Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

BRITTON TIMBERS | SMITHTON, AUSTRALIA | MARCH 2016

Hurricane MK Cyclones for PM emission reduction on a 2.5MWth biomass boiler at Britton Timbers. (8 760m³/h at 328°C)

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System type MK for particulate matter reduction from the flue gas of a biomass boiler in Australia. The boiler was installed at Britton Timbers, a diversified company with interests in timber harvesting, sawmilling, international timber import and export, and distribution. From humble beginnings in Tasmania's timber-rich north-west coast, Britton Timbers has grown to become Australia's largest importer of sustainably-produced exotic hardwoods and the preferred source for premium Tasmanian timbers.

ACS was contacted to reduce particulate matter (PM) emissions from a biomass boiler burning eucalyptus shavings and green sawdust.

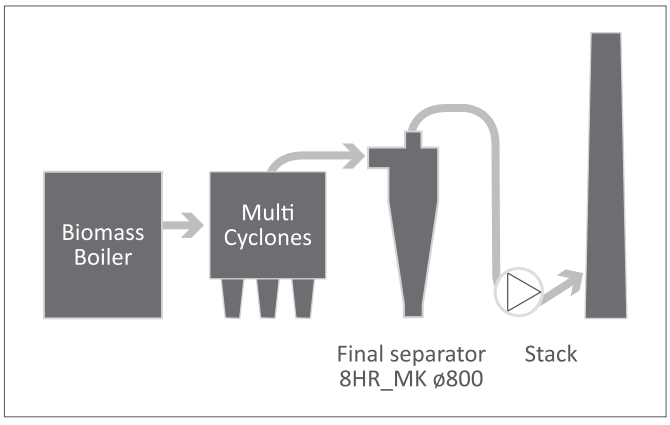

Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

The client had a 2,5MW$_{th}$ Steamline boiler burning woodchips (eucalyptus shavings and green sawdust) and has been working for 15 years equipped with a multicyclone, but couldn't achieve the needed PM emissions limit to face the new Australian regulation, which is currently 100mg/Nm³ for this kind of process.

Despite that limit, the client asked ACS to guarantee emissions bellow 80mg/Nm³ allowing a good safety margin and the compliance in terms of PM emissions with a future stricter legislation.

Considering the usual silice content on the fly ashes from wood chips combustion, ACS kept the existing multicyclone as a first stage separation to remove the coarser and more abrasive particles and installed the final separator (Hurricane MK) downstream with an additional fan dimensioned to overcome its own pressure drop.

For this project at Britton Timbers (the first in Australia), after confirming what particle size distribution (PSD) to consider for the case (see Fig.3), ACS designed a Hurricane MK system comprising 8 Hurricane MK numerically optimized cyclones, with ø800mm, disposed in two batteries of four units. The system is capable of reducing emissions to under 50mg/Nm³ at a pressure drop of 0.9kPa, maintaining that the emissions after the existing multicyclone are under 250mg/Nm³.

A simple process diagram is shown in fig. 1.

ABOUT HURRICANE CYCLONES

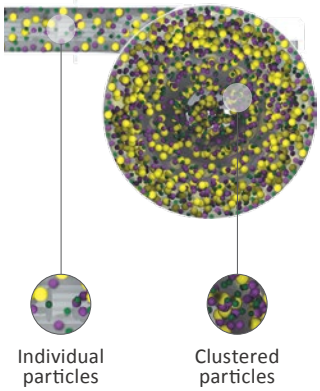

Fig. 2 – Agglomerator Cyclone

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. 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.

In 2014, a better understanding of agglomeration has allowed ACS to develop a completely new line of cyclone geometries, different from any other in the world: the **Hurricane MK**. It was obtained by combining stochastic numerical optimization with ACS (Particle Agglomeration in Cyclones (PACyc) model - (Chemical Engineering Journal 162 (2010) 861–876).

Emissions of these cyclones can be as low as 30mg/Nm³ for many industrial processes.

DESIGN BASIS

- Fuel **[eucalyptus shavings and green sawdust]**
- Particle size distribution **[Fig.3]**
- Temperature (ºC) **[328]**
- Actual flow rate (m^3/h_{wet}) **[8 760]**
- Normalized flow rate (Nm^3/h_{dry}) **[3 210]**
- Inlet concentration (mg/Nm^3) **[207]**

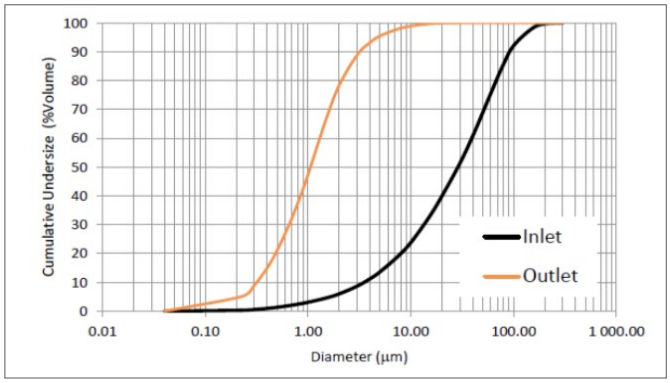

Fig. 3 - Particle size distribution used in simulation

SYSTEM SPECIFICATIONS | PARTICLE EMISSIONS

- Emissions to Guarantee (mg/Nm^3) **[<80]**
- Expected total pressure drop (kPa) **[0.9]**
- Measured Emissions in April/2016 (mg/Nm^3) **[48]**

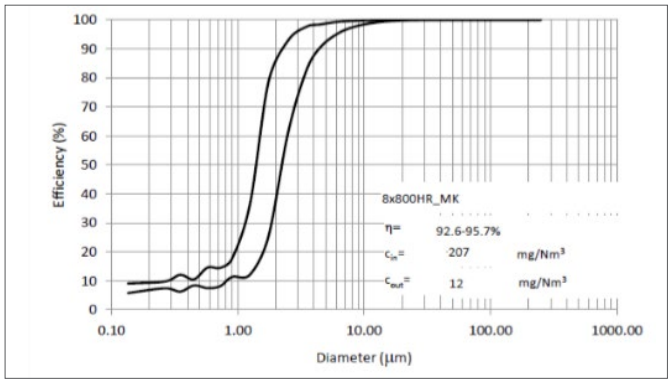

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

CONCLUSIONS

Currently Britton Timbers is very satisfied with the performance of the system and the overall results.

Results confirmed that the Hurricane MK safely achieves PM emissions under the guaranteed 80mg/Nm³. On April 2016 PM emissions measurements were done and results were 48mg/Nm³ at 12%O_2, thus confirming the achievement of the ELV 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).

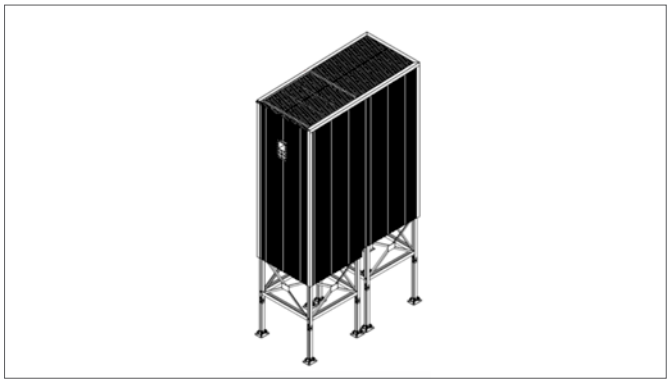

Fig.5 – General arrangement of the Hurricane cyclone system