EMISSION CONTROL

CASE STUDY

JOHN COCKERILL | Belgium | 2020

Hurricane AT System for activated carbon recovery at high temperature from the off gases of a regenerator furnace and before post-combustion

FOREWORD

ACS designed and supplied a **Hurricane system** for **John Cockerill** to be installed at **Chemvirom** plant in Feluy, Belgium.

John Cockerill is a multi-national Group with more than 1 billion Euros turnover, which develops large-scale technological solutions in the fields of Energy, Hydrogen, Defense, Industry and Environment. At Feluy, their Environment division installed "The Nesa Solution®", based on the Multiple Hearth Furnace technology (MHF) for thermal treatment of solids.

Chemviron, the end client, is the leading global manufacturer and supplier of activated carbons, filter aids, innovative treatment systems. In Feluy, it operates the world's largest activated carbon reactivation facility, daily recycling large quantities of spent granular and pelletised carbons for a diverse range of customers and applications.

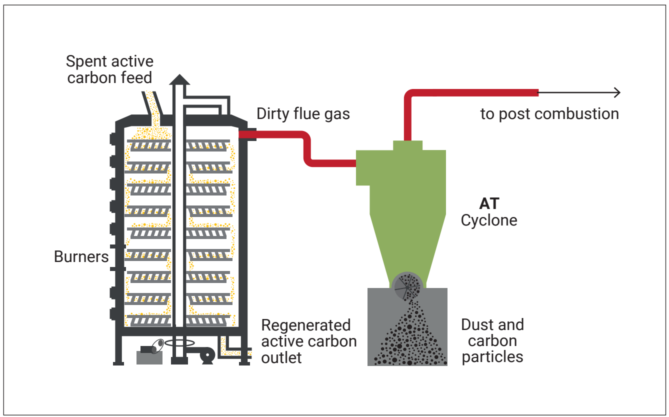

Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

Chemviron's activated carbon is used by numerous industries for various applications including filtration because of its excellent absorption properties. As it is used, activated carbon loses its effectiveness and is eventually saturated. It is therefore necessary to regenerate it. Thanks to the Multiple hearth furnace (MHF) developed by John Cockerill's "The Nesa Solution®", the "contaminated" carbon will be regenerated in a controlled atmosphere and temperature and regains its initial structure and absorbing characteristics.

John Cockerill approached ACS, to optimize a cyclone system to separate particulates from the off-pyrolysis gases of this MHF regenerator. The objective was to separate 80% of activated carbon particulates at high temperature (550°C) with allowance up to 900°C. The hot gas had a dust concentration of 2 086 mg/Nm^3, on a maximum flow rate of 28 213 m^3/h at 900°C.

ACS designed a numerically optimized ø1600mm Hurricane AT cyclone with dip-leg and hopper, designed to withstand the maximum temperature and pressure.

The expected efficiency is 89.0 – 90.2% for a pressure drop of 0.4 – 0.7 kPa.

ABOUT HURRICANE CYCLONES

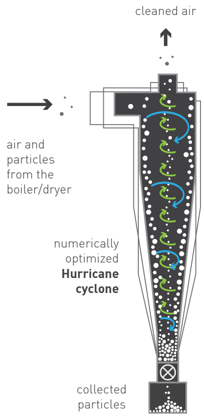

Fig. 2 – Hurricane Cyclone

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 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.

CSJCOCKERILL20231023

DESIGN BASIS

- Particles **[Metals, salts, Si, Ca]**
- Particle size distribution **[Fig.3]**
- Temperature (°C) **[900]**
- Actual flow rate (m^3/h) **[28 213]**
- NTP flow rate dry basis (Nm^3/h_{dry}) **[2 997]**
- Moisture content (% H20 v/v) **[7.1]**
- Absolute pressure (Pa) **[100 129]**
- Particulate concentration at inlet in NTP dry (mg/Nm^3_{dry}) **[2 997]**
- Site location **[Outdoors]**

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected global separation efficiency (%) **[89.9 – 91.6]**
- Expected emissions in NTP dry (mg/Nm^3_{dry}) **[202]**
- Guaranteed maximum emissions in NTP dry (%) **[95]**
- Pressure drop (kPa) **[0.7]**

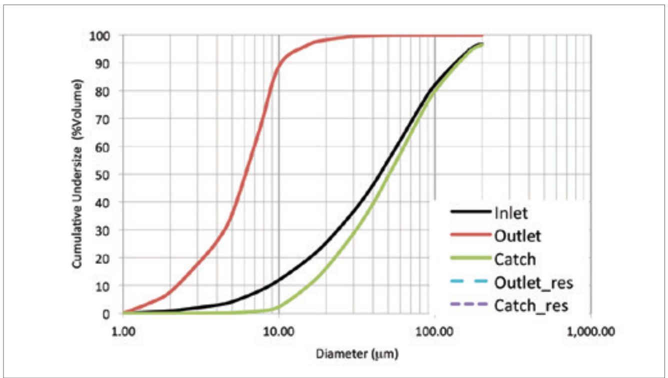

Fig. 3 – Particle size distribution used in simulation

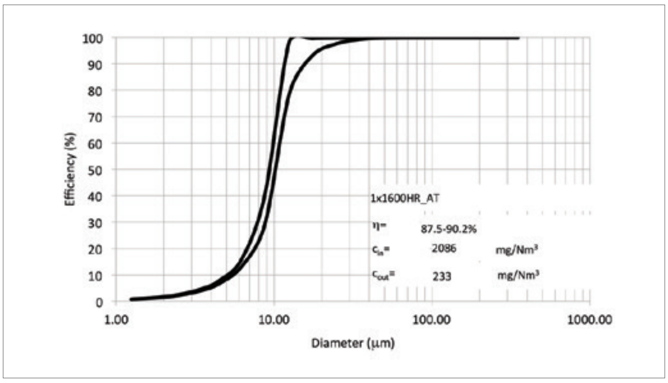

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

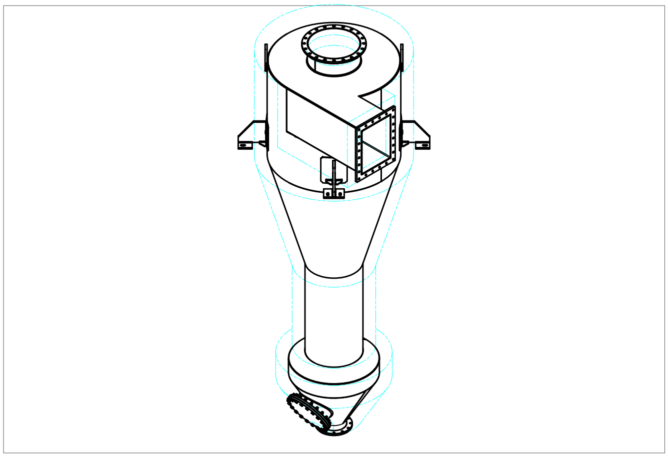

Fig.5 – ACS solution [1 AT ø1600]

CONCLUSIONS

ACS' solution was installed on the first quarter of 2021 and is running perfectly ever since.

Its compact design, yet higher than requested efficiency (~90% vs 80%) provides great Value and proves to be a very cost-effective solution for large flow rates at high temperatures: a single cyclone can handle the entire flow rate, which is very desirable in high temperature processes, because alternative high efficiency solutions, would require multiple cyclones (given the same diameter), which would implicate larger investment and complexity on the dust discharge and inlet/outlet distribution (mechanically, geometrically and given the required thermal expansions joints...).

End customer can therefore benefit from a simple and problem free solution, yet effective and reliable, to separate the active carbon dust.