Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

CARECO | SÃO JOÃO DA MADEIRA, PORTUGAL | DECEMBER 2013

Hurricane HR Cyclones to Reducte Off-Gases From A Meat And Bones Mixture Gasifier At High Temperature.

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System for **Careco**, a Spanish company working in the Energy applications for animal and agriculture industry. End customer is Luís Leal S.A., a company based in São João da Madeira (Portugal) dedicated to the treatment of animal waste.

ACS was contacted with the objective of cleaning particulate matter (PM) from synthesis gas (syngas). Syngas is a fuel gas mixture consisting primarily of hydrogen and carbon monoxide.

The syngas is frequently called "dirty gas", as it has great deal of particulates and tars (Fig. 1).

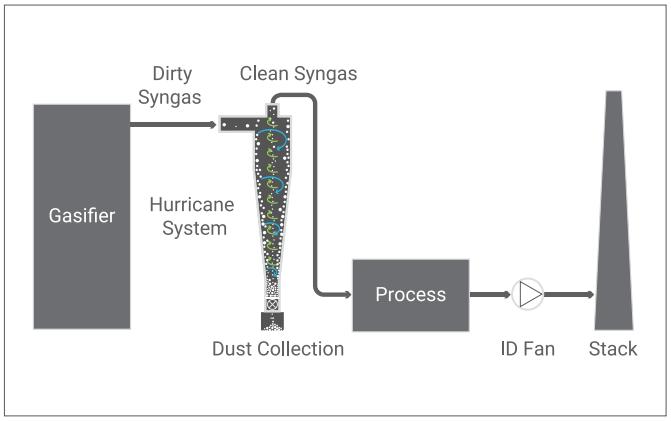


Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

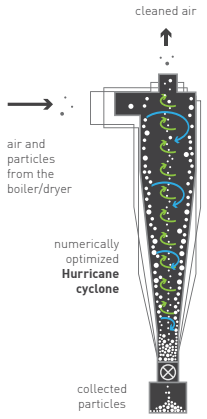
In order to reduce particulate matter from 13.820 mg/Nm^3_{dry} to less than 750 mg/Nm^3_{dry}, considering a design flow rate of 18.000 m^3/h at 700ºC, ACS installed a Hurricane system comprising 2 Hurricane HR Cyclones, with ø1100 mm.

The goal was to reduce, at high temperature, PM from the off-gases of a MBM (Meat and Bones Mixture) gasifier. The gasification of MBM for thermal applications allows valorization of this product, that in other conditions would be waste. It also reduces the money and resources spent in waste treatment.

To run a simulation over this case and estimate the expected efficiency, ACS made use of its extensive database and considered a typical particle size distribution (PSD) (Fig. 3).

The system was designed to reduce emissions with an expected separation efficiency of 91.2-98.1% and a pressure drop of 1.0 kPa (Fig. 4).

ABOUT HURRICANE CYCLONES



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 recenet 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.

Fig. 2 – Hurricane cyclone

DESIGN BASIS

- Solids **[Fly ash from MBM mix. gasification]**
- Particle size distribution **[Fig.2]**
- Gas flow temperature (ºC) **[700]**
- Actual flow rate (m^3/h) **[18 000]**
- Normalized flow rate (Nm^3/h_{dry}) **[4 949]**
- Inlet concentration (mg/m^3) **[3 800]**
- Inlet concentration (mg/Nm^3_{dry}) **[13 820]**

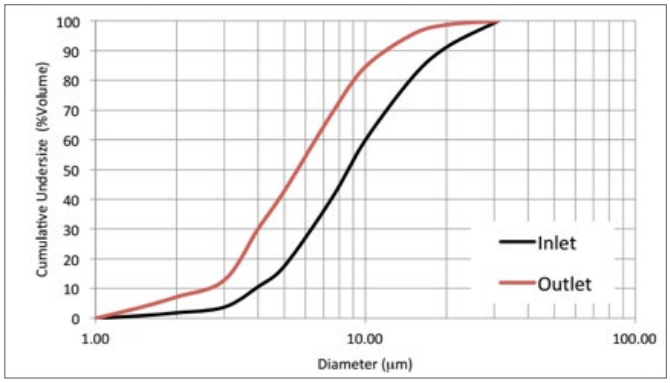


Fig. 3 - Particle size distribution used in simulation

SYSTEM SPECIFICATIONS | PARTICLE EMISSIONS

- Expected separation efficiency (%) **[91.2-98.1]**
- Expected emissions (mg/Nm^3_{dry}) **[740]**
- Expected total pressure drop (Kpa) **[1.0]**

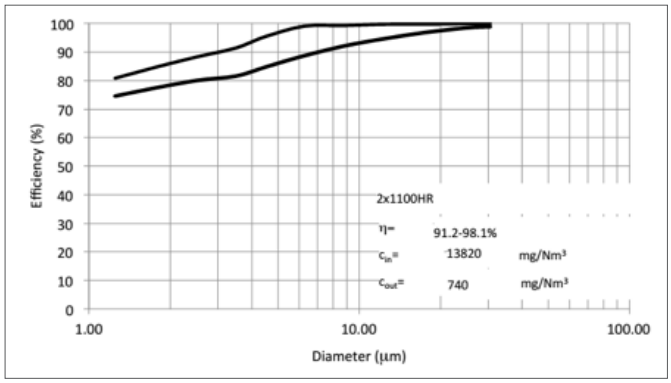


Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

CONCLUSIONS

In the production of syngas for thermal applications, by being able to clean the gas at high temperature (≈ 700ºC), a Hurricane Cyclone System shows a much higher effiicency than other cyclones in the market and to be the best technical solution when comparing to more expensive alternatives. Indeed, ESPs or Bag Filters cannot be used at 700ºC and ceramic filters have considerable operational problems when dealing with a high content of tars and chars resulting from gasification of MBM.

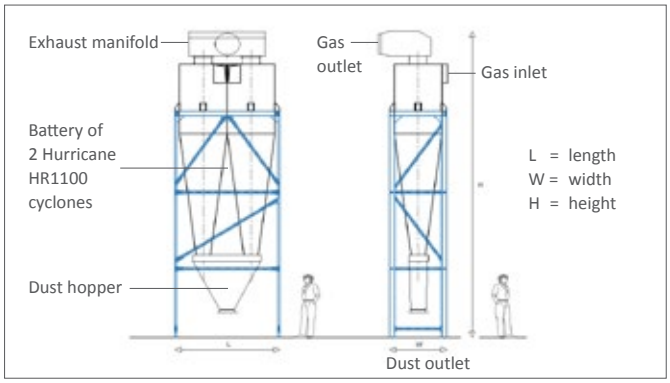


Fig.5 – General arrangement of the Hurricane cyclone system