



High Efficiency
Cyclones for Food
Product Recovery
after Drying

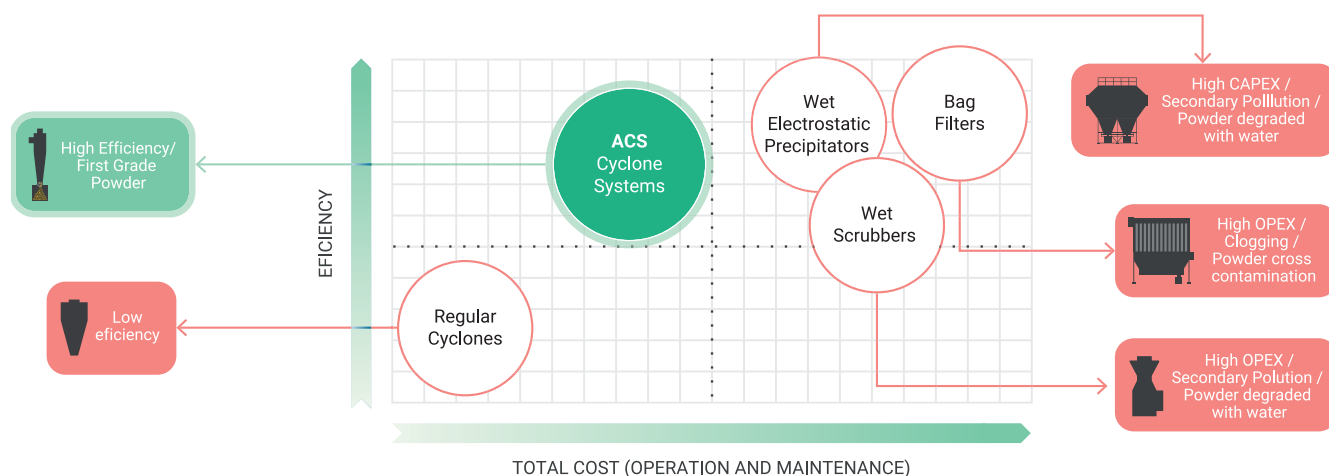
Hurricane & ReCyclone® Systems

Advanced Cyclone Systems (ACS)

Total Particulate Capture with Optimized Cyclone Systems.

ACS specializes in the development and worldwide commercialization of highly efficient cyclone systems.

Based on our extensive scientific knowledge in numerical optimization and particle agglomeration, we have installed over 400 systems around the world to increase the **product recovery yield** or to **minimize emissions** with lower CAPEX and OPEX compared to other air pollution control technologies.



About Hurricane Cyclones

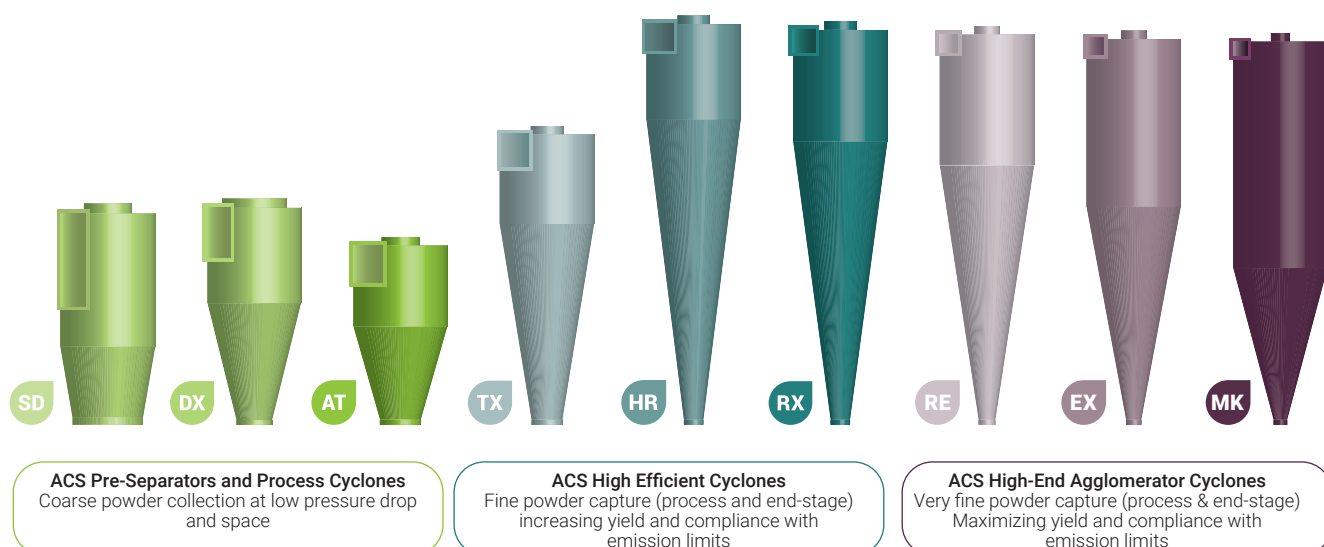
Numerically Optimized ACS Cyclones

hurricane

Most cyclones on the market are designed based on empirical methods. Although CFD (Computational Fluid Dynamics) can be used for partial optimization, it is not sufficient for complete optimization. The suboptimal design of cyclones and their low capture efficiency is often the result of not accounting for particle agglomeration.

With this in mind, ACS developed efficiency prediction models that explain why submicrometric particles are captured with greater efficiency than expected by traditional models. **Fine particles** tend to **agglomerate with larger ones**, being captured by drag, which results in higher efficiency. This phenomenon is intensified by wide particle size distributions, longer residence times in the cyclone, and higher particle concentrations.

ACS uses this knowledge in its **PACyc** simulation tool (**Particle Agglomeration in Cyclones**), and developed a complete line of Hurricane cyclones from different families for different needs. From compact, low-pressure-drop cyclones for coarser particle size distributions (**SD** to **AT** families) to highly efficient agglomerator cyclones for fine powder capture (**RE** to **MK** families), ACS offers solutions for both 1st stage process cyclones to 2nd stage cyclones than can exempt bag filters and ESPs achieving emissions as low as 20 mg/Nm³.

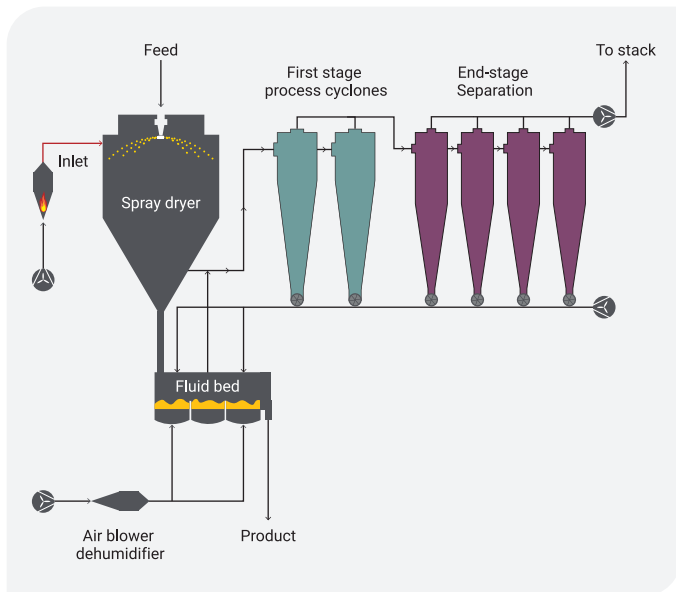


Hurricane Cyclones for Food Powders Recovery after Drying

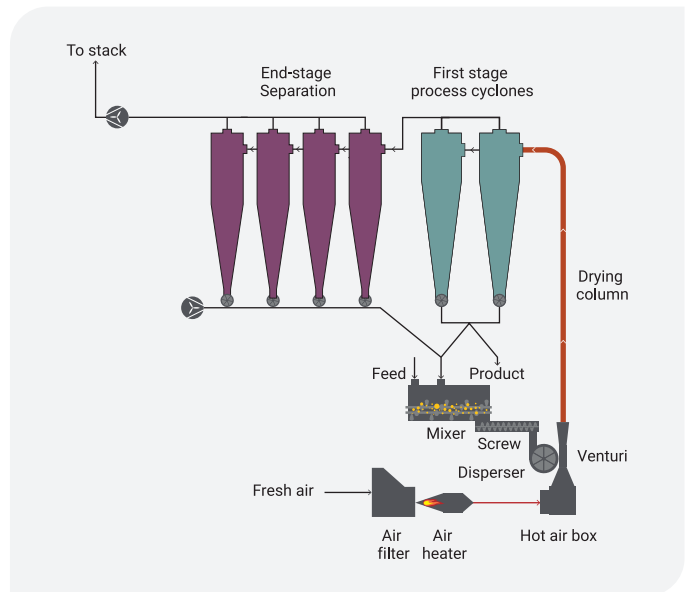
ACS offers cyclone solutions for high efficiency 1st stage powder separation and 2nd stage emissions control avoiding product losses

The need to separate powder-based **Food Ingredients** occurs in many industries, from the **dairy** to **chocolate making** and from **beverages** to **starches** and **yeasts**. Processes needing separation of powders include Spray Drying, Flash & Ring Drying. **Efficient recovery** of Food Ingredients can be quite challenging, especially for finer particles. That is particularly evident in **Spray Drying** of high value milk derived proteins such as **Demineralized Whey**, **Whey Protein Concentrate**, **Protein Hydrolysates** or **Infant Formulas**. Similar needs occur in spray dried plant-based proteins such as high concentration **Protein Isolates** derived from pea or soy seeds or spent grain. **Flash** and **Ring drying** also have challenges with finer fractions of starches and modified starches derived from wheat or corn/maize.

Spray Drying with Vibrating Fluid Bed Arrangement



Flash Drying Arrangement



First Stage Process Cyclones

TX, HR or RX hurricane cyclones for maximizing powder recovery in Spray, Flash and Ring Drying

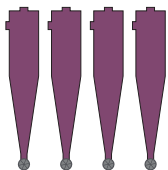


The TX, HR, and RX cyclone families from ACS are numerically optimized, achieving 40 to 60% lower particle losses than standard cyclones from the dryer vendors. These high efficiency cyclones significantly boost product recovery, which is crucial for valuable powders like casein and infant formula, where even small improvements in capture yield have a substantial economic impact.

By minimizing particle carryover to downstream equipment, ACS process cyclones enhance process efficiency, reduce the need for filter or scrubber cleaning, and lower energy consumption, contributing to a cleaner, more sustainable operation.

End-Stage Separation

RE, EX or MX cyclones to minimize emissions and exempting Bag Filters, Wet Scrubbers and WESPs



End-stage separation can be efficiently managed using high efficiency cyclones from the RE, EX, or MK families, which can eliminate the need for bag filters, wet scrubbers, or WESPs in applications like starches and milk powders. These advanced agglomerator cyclones capture 80 to 95% of fine particles escaping from process cyclones, achieving emissions below 20 mg/Nm³, depending on the powder type.

ACS End-stage cyclones are ideal for food-grade applications, manufactured with stainless steel construction, CIP cleaning, and eliminating cross-contamination issues often experienced with bag filters. ACS cyclones ensure a fully aseptic setup, free of contamination risks, allowing recovered powder to be safely mixed back into the main product stream, an essential advantage for food safety and process efficiency.

Examples of ACS High Efficiency Cyclones



Hurricane RE Cyclone system composed of two cyclones with a diameter of $\varnothing 2900$ mm. The cyclones were placed downstream of the existing cyclones, treating only the whey powder escaping the process spray dryer cyclones.

The new system allowed for emission limit compliance.

Effective flowrate is $49\,955\text{m}^3/\text{h}$ at 78°C .

Client: **Lactalis** | Country: Croatia | Year: 2017

Efficiency: 96.9%

Type: End-stage cyclones



Hurricane HR Cyclone system composed of eight cyclones with a diameter of $\varnothing 850$ mm disposed in 2 batteries, operating in parallel to reduce emissions of skimmed milk powder fines escaping the process cyclones.

The new system allowed for emission limit compliance.

Effective flowrate is $31\,100\text{m}^3/\text{h}$ at $70\text{--}80^\circ\text{C}$.

Client: **Nestlé** | Country: Portugal | Year: 2012

Efficiency: 98.9 – 99.27%

Type: End-stage cyclones



Hurricane RE Cyclone system composed of four cyclones with a diameter of $\varnothing 1450$ mm to maximize fish and seafood flavours recovery from a flash dryer to meet zero waste goals.

The new system allowed for emission limit compliance.

Effective flowrate is $16\,800\text{m}^3/\text{h}$ at 80°C .

Client: **Firmenich** | Country: Norway | Year: 2021

Expected efficiency: 98.1 – 99.7%

Type: Process cyclones



Hurricane HR Cyclone system composed of two cyclones for increasing milk proteins product recovery (caseinate) after a spray dryer.

Effective flowrate is $92\,000\text{m}^3/\text{h}$ at 65°C .

Client: **Arla Foods** | Country: Denmark | Year: 2012

Expected efficiency: 99.4–99.8 %

Type: Process cyclones