Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

AMORIM CORK COMPOSITES | MOZELOS, PORTUGAL | MARCH 2014

Hurricane cyclones to reduce particulate matter from a biomass boiler at **Amorim Cork Composites** *(54.000 m³/h a 177ºC)*

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane cyclone system for Amorim Cork Composites (ACC).

ACC, based in Porto (Portugal), has grown to become the world's largest producer and distributor of cork products. Apart from traditional bottle stoppers, the proverbial "cork" so intimately associated with wine, the company has over the decades developed a range of building construction, interior design, footwear and other products exploiting the unique properties of the bio-material.

ACS was contacted to radically reduce particulate matter (PM) emissions from two biomass heat generators and one boiler burning cork dust under 100 mg/Nm³ (Fig. 1).

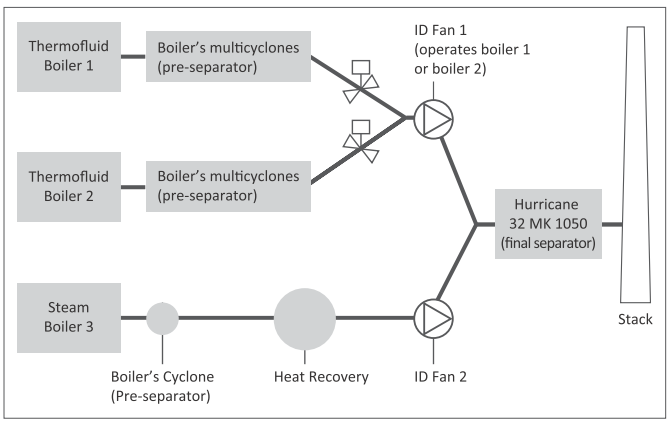

Fig. 1 – Process Diagram

IDENTIFYING PROBLEM AND SOLUTION

In the processing of cork, the outer bark from the cork oak tree, generates large amounts of dust. This has a significant calorific content that cork processors are keen to use. However, cork dust combustion produces a significant amount of ash and fly ash. The heat generation units supply 9 MKcal/h as thermo-fluid and 3.6 MKcal/h as vapour producing nearly 54.000 m³/h at 177ºC flow rate at the flue-stack. Emissions of particulates amounted to 1.240 mg/Nm³. The goal of ACC was to decrease it by a factor of 10, to under 100 mg/Nm³.

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 Hurricane system comprising 32 Hurricane MK numerically optimized cyclones with ø1050 mm, disposed in 8 batteries, operating in parallel. The system is capable of guaranteeing emissions under 100 mg/Nm³ (expected under 50 mg/Nm³) at a pressure drop of 1.5 kPa.

ABOUT HURRICANE CYCLONES

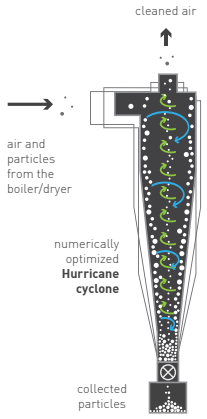

Fig. 2 – Hurricane Cyclone

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 Median Volume Diameter (MVD) 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. For more information please click **here**.

DESIGN BASIS

- Fuel **[Cork dust]**
- Fly ash particle size distribution **[Fig.3]**
- Approximate effective flow rate (m^3/h) **[53.694]**
- Normal flow rate (Nm^3/h_{dry}) **[31.402]**
- Gas flow temperature (ºC) **[177]**
- Moisture content in gas (%H_2O v/v) **[11]**
- Inlet concentration considering 11% O_2 (mg/Nm^3) **[1.240]**

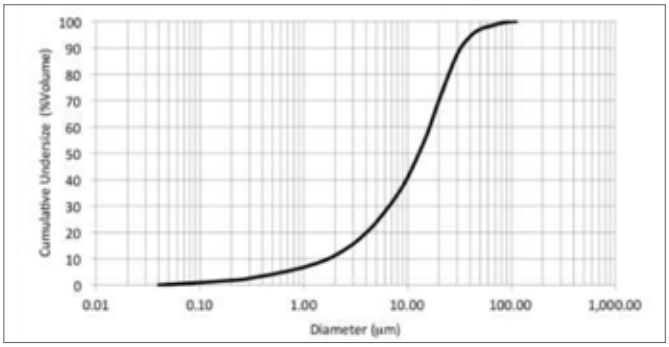

Fig. 3 - Particle size distribution used in simulation

SYSTEM SPECIFICATIONS | EMISSIONS

- Guaranteed maximum emissions considering 11% O_2 (mg/Nm^3) **[100]**
- Expected emissions considering 11% O_2 (mg/Nm^3) **[45]**
- Verified emissions considering 11% O_2 (mg/Nm^3) **[19]**
- Expected total pressure drop (KPa) **[1.5]**

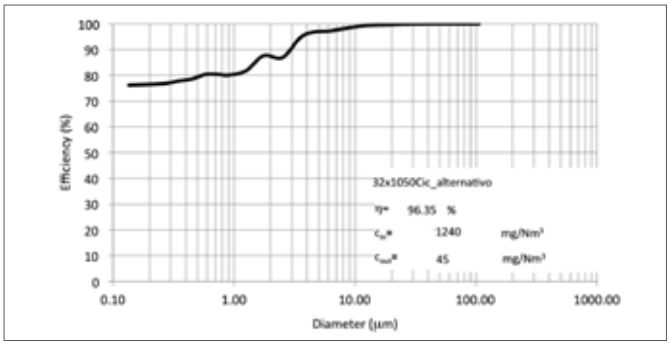

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

CONCLUSIONS

Results confirmed that the Hurricane MK achieves PM emissions under 100 mg/Nm^3. Measurements in January 2015 show PM emissions of 19 mg/Nm^3, 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).

GENERAL ARRANGEMENT

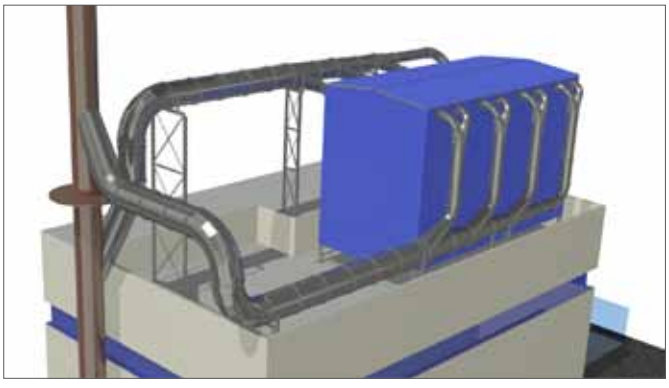

Fig.5 – General arrangement scheme