About Hurricane Cyclones
ACS numerically optimized cyclones

**Hurricane Cyclones**

Cyclones have been designed and improved mostly by empirical means. Computerized Flow Dynamics (CFD) can be used for partial cyclone optimization but it is still incomplete for full cyclone optimization. Notably low collection efficiency results from the fact that particle agglomeration for cyclone modelling has been disregarded until present days.

This knowledge has helped ACS build very accurate models of efficiency prediction, capable of explaining why sub-micrometer particles are often captured with much higher efficiency than expected. Particles tend to form bigger agglomerates (clusters) which are much easier to collect than the original particles. Agglomeration increases in the presence of wide particle size distributions, long residence times in the cyclone and high inlet particle concentrations. This has been incorporated in ACS numerical simulation tool, combining a sophisticated stochastic algorithm with a classical numerical model to predict cyclone performance: the PACyc (Particle Agglomeration in Cyclones) model.

ACS developed a complete line of very different Hurricane cyclone families for each different need, considering how inter-particle agglomeration / clustering affects collection efficiency. From coarse particle pre-separation proportioned by compact and low pressure drop cyclones, such as the SD and DX lines, to fine particulate capture with high-end geometries such as the EX and MK, ACS provides solutions for a wide range of industrial cases, being able to reach emissions comparable to ESPs (down to less than 30mg/Nm$^3$).

**Objectives / Applications:**
- **MK**: The agglomerator cyclone – Maximum agglomeration. Most efficient cyclones available on the market.
- **EX**: Ultra high efficiency with agglomeration to compete with ESPs.
- **RE**: Very high efficiency cyclone with agglomeration for strict emissions.
- **RX**: Final stage dedusting for stricter emission limits.
- **HR**: Compact high efficiency cyclones for multiple applications. Half the emissions of Multicyclones.
- **TX**: Final stage dedusting for moderate emission limits. Better performance than multicyclones.
- **AT**: Enhanced Pre-Separation. Sparks & silica reduction upstream of dryers.
- **DX**: Improved pre-Separation for coarse and medium particle size. Alternative to axial multicyclones.
- **SD**: Coarse particle separation. Abrasion reduction before other cyclones and FANS.

**Emissions (mg/Nm$^3$):**
- **EX**: <270
- **RE**: <357
- **RX**: <458
- **HR**: <196
- **TX**: <166
- **AT**: <132
- **DX**: <96
- **SD**: <60

Comparative residual emissions are merely indicative and obtained for wood chips combustion in a 4MWth grate type boiler. Flue gas with 750mg/Nm$^3$ PM at 180ºC.
The Problem With Emission Control In Wood Rotary Dryers

Pellets are typically manufactured from wood chips and sawdust. The material is dried in a rotary dryer, which is heated by a biomass furnace and finally collected in so called “dryer cyclones”. The whole dried material is carried over to the dryer cyclones. In addition to wood particles, a much smaller amount of fine ash from the biomass combustion is released and captured in the cyclones. The total concentration of wood dust and ash entering the cyclones is typically 200 to 300g/Nm³. Usual cyclone dryers are capable of capturing the particles to a quite high degree (>99%) but often still have emissions of 200-350mg/Nm³. This level of concentration of particles is too high for most countries regulatory emission limits and therefore the plants have to be equipped with an end stage deduster to bring emissions under 50mg/Nm³.

ACS has solutions to meet emissions below 50mg/Nm³ both either with dryer cyclones or with secondary cyclones.

Examples Of High Efficiency Cyclones Installations

**USUAL DEDUSTERS CANNOT TECHNICALLY SOLVE THE PROBLEM**

- **Multicyclones** have an efficiency of less than 50%
- **Bag Filters** are not used due to tars, which stick to the collecting surfaces.
- **Venturi Scrubbers** are not used due to high energy consumption, erosion, corrosion and secondary pollution
- **Dry ESPs** are not used because of explosion risks due to organic (wood) particles

**WESP: A SOLUTION WITH HIGHT INVESTMENT AND OPERATING COSTS**

- Very efficient for PM10 and PM2.5
- Can handle sticky tars
- Very high investment cost
- Wastewater treatment requirement
- Clean water consumption or treatment requirement
- Operational problems in the water treatment process (corrosion, plugging...)

**Hurricane®** system to capture particles from a woodchip and sawdust dryer operating in a wood pellet plant, with a flow rate of 71,839 m³/h at 88ºC. System is located after the existing (secondary) dryer cyclones with the objective of achieving 50mg/Nm³

Client: **Glowood** | Location: Portugal | Year: 2014
Inlet Concentration: 500mg/Nm³ | Emissions: <50mg/Nm³

**Hurricane®** system for product recovery and emission control of a 12t/h sawdust dryer, with a flowrate of 52,228m³/h at 60ºC. The system is located after the dryer (dryer cyclones).

Client: **Vert Deshy** | Location: France | Year: 2018
Inlet Concentration: 115,237mg/Nm³ | Emissions: <20mg/Nm³
About us:

Advanced Cyclone Systems, S. A. (ACS) is a company exclusively dedicated to the development of high efficiency cyclone systems worldwide. ACS’ mission is to achieve total particle capture exclusively with cyclone systems through continuous investment in Innovation and R & D.

NUMERICALLY OPTIMIZED CYCLONES (HURRICANE) AND RECYCLONE® SYSTEMS CONTRADICT THE GENERAL THINKING THAT CYCLONES ARE INEFFICIENT POWDER COLLECTORS. THESE CYCLONE SYSTEMS CAN REPLACE BAG FILTERS IN MANY DEMANDING OPERATING PROCESSES.

Application Areas

- BIOMASS & COAL BOILERS
- FUEL OIL BOILERS
- STEEL & FERROUS ALLOYS
- CLINKER COOLER
- AIR DEDUSTING PYROLISIS, INCINERATION & GASIFICATION
- CALCINATION PROCESSES
- GLASS & CERAMIC FURNACES
- AIR CAPTION AND DEDUSTING
- HIGH TEMPERATURE SEPARATION PROCESSES