Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

NORBIDEL | Porto, Portugal | 2013

Hurricane HR System to Reduce Particulate Matter From a Biomass Boiler Burning Pellets Under 50mg/Nm^3

FOREWORD

ACS designed and supplied a Hurricane Cyclone System for Norbidel, a Portuguese boiler manufacturer. End customer for boiler and Hurricane is Fepsa, a company that focuses its production on felts for hats. Its underlying processes involve compression and vibration, under the action of water and heat.

Norbidel, based in Maia (Porto, Portugal) is a company dedicated to the manufacture and commercialization of industrial equipment, manly biomass boilers.

ACS was contacted with the objective of reducing particulate matter (PM) emissions under 50mg/Nm3 from a biomass boiler burning Pellets (Fig. 1).

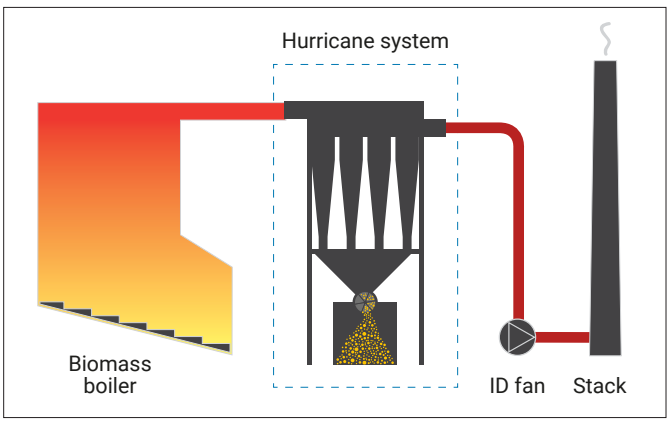

Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

In order to reduce particulate matter from estimated 200mg/Nm$^3_{dry}$ to less than 50mg/Nm^3, considering a design flow rate of 10.500m^3/h at 220°C, ACS installed a Hurricane HR system comprising 4 Cyclones, optimized for Pellet combustion, with Ø700 mm.

The goal was to guarantee 50mg/Nm^3, in order to comply with future Portuguese PM Environmental Regulation and to avoid smoke visible to the naked eye, given the proximity of the plant to neighbor industries and houses.

To design the most appropriate system for this case, a dust sample was collected through an isokinetic sampling at the stack of another plant with equivalent operating conditions. The sample was subsequently measured in a laser sizer to obtain the Particle Size Distribution (Fig. 2).

The provided system was designed to reduce emissions by at least 75% representing a decrease of dust concentration from 200mg/Nm$^3_{dry}$ down to 50mg/Nm$^3_{dry}$ with a pressure drop of 1.2 kPa.

ABOUT HURRICANE CYCLONES

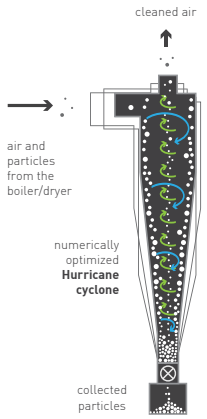

Fig. 2 – Hurricane Cyclone

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).

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

DESIGN BASIS

- Fuel **[Pellets with 0,5% ash content]**
- Particle size distribution **[Fig.3]**
- Temperature (°C) **[220]**
- Actual flow rate (m^3/h) **[10 500]**
- Normalized flow rate (Nm^3/h_{dry}) **[5 523]**
- Inlet concentration (mg/m^3) **[105]**
- Inlet concentration (mg/m^3_{dry} at 6% O_2) **[200]**

SYSTEM SPECIFICATIONS | EMISSIONS

- Guaranteed maximum emissions (mg/Nm^3_{dry} at 6% O_2) **[50]**
- Expected maximum emissions (mg/Nm^3_{dry} at 6% O_2) **[<30]**
- Guaranteed pressure drop at design point (kPa) **[1.2]**

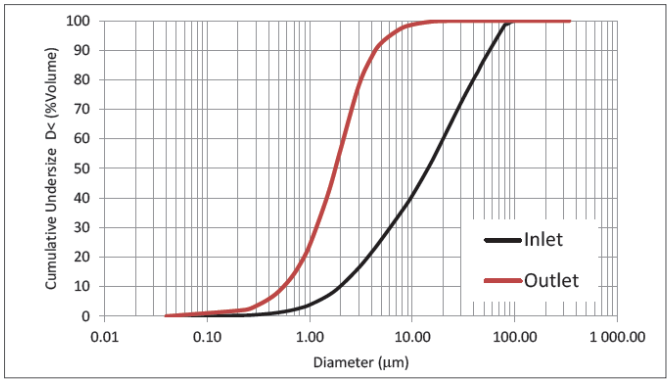

Fig. 3 – Particle size distribution used in simulation

Fig. 4 – Look of the stack at normal boiler operation

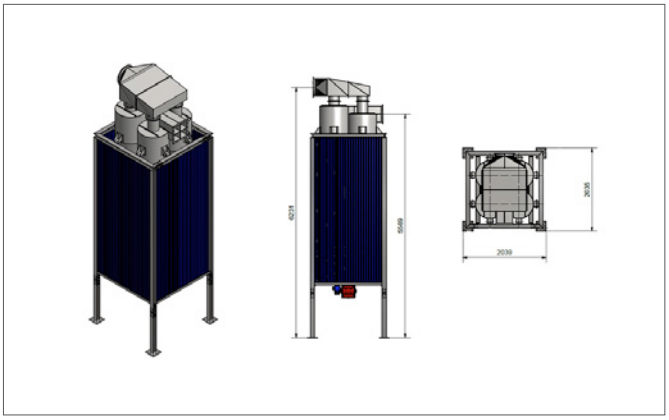

Fig.5 – ACS solution [4 HR ø700]

CONCLUSIONS

Results from emission tests confirm PM emissions under 50mg/Nm^3 at 6% O_2 (30mg/Nm^3 at 11% O_2 (measured)), thus assuring the achievement of future imposed emission standards with an equipment which has much lower investment, maintenance and operating costs, when compared with ESPs and Bag Filters.