Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

EDP GÁS | PORTO, PORTUGAL | JANEIRO 2016

Hurricane HR Cyclones

for cleaning Black Powder in natural gas lines caused by erosion and corrosion of the pipes

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System for EDP Gás, a public service company for natural gas distribution. EDP Gás focuses its activity on the development and operation of the public network distribution of natural gas in the north coastal region of Portugal.

ACS was contacted with the objective of cleaning black powder originated in the ducting to keep it from reaching their clients' equipments, that vary from a wide range of large scale industrial compressors to domestic appliances. Black Powder is a solid contaminant found in natural gas transmission and distribution systems throughout the world. It consists primarily of iron oxides, iron sulfides and some silica which results from internal erosion and corrosion of carbon steel pipelines.

IDENTIFYING THE PROBLEM AND SOLUTION

EDP Gás has long been experiencing problems deriving from the presence of this particulate matter including contamination of the natural gas, wear of the compressors, instrumentation clogging or erosion and sealing problems in valves. EDP has already had to replace expensive compressors used by their clients due to damages caused by black powder.

To date it has been difficult to find an appropriate solution. Magnetic separation, for instance, involves a very high initial investment plus operating costs. Cartridge filters are continually clogging, sometimes forcing daily or twice daily maintenance interventions.

ACS designed a system for efficient dust removal that can ensure the capture of particles in the entire size spectrum at very high pressure (16 Bar), while drastically reducing operating and maintenance costs.

This system comprises a set of 4 HR cyclones that are designed to work at maximum flow associated with winter conditions and it is also possible to switch each one off independently to better optimize performance according to very low flow conditions, for example in the summer time.

Fig. 1 – Existing process scheme

ABOUT HURRICANE CYCLONES

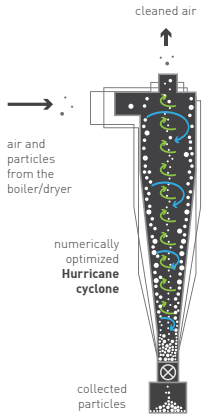

Fig. 2 – Hurricane cyclone

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, Portugal 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 please visit our website: **www.acsystems.pt**

DESIGN BASIS

- Type of Particles **[Iron dust]**
- Particle Size Distribution **[Fig.3]**
- Gas Flow Temperature (ºC) **[11]**
- Actual Flow Rate (Am^3/h) **[842]**
- Normal Flow Rate (Nm^3/h_{dry}) **[13 846]**
- Barometric pressure operation (kPa) **[13 846]**
- Inlet Concentration (mg/Nm^3_{dry}) **[100]**

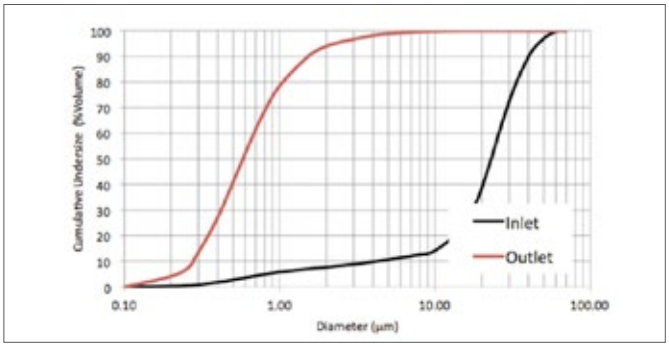

Fig. 3 - Particle size distribution used in simulations (Coulter)

SYSTEM SPECIFICATIONS | EMISSIONS

- Expected Emissions (mg/Nm^3_{dry}) **[6]**
- Emissions to Guarantee (mg/Nm^3) **[<10]**
- Expected Collection Efficiency (%) **[94 – 95]**
- Expected Total Pressure Drop (kPa) **[19]**

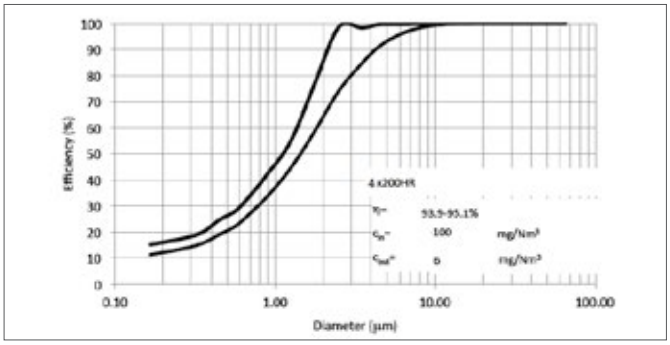

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

GENERAL ARRANGEMENT

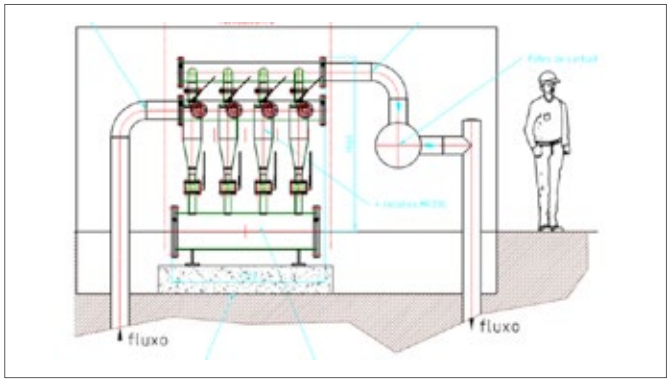

Fig.5 – General arrangement scheme | 4 Hurricane HR cyclones of Ø 200mm

CONCLUSIONS

The system was installed at the beginning of the cold season, in late November. Having now operated continuously for several months, there has been no clogging of the cartridge filters installed downstream of the system as it normally happened. This means that the unscheduled frequent maintenance operations brought on by continuous clogging of these filters is a problem that has been completely overcome. Also, it ensures the black powder is being effectively captured, protecting EDP´s multiple equipment and thus exempting EDP from their liability for damages to such equipments.