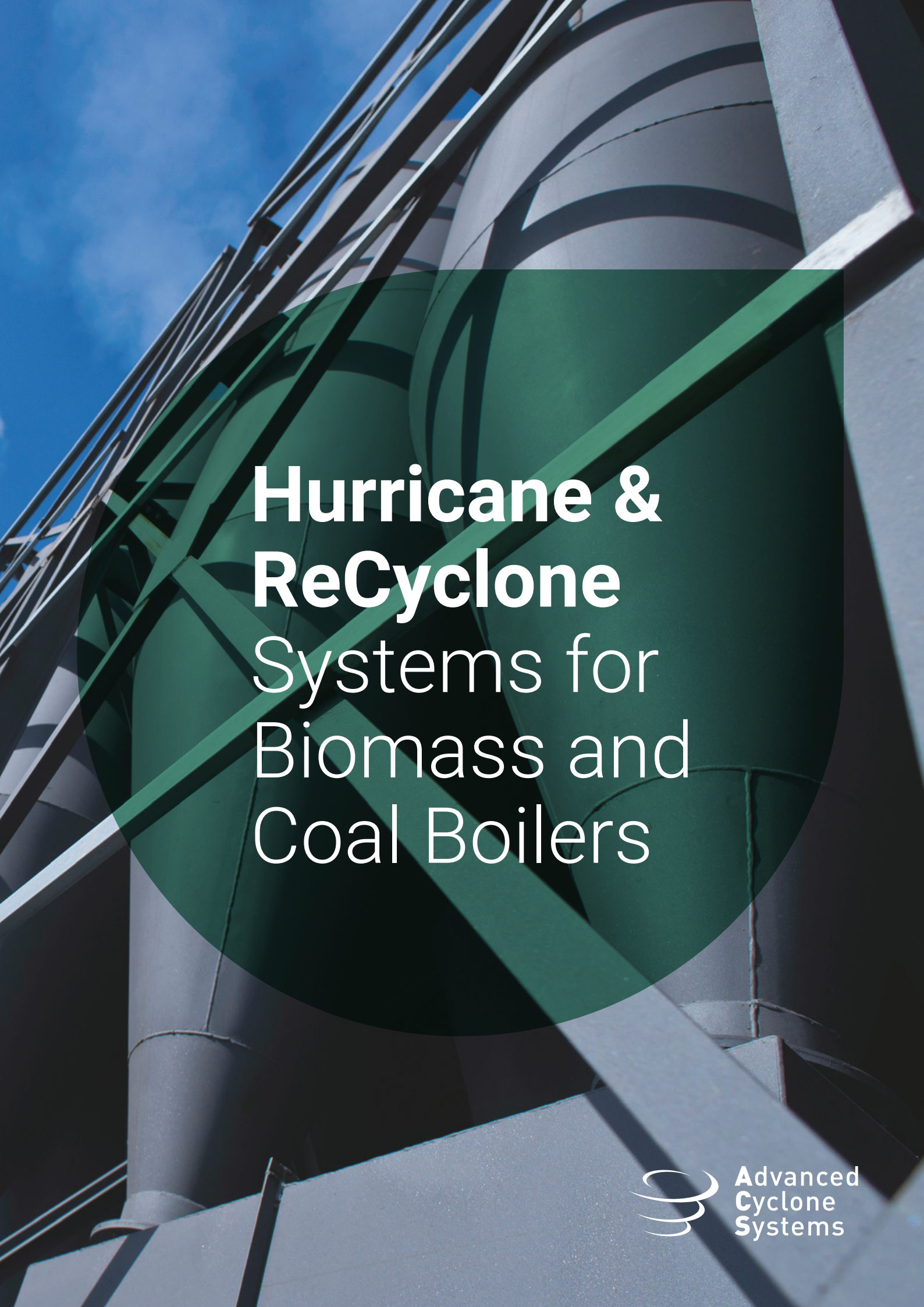


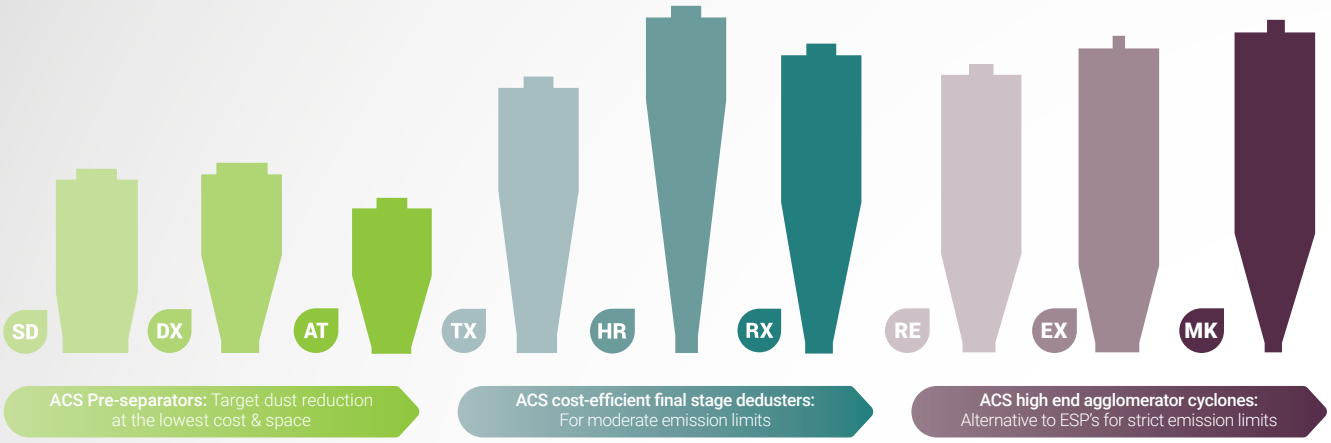
Hurricane & ReCyclone Systems for Biomass and Coal Boilers

Advanced Cyclone Systems

About Hurricane Cyclones

ACS numerically optimized cyclones

hurricane



HURRICANE CYCLONES

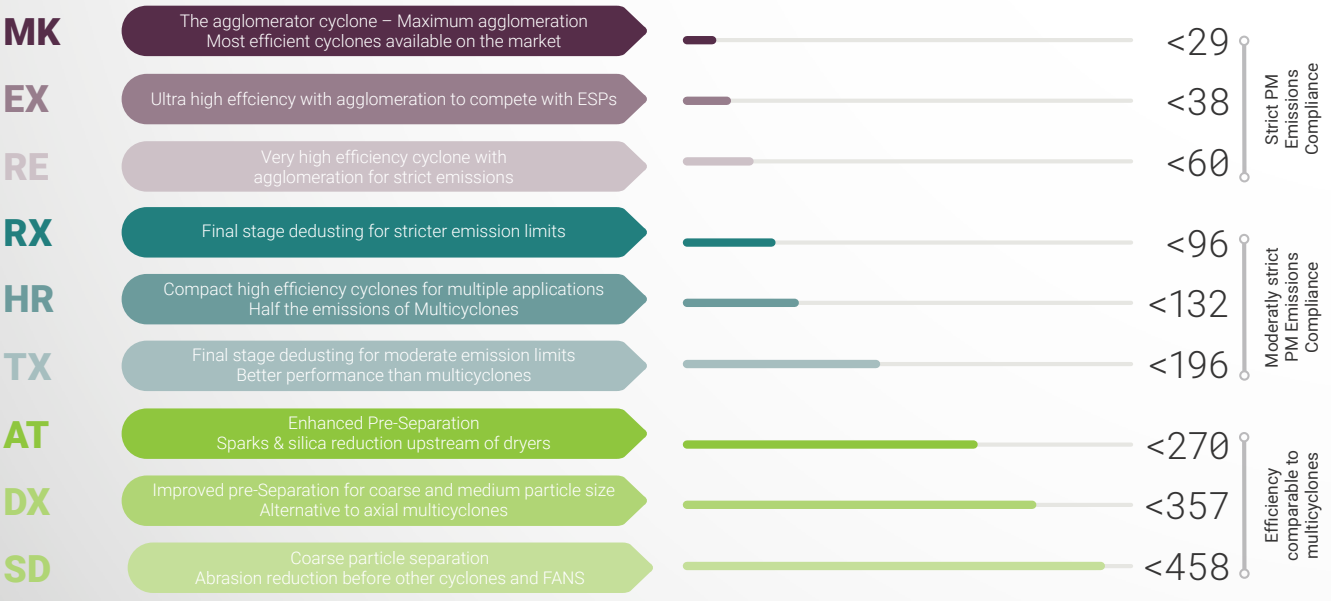
Cyclones have been mostly designed and improved by empirical means. Computerized Flow Dynamics (CFD) can be used for partial cyclone optimization but it is still incomplete for full cyclone optimization. The fact that **particle agglomeration for cyclone model-ling** has been disregarded until present days is one of the reasons for notably low collection efficiency results.

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) 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:

EMISSIONS (mg/Nm^3):



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.

ReCyclone MH & EH

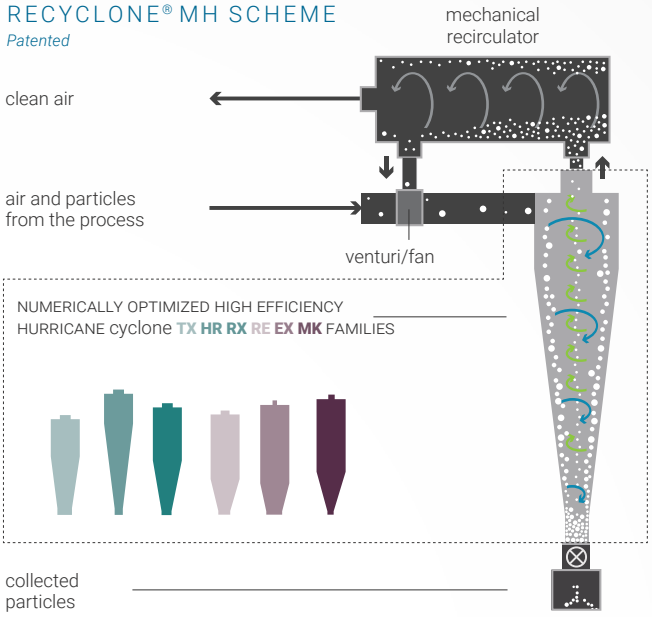
Recirculation systems to increase the efficiency of cyclones.

ReCyclone® MH System

ReCyclone® EH System

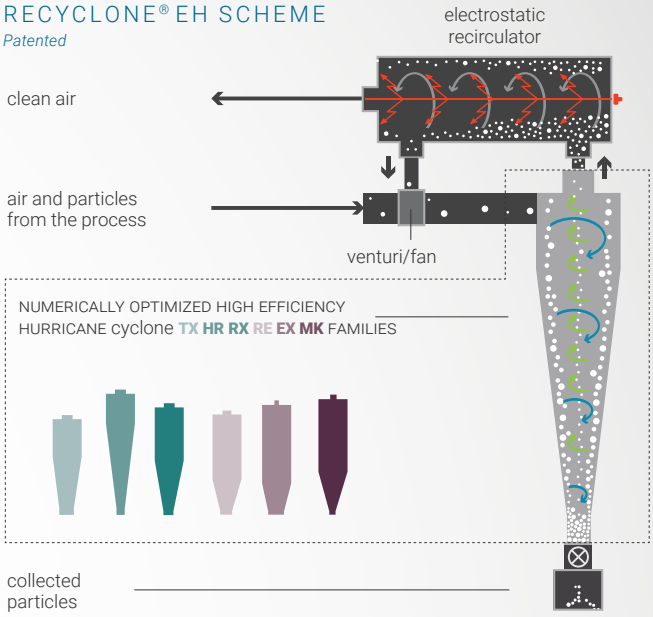
RECYCLONE® MH SCHEME

Patented



RECYCLONE® EH SCHEME

Patented



RECYCLONE® MH (MECHANICAL)

Made up of a high efficiency **Hurricane** and a particle separator, the MH is a **compact recirculator that can be placed on top of cyclones.** It reintroduces the uncaptured particles into the cyclones after they have been driven to the outer walls of the recirculators by centrifugal forces. Recirculation is achieved through an additional fan.

RECYCLONE® EH (ELECTROSTATIC)

Made up of a high efficiency **Hurricane** and a particle separator, the EH is a **compact recirculator that can be placed on top of cyclones.** A DC high voltage is applied to the recirculator, allowing the **recirculation of very fine nanometric particles, more resistant to centrifugal forces, to the cyclone collector.** Electrically charged fine particles are attracted by the cyclone walls, while agglomerating with larger particles entering the system – promoting their easier capture.

TECHNOLOGY COMPARISON BETWEEN ACS AND OTHER PRODUCTS

Technology comparison for wood chip combustion	Multicyclones	Wet Venturi Scrubbers	Bag filters	ESP´s	Hurricane systems	ReCyclone® MH systems	ReCyclone® EH systems	
Efficiency (%)	50 to 80	89 to 93	98-99 +	95 to 99	82 to 96	87 to 97	94 to 99	Maximize Efficiency
Emissions: (depending on Hurricane collector)	> 150	49 to 70	< 20	5 to 35	29 to 132	21 to 97	10 to 44	
Temperature limitations (°C)	No	No	< 250	Yes	No	No	<400	Universal Application
Fire risk	No	No	Yes	No	No	No	No	
Resistivity sensitivity?	No	No	No	High	No	No	Low	
Pre-separation needed?	No	No	Always	Frequently	Unfrequent	Unfrequent	Unfrequent	
Consequences of electrical field failure	None	None	None	Plant shut down	None	None	Works mechanically	Minimize Total Cost of Ownership
Moving/replacement parts	No	No	Yes	Yes	No	No	No	
Relative investment costs	20/100	(45 to 55)/100	60/100	100/100	(35 to 55)/100	(45 to 65)/100	(60 to 70)/100	
Relative operating costs (Energy and Maint.)	4/100	20/100	20/100	10/100	4/100	6/100	10/100	
Future retrofitting costs	Very low	Low	Low	Very high	Very low	Very low	Very low	
Downtime costs	Very low	Low	High	Low	Very low	Very low	Low	
Comments	Dry-System	Sec. Pollution Needs Treatment	Dry-System	Dry-System	Dry-System	Dry-System	Dry-System	

Indicated values are from example of previous page. Example: 4MWth biomass boiler. Range of emissions depends on the cyclone family used as colector.

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

Advanced Cyclone Systems

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