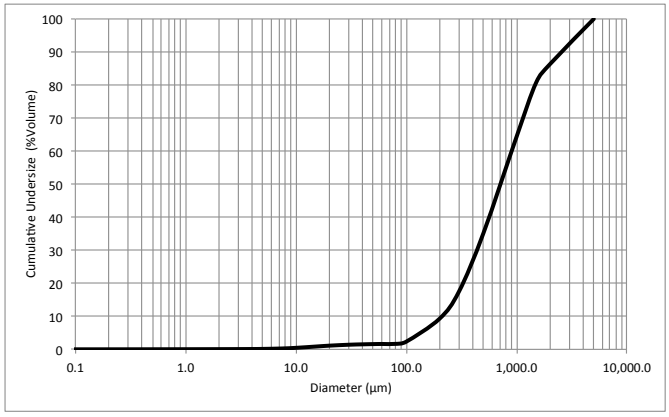


Fig. 2 – Particle Size Distribution used in simulations

Several alternative solutions were evaluated:

1. Replacing the existing cyclones by a battery of *Hurricane* type optimized cyclones; **2.** Treating the offgases of the existing cyclones with a battery of *Hurricane* cyclones; **3.** Replacing the existing cyclones with a mechanical **ReCyclone®** system; **4.** To treat the offgases of the existing cyclones with a mechanical ReCyclone® system; **5.** Doing a mechanical recirculation to the existing cyclones.

With options **#2** and **#4**, ACS could guarantee emissions of less than 50 mg/Nm^3. However, since the emission limits were 150 mg/Nm^3 and taking the reduced layout space in the plant into consideration, the client decided for the most compact and cost efficient solution (*Hurricane* cyclones to replace existing cyclones) to be upgraded in the future for a ReCyclone® MH, if necessary.

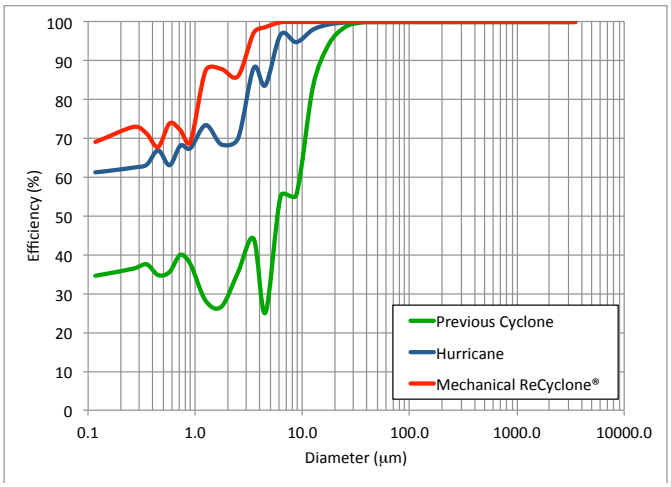


Fig. 3 – Predicted grade collection efficiency

DESIGN BASIS

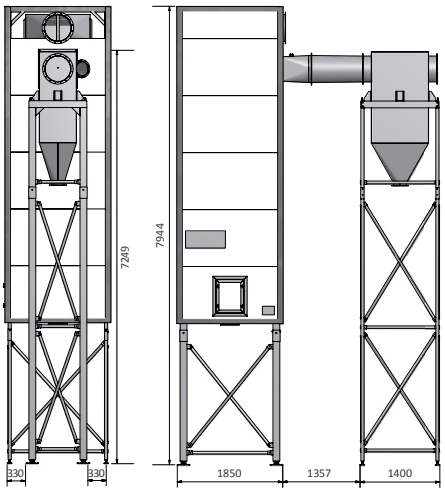
• Powder	Sawdust
• Particle Size Distribution	(see Fig. 2)
• Temperature (ºC)	110
• Actual flow rate (m^3/h)	8,074
• Dust concentration from dryer (mg/Nm^3$_{dry}$)	293,923

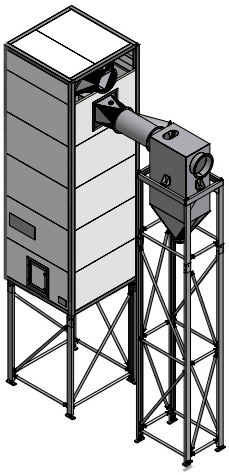
SPECIFICATIONS

• Emissions from existing cyclone system (mg/Nm^3$_{dry}$) (Existing cyclone was replaced by *Hurricane* system)	1625
• Estimated emissions from *Hurricane* system (mg/Nm^3$_{dry}$)	178
• Measured emissions from *Hurricane* system (mg/Nm^3$_{dry}$)	108
• Pressure drop of *Hurricane* system (kPa)	1.1

GENERAL ARRANGEMENT

The system was composed by a settling chamber, followed by 4 *Hurricane* cyclones in parallel (HR750) with discharge hopper and airlock rotary valve. All equipment was manufactured in carbon steel St30-2 and completely thermal insulated to avoid condensation.





CONCLUSION

Measured emissions from the *Hurricane* (108 mg/Nm^3) are lower than predicted (178 mg/Nm^3) which can be attributed, among other factors, to the fact that ACS' Particle Agglomeration in Cyclones – Model underpredicts efficiency, especially in the presence of very high agglomeration due to very heavy particle loads.

The *Hurricane* system clearly outperforms the original cyclones by a very large margin, reducing emissions significantly (93 % reduction as observed).

Fig. 3 shows that by adopting mechanical recirculation within *Hurricane* collectors, it will be possible to reduce emissions below 60 mg/Nm^3 with a good safety margin.

Guaranteed values of 50 mg/Nm^3 can be obtained with other cyclone configuration as previously shown.