Advanced Cyclone Systems

POWDER RECOVERY

CASE STUDY

Hovione | Portugal | 2008

Hurricane HR Cyclone

to increase yield of Powder Capture after a Pharmaceutical Spray Dryer at Hovione (1500 kg/h at 85ºC)

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone for Hovione, a multinational pharmaceutical company. Hovione provides high technology products (APIs) and innovative services to the pharmaceutical industry. It has research centers in Portugal, USA and China; industrial-scale production units in Portugal, Ireland and China; and offices in Hong Kong, India and Switzerland.

In 2018, Hovione approached ACS to supply one high efficiency cyclone for the company's largest Spray Dryer. The target was to improve the yield of the existing cyclone of the Spray Dryer manufacturer, increasing the recovery of very fine and valuable powder (Fig. 1).

IDENTIFYING THE PROBLEM AND SOLUTION

The existing cyclone had an efficiency of 83%, resulting in 17% losses of a very valuable powder into a bag filter. Due to GMP requirements and in order to avoid contamination, only the powder recovered in the cyclone can be considered as product.

In order to increase powder recovery, considering a design flow rate of 1500kg/h at 85ºC, ACS installed a Hurricane Cyclone with a diameter of Ø530mm. As requested, Hovione provided ACS the particle size distribution, which is key for an accurate efficiency estimation and guarantee. Thus, by using a numerical simulation tool developed internally – the PACyc (Particle Agglomeration in Cyclones), ACS guaranteed a reduction in powder losses from a 17% down to 2 to 4%.

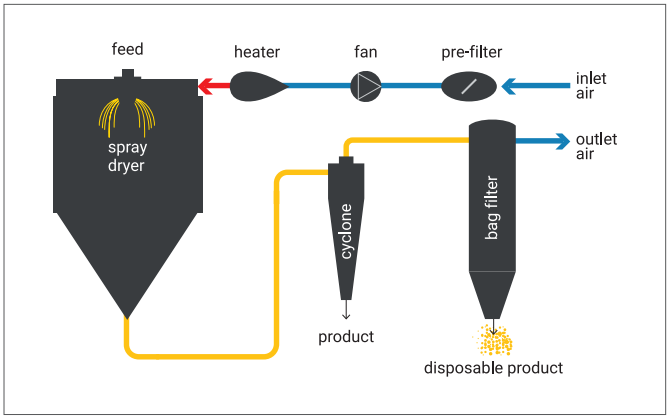


Fig. 1 – Process diagram

Fig. 2 - Installation of a similar hurricane cyclone at Hovione

ABOUT HURRICANE CYCLONES

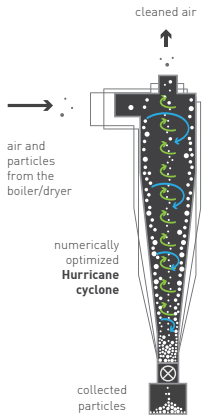


Fig. 3 – Hurricane Cyclone

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 recenet findings of the impact of agglomeration in the cyclone collection efficiency (Chemical Engineering Journal 162 (2010) 861–876).

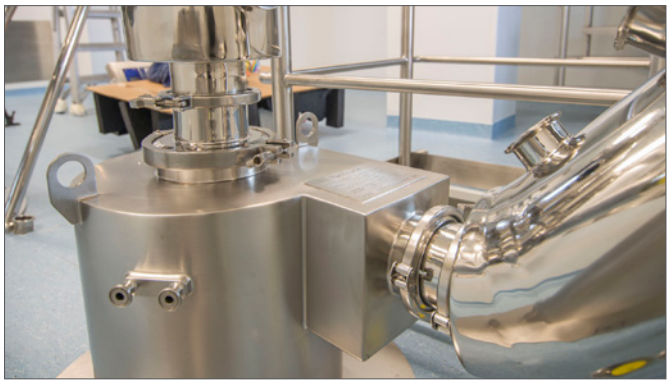
A single Hurricane is more efficient than any other known cyclone available in the market for the same pressure drop.

DESIGN BASIS

- Particle size distribution **[Fig.3]**
- Gas composition (kg/h) **[1500 (N_2) + 40 (H_20)]**
- Temperature (ºC) **[85]**
- Design Flow Rate (Kg/h) **[1500]**
- Inlet concetration of solids (kg/h) **[5-6]**
- Median particle size (µm) **[5.5]**

SYSTEM SPECIFICATIONS | RECOVERY

- Diameter (mm) **[530]**
- Material (all material in contact with the powder) **[AISI 316L]**
- Maximum pressure drop (mm w.g.) **[200]**
- Expected efficiency (%) **[>97]**
- Guaranteed efficiency (%) **[>96]**



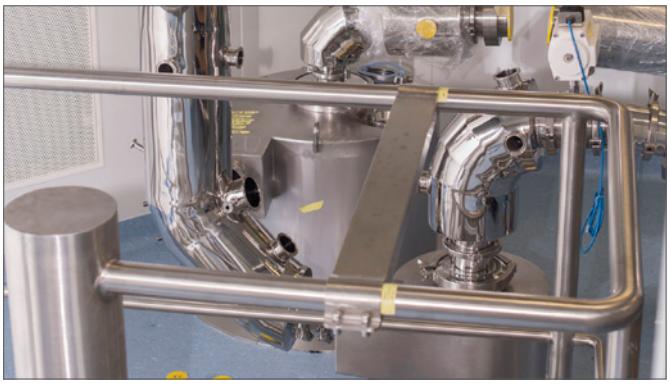


Fig 4 & 5 - Gas inlet (from Spray Dryer) and Gas outlet (to bag filter)

CONCLUSIONS

Although experimental grade-efficiencies obtained with the Hurricane 530 in Hovione's facilities was not possible to obtain, ACS was informed that the global efficiency was between 96 and 98 %, in total agreement with the PACyc model.

Since 2008 Hovione went on purchasing other cyclones for 14 other Spray Dryers of different sizes and a tight cooperation between both companies was established.

ACS CYCLONES ADDED VALUE FOR HOVIONE CAN BE CALCULATED BY THE SAVINGS PER YEAR IN LOST API TO THE BAG HOUSE, FROM WHICH IT IS IMPOSSIBLE TO RECOVER THE POWDER DUE TO CONTAMINATION RESTRICTIONS.

Even though ACS is not aware of the exact figures of the value per Kg of this specif API, the 50k€ invested by the client had an almost immediate payback, according to Hovione.

REFERENCE COSTS

Range Active Pharmaceutical Ingredient Cost [€/kg]	[5.000 ; 500.000]
Range of Batch [kg]	[50 to 3000]

OPERATING CONDITIONS FOR SPECIFIC CASE

Average Flowrate [kg/h]	1500 N2 kg/h + 40 (H20) kg/h
API - Powder into cyclone [kg/h]	5,5
Estimated API cost [€/kg]	15 000
Assumed Batch [kg]	500
Assumed Batch value [€]	7 500 000

POWDER RECOVERY COMPARISON

	Cyclone dryer from supplier	With ACS
Average pressure drop [kPa]	2	2
Collection efficiency [%]	83	96
Powder losses [%]	17	4
Losses per batch [kg]	85	20
Losses per batch [€]	1 275 000€	300 000€
Total Savings per batch [€]		975 000€