Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

VERDO | ANDOVER, UNITED KINGDOM | NOVEMBER 2015

Hurricane HR Cyclones *to Reduce Emissions from Wet Woodchips Grinding at Verdo Renewables Ltd. (8 000 m³/h at 20ºC)*

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied two Hurricane Cyclones, HC series, for Verdo Renewables Ltd.

The company is a fully owned subsidiary of Verdo Holdings A/S which has its HQ in Randers, Denmark. It has two production plants in the UK: Andover in Hampshire and Grangemouth in Scotland. Each plant has an annual production capacity of 55 000 tonnes of wood pellets and 15 000 tonnes of briquettes, making them one of the largest pellets/briquette producers in UK and Ireland.

ACS was contacted to provide two cyclone systems to improve particulate matter (PM) removal after two lines of wet woodchips grinding (hammermill) in the Andover plant.

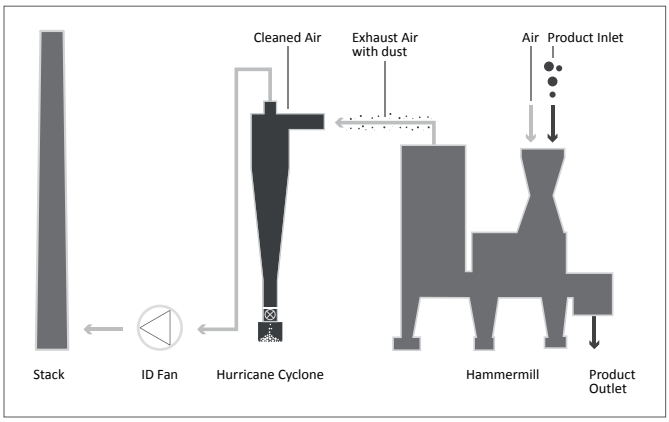

Fig. 1 – Process scheme

IDENTIFYING THE PROBLEM AND SOLUTION

The hammermills that Verdo acquired to grind wet woodships came, as a standard, with an attached filter to recover the product and control PM emissions. This particular filters (cyclo-filters) combine the operating principles of cyclones with some cartridges on the top to prevent the fines from escaping to the atmosphere. However, since these cartridges clog very often (due to the high moister content of the product), the client had to remove them, to be able to operate. Despite solving the operational issue, this led to a secondary problem: emission increase. Therefore, ACS was asked to provide a solution.

ACS designed a cyclone system to be installed downstream of each hammermill cyclo-filter to solve the problem.

To design the most efficient system, a dust sample was provided by the client and measured by ACS in a laser sizer to obtain the Particle Size Distribution (PSD).

After confirming the PSD (Fig. 3), ACS designed two Hurricane Cyclones, HC series, with ø1250mm at a pressure drop of 1.2 kPa, one for each line. ACS ran simulations considering an inlet dust concentration of 425mg/Nm³ and the predicted emissions were as low as 15mg/Nm³ (fig. 4).

ABOUT HURRICANE CYCLONES

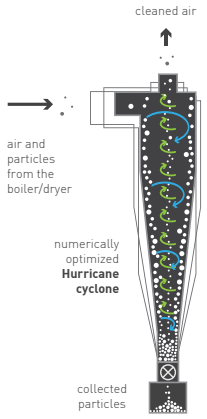

Fig. 2 – Hurricane cyclone

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, visit our website: **www.acystems.pt**

DESIGN BASIS

- Type of particles **[Wood dust]**
- Particle size distribution **[Fig.3]**
- Gas flow temperature (ºC) **[20]**
- Actual flow rate (m^3/h) **[8 000]**
- Normalized flow rate (Nm^3/h_{dry}) **[7 353]**
- Moisture content in gas (%H2O v/v) **[0]**
- Inlet concentration (mg/Nm^3_{dry}) **[425]**

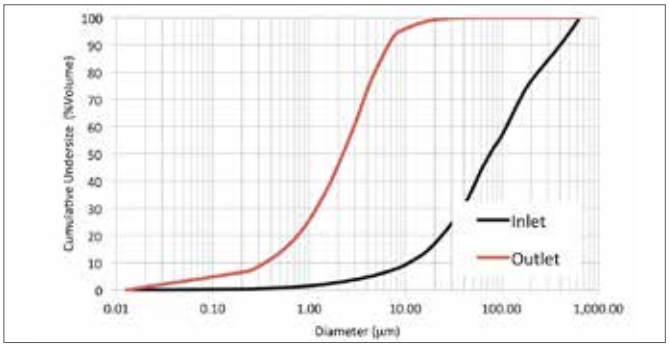

Fig. 3 - Particle size distribution used in simulations (Coulter)

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected emissions (mg/Nm^3_{dry}) **[15]**
- Emissions to guarantee (mg/Nm^3) **[150]**
- Expected total pressure drop (Kpa) **[1.2]**

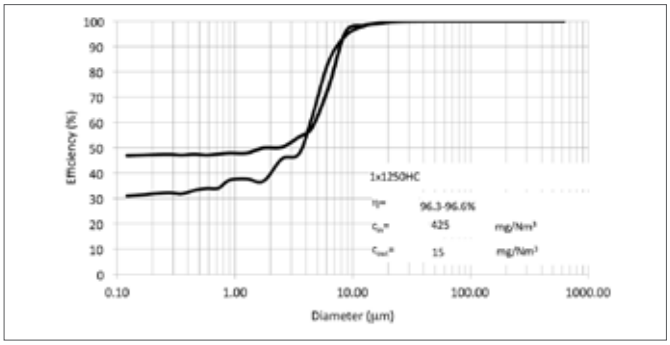

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

GENERAL ARRANGEMENT

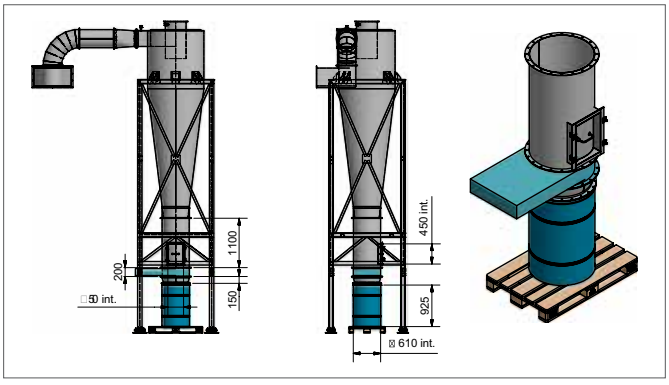

Fig.5 – General arrangement scheme

CONCLUSIONS

Although stack tests have not yet been carried out, the preliminary results from observation of the air outlet show the air is completely clean from particles and the recovery rates of the hurricanes are high (actually capturing twice of the design values), indicating results are better than predictions. Hurricane cyclone systems, are a very cost effective solution to solve this problem, achieving very low PM emissions, thus guaranteeing the achievement of present and future emission standards with an equipment which has much lower investment, maintenance and operating costs, when compared with WESPs and Bag Filters.