

Hurricane SD System to Reduce Particulate Concentration into an ESP



FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System type SD for particulate matter reduction from the flue gas of a biomass boiler.

Central de Biomassa Terras de Santa Maria (CBTSM) is a thermo-electric power plant in Portugal. CBTSM produces electricity from forestry biomass residues. All electricity produced at the plant is exported to the utility grid system.

The electric power of the biomass plant is 10 MWe. The estimated annual production is about 82 GWh, enough to serve around 20,000 households.

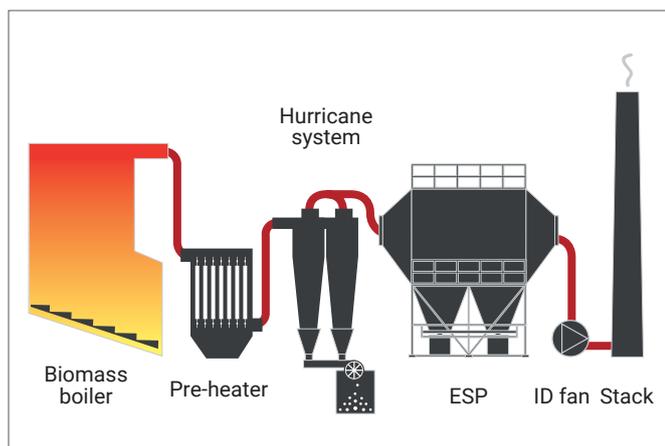


Fig. 1 – Process flow diagram from existing installation

IDENTIFYING THE PROBLEM AND SOLUTION

CBTSM was facing several problems due to the malfunctioning of the existing multi cyclone.

This equipment was suffering heavy wear due to the abrasion caused by aggressive fly ash released by the boiler and therefore needed to be replaced very often. In addition, it the multicyclone was operating with very high pressure drop, overloading the ID fan and representing very high energy costs. Also, the low efficiency was causing a large amount of particles to be dragged into the ESP, consequently its maintenance and operating costs were higher and its lifetime reduced at a higher rate than expected.

ACS was contacted to solve this problem. After all data was gathered and analysed, ACS proposed 2 SD cyclones to replace the multicyclones. ACS target was not only to reduce the inlet concentration into the ESP but also to prevent the premature wear of the equipment.

The SD cyclones were filled with ceramic based cement thereby reducing maintenance to near zero.

The installation was very demanding due to the very short time frame the client had to complete the project.

With a huge team effort, ACS was able to deliver the project just 10 weeks after receiving the order.

ABOUT HURRICANE CYCLONES

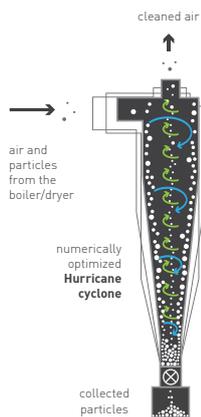


Fig. 2 – Hurricane Cyclone

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 recent findings of the impact of agglomeration in the cyclone collection efficiency (Chemical Engineering Journal 162 (2010) 861–876).

ACS developed a complete line of very different Hurricane cyclone families for each different need, considering how inter-particle agglomeration / clustering affects collection efficiency. For coarse particle pre-separation ACS created the SD and DX lines which are compact and low pressure drop cyclones.

A single Hurricane is more efficient than any other known cyclone available in the market for the same pressure drop.

DESIGN BASIS

- Solids [Biomass*]
- Particle size distribution [Fig.3]
- Temperature (°C) [200]
- Actual flow rate (m³/h) [170 571]
- Normalized flow rate (Nm³/h_{dry}) [89 164]
- Inlet Concentration (mg/Nm³) [2000]

*fly ashes

SYSTEM SPECIFICATIONS | EMISSIONS

- Separation efficiency (%) [>72]
- Emissions (mg/Nm³_{dry}) [<580]
- Total pressure drop (kPa) [<0.80]

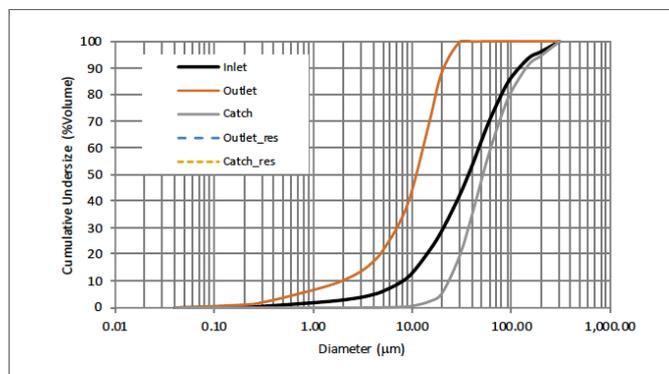


Fig. 3 – Particle size distribution used in simulation

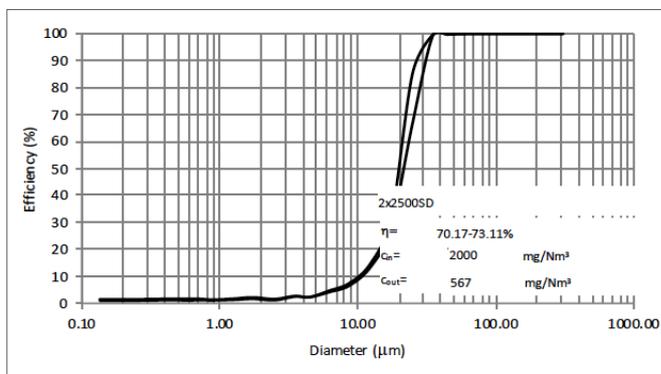


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

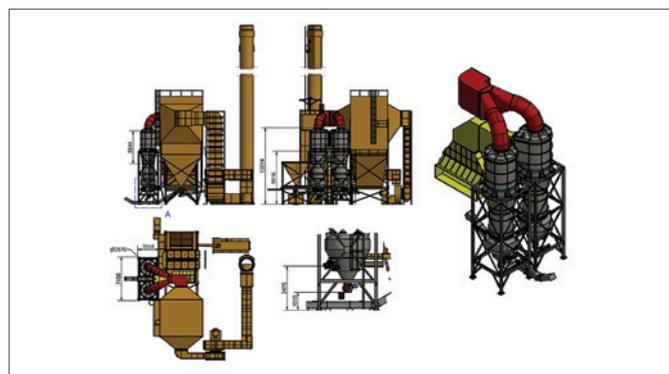


Fig.5 – ACS solution [2HR_SD ø2500mm]

CONCLUSIONS

The Hurricane SD cyclones proved to match and even exceed expectations, as they provide a lower pressure drop than former MC with near zero maintenance, alongside with higher capture rates of dust. Consequently, ID Fan works now with a much lower power consumption for the same regimen and ESP downstream operates with a lower inlet concentration, with more wear protection and longer lifetime.