Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

Glowood | Cercal, Portugal | 2014

Hurricane HR System
to reduce emissions of dryer cyclones in Glowood pellet plant (71.839m³/h at 87ºC)

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System to reduce PM emissions of existing dryer cyclones at **Glowood Pellet Plant**. The plant occupies a total area of 3.8 hectares with a total investment amounting to 10M€. Production (100.000ton/y) is 100% for export, as Portugal consumes under 10% of what it manufactures on a global basis (approximately 1M ton/y in 2012). A warm climate may until now have been the main reason for the inexistence of pellet consuming district heating facilities in Portugal. Unlike most pellet plants which are located above the Tejo river, Glowood is located in the south, near the port of Sines. It uses as raw material mainly sawdust from sawmills and unprocessed eucaliptus and pine wood .

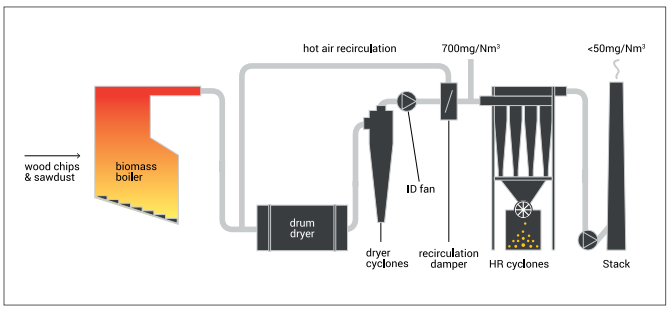

Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

Like many pellet producers Glowood uses a biomass boiler with the exhaust stream heating a rotary dryer to dry the incoming feedstock. The material is dried and carried over via dryer cyclones to the next stage in the pelleting process. In addition to separating wet wood particles from the dryer, a much smaller amount of fly ash from the biomass combustion is captured in these dryer cyclones.

PM emissions could be reduced to approximately 700mg/Nm³ in the worst drying conditions. Part of the flow rate was being recirculated back to the dryer for heat recovery, but the remaining part (71,839m³/h at 87ºC) was thrown into the atmosphere. This represented losses of material and essentially an environmental problem which is common to many European pellet manufacturing facilities.

In order to design the most efficient 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 confirming what PSD to consider for the case (Fig.3), ACS designed a system comprising 6 Hurricane HR numerically optimized cyclones, with ø1550mm, disposed in line. The system is capable of guaranteeing emissions under 150mg/Nm³ (expected under 50mg/Nm³) at a pressure drop of 1.2kPa, maintaining the dryer cyclone emissions under 700mg/Nm³. An additional fan was included next to the stack to overcome the additional pressure drop of the system controlled by a frequency driver.

ABOUT HURRICANE CYCLONES

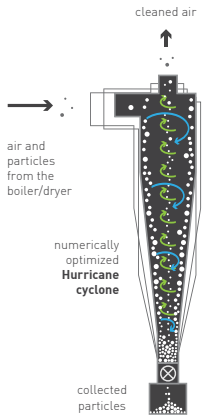

Fig. 2 – Hurricane Cyclone

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. 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 recenet 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.

I was confident that the project would be efficient. However, the results are excellent and were achieved thanks to a brilliant engineering project.

Engº Álvaro Magalhães | Managing Director | Glowood

DESIGN BASIS

- Type of particles **[Fines of mill sawdust escaping dryer cyclones]**
- Particle size distribution **[Fig.3]**
- Gas flow temperature (ºC) **[87]**
- Actual flow rate (m^3/h) **[71 839]**
- Normalized flow rate (Nm^3/h_{dry}) **[25 846]**
- Inlet concentration (mg/Nm^3_{dry}) **[700]**

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected separation efficiency (%) **[>93%]**
- Expected emissions (mg/Nm^3_{dry}) **[<50]**
- Emissions to guarantee (mg/Nm^3) **[150]**
- Expected total pressure drop (Kpa) **[1.2]**
- Measured emissions in Jan/2015 (mg/Nm^3) **[12]**

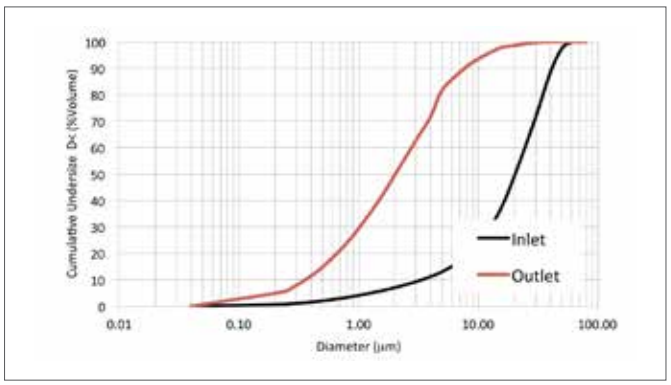

Fig. 3 – Particle size distribution used in simulation

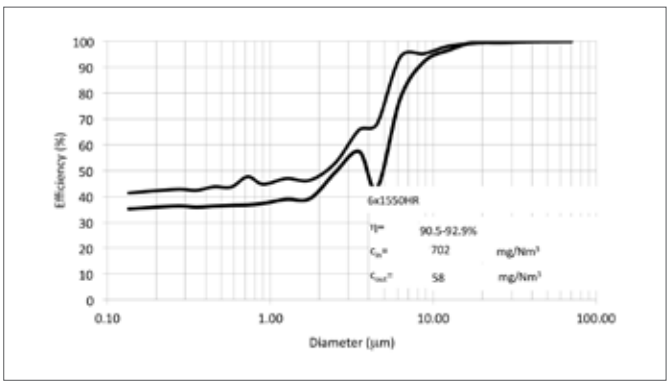

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

CONCLUSIONS

By installing the Hurricane system solution, Glowood can be looked as an example in terms of emissions not only in Portugal, but also abroad, with measured PM emissions of 12mg/Nm³ and clean plume. Apart from the reduced environmental impact of the plant, product losses were reduced in more than 99%, resulting in process optimization and savings for the company.

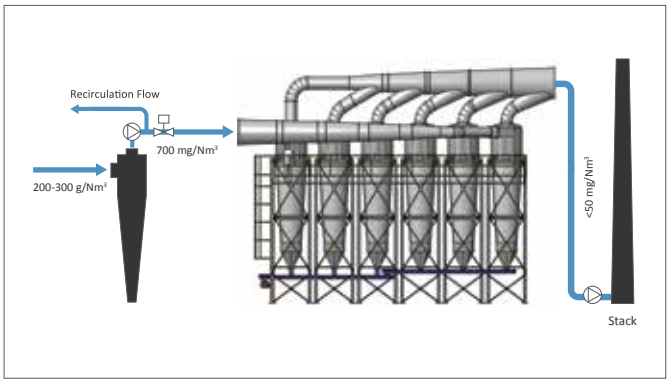

Fig.5 – General arrangement of the Hurricane cyclone system

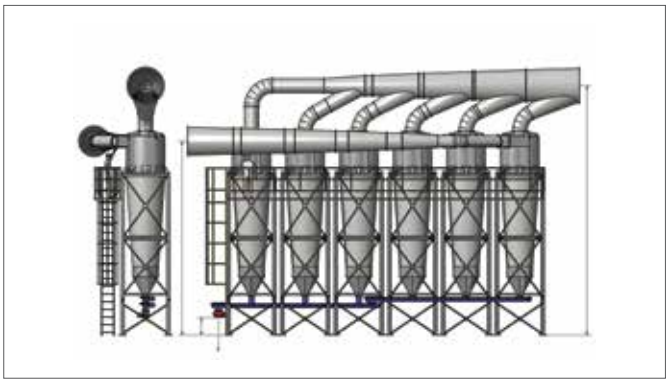

Fig. 6 – System composed by 6 Hurricane HR numerically optimized cyclones, with ø1550mm