Advanced Cyclone Systems

PRODUCT RECOVERY

CASE STUDY

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Hurricane HR system

for paprika powder recovery and emission control on three milling lines (11 011m³/h at 48ºC)

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane HR cyclone system for Paprika Powder Recovery and Emission Control on three milling lines. This system was installed at Juan José Albarracín a company founded in 1854. It is the oldest company in the manufacturing and commercialization of paprika in all its varieties, hence offering the top quality products.

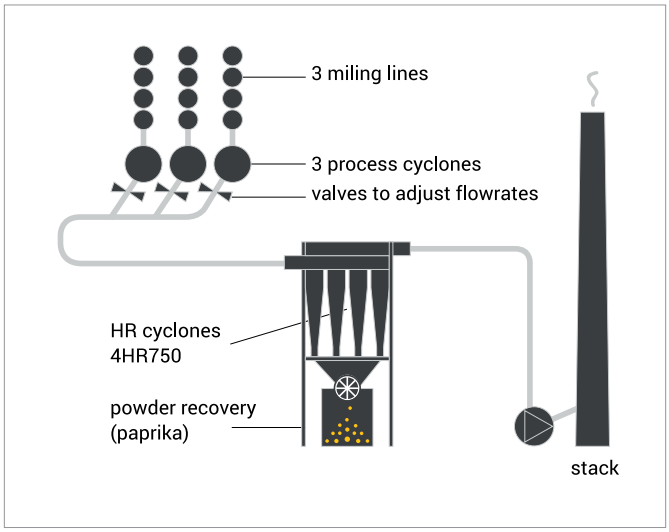

Fig. 1 – Process diagram

IDENTIFYING THE PROBLEM AND SOLUTION

Traditionally, each milling line have a process cyclone to recover the product. The cyclone has its own draft fan attached on top, which brings maintenance and operation problems due to vibration. The exhaust air is sent to a settling chamber, before being expelled to atmosphere by a stack on top. Several milling lines end at the same settling chamber, whose purpose is recovering the production as a backup, in case of any clogging at the process cyclones, and avoid it being expelled to atmosphere. Usually on a week operation time, the three milling lines lose about 100kg to settling chamber. This production was lost due to cross contamination issues and food quality requirements. Besides, the settling chamber was out of reach on regular basis and often, the operator only realizes that we was losing production after several hours of operation. These events implicate great loses.

The goal of our project was to treat the three milling lines at once, keeping the process cyclones in place but eliminating the draft fans on top and eliminate the sedimentation chamber, by installing a hurricane system for direct Product Recovery, easy to see and control, and Emission Control at the same time, avoiding emissions to atmosphere. At the end of line, a new general ID fan controlled with variable frequency driver and a stack was installed. A simple flow diagram is shown in (Fig. 1).

In order to design the most efficient system for this case, simulations were done, using a particle size distribution (PSD) of the paprika powder escaping the process cyclones (Fig. 3). ACS then designed the final separator comprising 4 numerically optimized hurricane HR_C cyclones Ø750 installed in one battery.

ABOUT HURRICANE CYCLONES

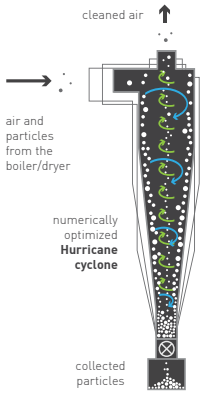

Fig. 2 – Hurricane cyclone

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 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

- Powder **[Paprika]**
- Particle size distribution **[Fig. 3]**
- Site location **[Indoors]**
- Actual flow rate (Am³/h) **[11 010]**
- Normal flow rate (Nm³/h) **[8 853]**
- Air flow temperature (ºC) **[48]**
- Powder concentration at inlet (mg/Nm³) **[272]**

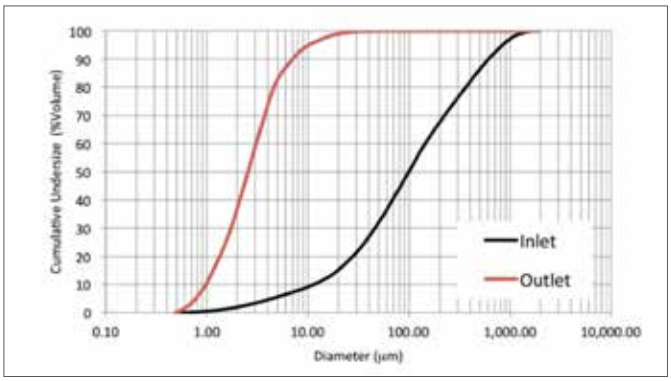

Fig. 3 - Particle size distribution used in simulations (sample measured by Malvern).

SYSTEM SPECIFICATIONS | EMISSIONS

- Guaranteed maximum emissions (mg/Nm³) **[30]**
- Expected separation efficiency (%) **[97.4 – 97.9, fig. 4]**
- Expected emissions (mg/Nm³) **[6, fig. 4]**
- Verified emissions (mg/Nm³) **[*]**
- Expected total pressure drop (KPa) **[1.4]**

(*) not verified yet, although we can see the air completely clean at the stack's outlet and powder recover rates in Hurricane system in line with ACS design

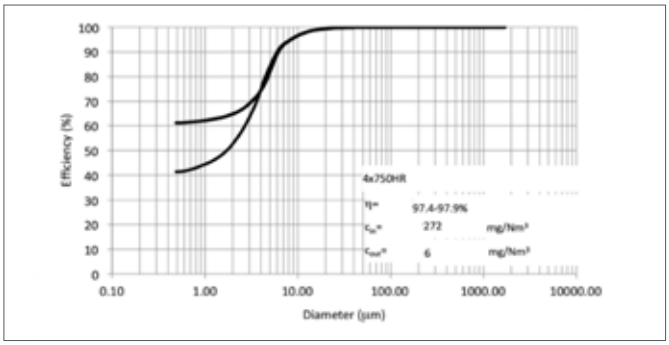

Fig. 4 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

GENERAL ARRANGEMENT

The system is composed by 4 Hurricane cyclones ø750mm installed in parallel, with a common hopper, rotary valve for air lock and 7 inspection doors. All equipment was manufactured in stainless steel AISI 304 with food grading finishing.

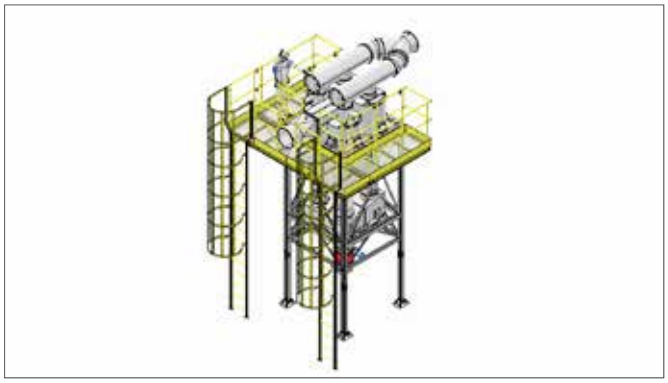

Fig.5 – General arrangement drawing

CONCLUSIONS

This installation was a complete success and client is fully satisfied for several reasons. The new installation allows recovering the losses of process cyclones, either during normal operation, as in special occasions when clogging the process cyclones occur. This will bring to its payback soon.

Besides, there are operational savings because this system leads to a direct product recovery, easier to control and handle than previous situation of settling chamber, difficult to access to. Avoiding cross contamination when product changes, general cleanliness and environmental benefits are also new features of this enhanced solution.

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