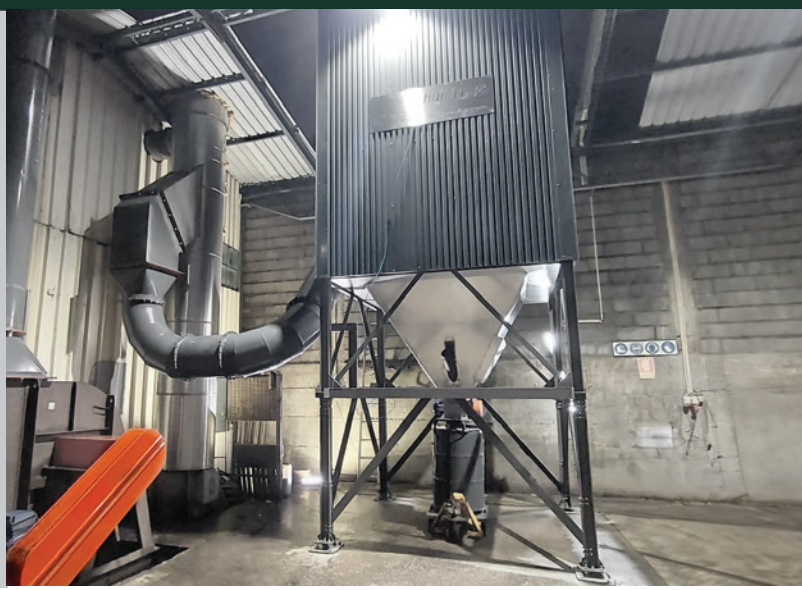
Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

PINHOSER | Sertã, Portugal | 2022

Hurricane RE_{22} System to reduce emissions from a 4.64MW biomass boiler (13 216m³/h at 86°C)



FOREWORD

ACS supplied, and installed a **Hurricane RE_{22} Cyclone System** to control flue gas emissions from an existing biomass boiler at **Pinhoser** facility in Cumeada, Sertã.

Pinhoser is a major player in the Portuguese forestry sector and its products are exported to multiple countries around the world. Their sawmill plant is primarily dedicated to sawing pinewood.

Pinhoser is part of the Palser Group, which is mainly involved in the forestry sector, the group's key activities are sawing of pine wood, production of pallets and wooden packaging and the sale of wood chips and sawdust.

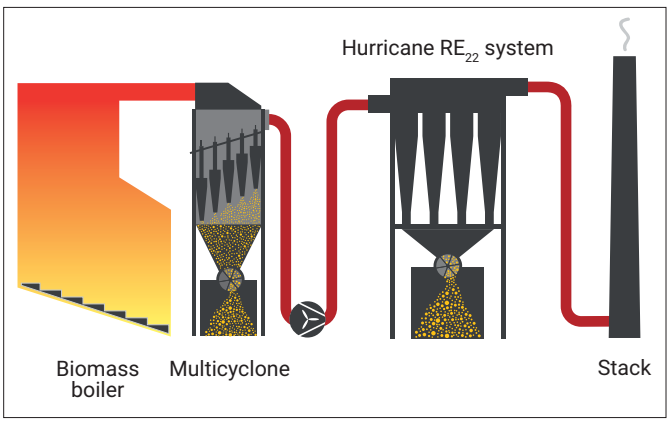


Fig. 1 – Process flow diagram from existing installation

IDENTIFYING THE PROBLEM AND SOLUTION

The plant's existing biomass boiler, which provides hot water for the wood kilns used in the heat treatment of wood, could no longer meet the new emission limits due to emission restrictions. Pinhoser was therefore looking for a solution to ensure that the wood kiln operation would not be affected in the future.

The client considered other technologies and found that an ESP was too expensive for this relatively small boiler and when high humidity conditions were to exist, a baghouse system would have major fouling issues and the bags would most likely need frequent replacement. Under such circumstances, ACS was contacted to verify if numerically optimized cyclones could be a solution for this problem.

ACS designed a Hurricane RE_{22} system that was numerically optimized for the boiler at full power, despite normal operation being at lower rates. The system is composed by 4 Hurricane RE_{22} cyclones ø1100mm installed in parallel that discharge to a common hopper and then through a rotary valve airlock into a 100L discharge vessel. The cyclones were insulated with rockwool, and the system was preinstalled in a support structure with lacquered steel cladding.

Given the space constraints and connection to the existing equipment a 3D laser mapping of the site was performed to insure proper fitting of the equipment and ducting. The retrofit was planned and executed by ACS at the client's plant in Sertã, Portugal.

ABOUT HURRICANE CYCLONES

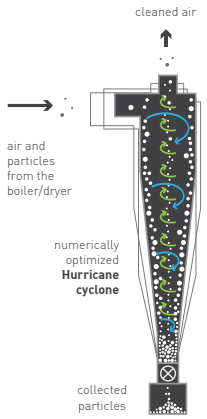


Fig. 2 – Hurricane Cyclone

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 **[Pinewood chips]**
- Type of particles **[Fly ash]**
- Particle size distribution **[Fig.3]**
- Temperature (°C | °F) **[86 | 187]**
- Actual flow rate (m^3/h | acfm) **[13216 | 7779]**
- Normalized flow rate (Nm^3/h_{dry} | dscfm) **[8955 | 5271]**
- Inlet concentration (mg/Nm^3_{dry} | gr/dscf) **[616 | 0.2689]**
  (lb/MMBtu) **[0.7681]**

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected separation efficiency (%) **[>85.2]**
- Expected emissions (mg/Nm^3_{dry} | gr/dscfm) **[<122]**
- Emissions to guarantee (mg/Nm^3 | gr/dscfm) **[150 | 0.0533]**
  (lb/MMBtu) **[0.1521]**
- Expected total pressure drop (kPa | in w.g.) **[2.79 | 11.2]**

VERIFIED RESULTS (Q/A)

- Measured emissions in 06/22 (mg/Nm^3_{dry} | gr/dscfm) **[<10 | <0.0044]**
  (lb/MMBtu) **[0.01781]**

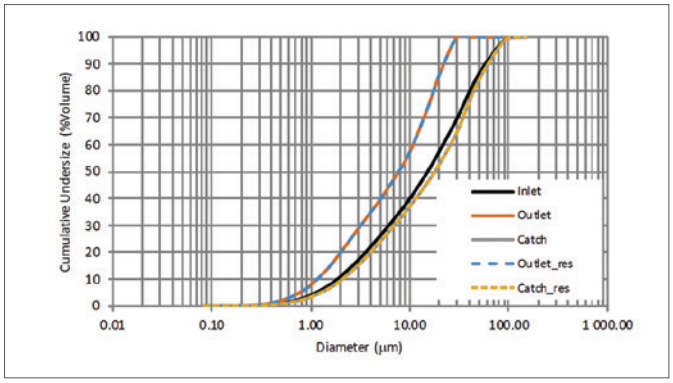


Fig. 3 – Particle Size Distribution used in simulations

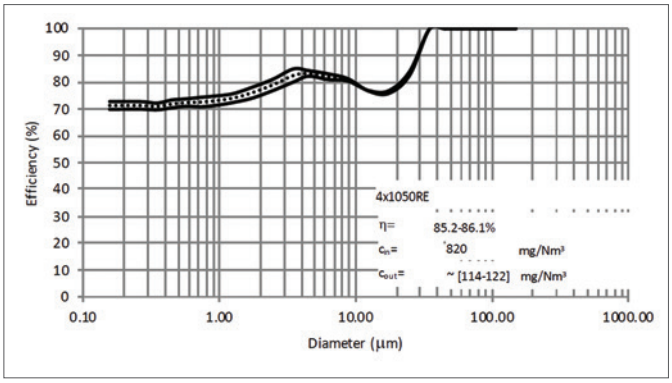


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

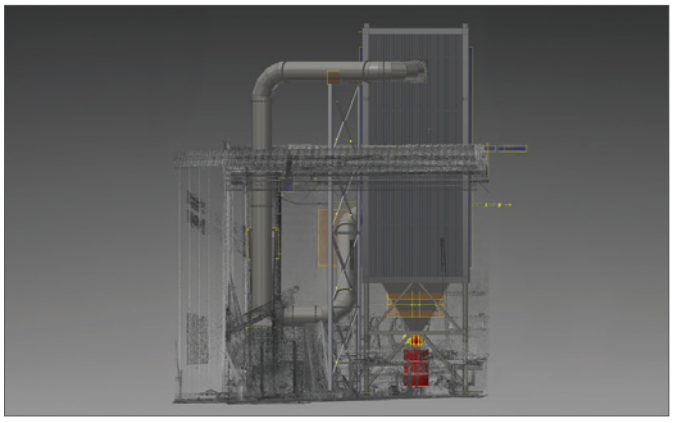


Fig.5 – ACS solution [4 RE_{22} ø1100mm]

CONCLUSIONS

By installing the Hurricane cyclone system with particle emissions measured below 10mg/Nm³ and a visually clear stack, Pinhoser can be considered as an example in terms of emissions for relatively small boilers, not only in Portugal, but also at a global level. Confirming it's possible to have emissions below 50mg/Nm³ for small size boiler with ACS systems. Even with the unavoidable condensation due to the high humidity, it was demonstrated that the system, unlike other technologies, can cope with such conditions.