Advanced Cyclone Systems

EMISSION CONTROL

CASE STUDY

TRADEWINDS | BINTULU, MALAYSIA | 2016



ReCyclone MH System

to Reduce Particulate Matter from a biomass boiler burning a mixture of mesocarp fibre and palm kernel shell

FOREWORD

Advanced Cyclone Systems, S.A. (ACS) designed and supplied a Hurricane Cyclone System for Tradewinds Plantation Management SDN BHD in Malaysia, with the objective of reducing Particulate Matter (PM) emitted by a Palm Waste Boiler from 500mg/Nm^3 to less than 150mg/Nm^3 at 12% CO_2.

Tradewinds Plantation Management SDN BHD is comprised of a group of subsidiaries companies located in Malaysia, dedicated to the cultivation of palm oil plantations, crude palm oil extraction commercialization of edible oils and shortenings. As many other palm oil mills, Tradewinds, is self-sufficient in terms of energy. However, burning of biomass fuel in a boiler generates a serious air pollution problem especially due to an inefficient dust collection system (multicyclone). New regulation in Malaysia forces companies to progressively comply with emission limits, presently at 400 mg/Nm^3, down to 150mg/Nm^3 in 2019.

Tradewinds operates several palm mills in Malaysia, and decided to solve the emission problem firstly at Kuala Suai Palm oil mill, located in Bintulu, Sarawak. This mill is operating a 35ton/h Advance Boilers water tube boiler (137,620m^3/h at 320ºC).

IDENTIFYING THE PROBLEM AND SOLUTION

The Malaysian palm industry has many special features. Usually water tube steam and water boilers are used comprising steam flows between 20 and 60 ton/h and burning a mixture of mesocarp fibre and palm kernel shell (PKS) and/or empty fruit brunch (EFB). Multicyclones are installed after the boilers to keep the emissions bellow 400mg/Nm^3 corrected to 12% CO_2 (actual emission limit in Malaysia), but offen these value is exceeded due to very low efficiency of the multicyclone and variable boiler conditions. Indeed emissions and the particle size distribution (PSD) are very variable, depending on the relative weight of the fibre, shell and EFB, and also on the boiler and operation type.

Worldwide legislation is changing and becoming increasingly tight when it comes to emissions of pollutants. Malaysia is one of the countries were these concerns are especially increasing and the DOE (Department of Environment) of Malaysia is already monotoring the changes corrected to 12% CO_2 which must be fulfilled by all plants by 2019.

After confirming what particle size distribution (see Fig.2) to consider for the case in Kuala Suai Palm oil mill (the first in Sarawak state) , ACS designed a Mechanical ReCyclone system comprising 24 Hurricane HR numerically optimized cyclones, with ø1000mm, disposed in six batteries of four elements and 24 new V-Type Mechanical Recirculators (one per each cyclone). The system is capable of reducing emissions to under 100mg/Nm^3 at a pressure drop of 1.25kPa, maintaining that boiler emissions after existing multicyclone are under 500mg/Nm^3.

ABOUT RECYCLONE SYSTEMS

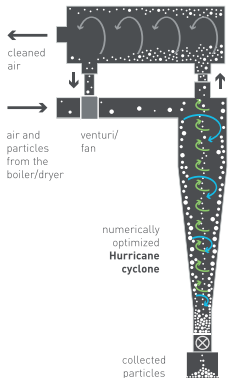

Fig. 1 – ReCyclone MH

A mechanical ReCyclone® (**ReCyclone® MH**) is made up of a Hurricane and a particle separator (straight-through cyclone), placed downstream of the cyclone – called the "recirculator" (please see figure).

The main purpose of the recirculator is to reintroduce the fine uncaptured particles into the cyclone after they have been driven to the outer walls of the recircula¬tor by centrifugal forces.

While this tangential gas stream is enriched in particles, the axial gas stream exhaust to the stack is clean of particles. Recirculation is achieved through an additional fan. Since the recirculation system only serves the purpose of dust separation (and not collection), the particles are exclusively collected in the cyclone and the need of rapping mechanisms is thus avoided. Efficiency increases due to recirculation and agglomeration of very small particles with larger ones coming directly from the process. A **ReCyclone® MH** decreases emissions of Hurricane cyclones alone by 40 to 60 %. As with cyclone systems, **ReCyclone® MH** systems are very robust, do not have temperature limitations and do not have moving parts to be frequently changed. Finally, recirculation control provides the benefit of handling variable process flow rates very well.

DESIGN BASIS

- Fuel **[Biomass – Palm Shell and Fiber]**
- Particle size distribution **[Fig.2]**
- Temperature (ºC) **[320]**
- Actual flow rate (m^3/h_{wet}) **[137 620]**
- Normalized flow rate (Nm^3/h_{wet}) **[49 974]**
- Inlet concentration (mg/Nm^3) **[500]**

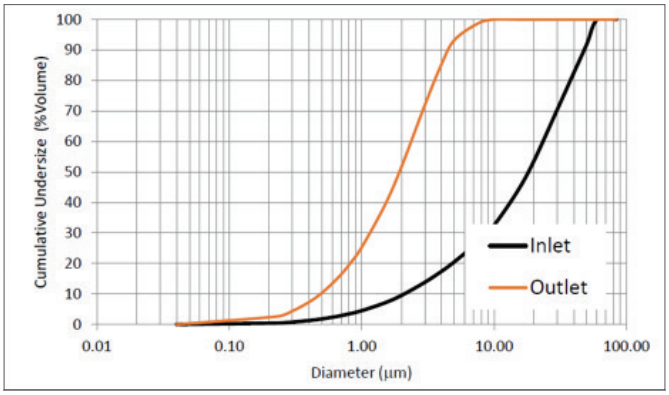

Fig. 2 - Particle size distribution used in simulation

SYSTEM SPECIFICATIONS | EMISSIONS

- Guaranteed emissions 12% CO_2 (mg/Nm^3), after the system **[<150]**
- Expected emissions 12% CO_2 (mg/Nm^3), after the system **[<100]**
- Expected total pressure drop (KPa) **[<1.25]**

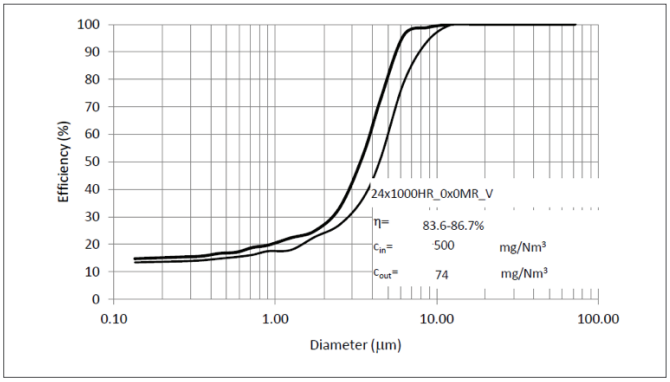

Fig. 3 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

CONCLUSIONS

Currently, despite the system is at it's final stage of commissioning, we are in the process of supplying three new systems for other plants in Malaysia. Efficiency verified results confirm that the **ReCyclone® MH System** can achieve PM emissions under $100mg/Nm^3$ already corrected to 12% of CO_2 for inlet concentrations of fine particulates (escaping a multicyclone) of more than $500mg/Nm^3$, thus achieving imposed emission standards with an equipment which has lower investment costs, when compared with ESPs, and lower maintenance and operating costs, when compared to Bag Filters.

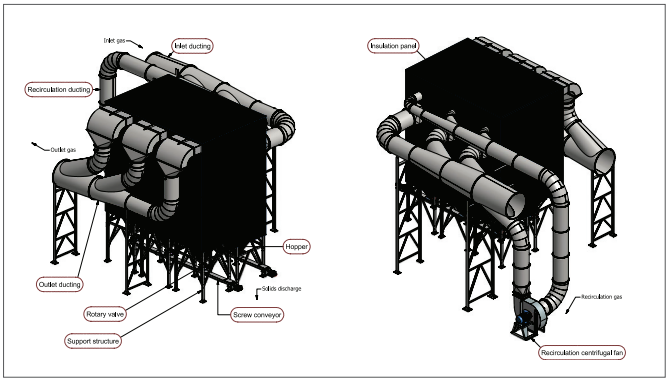

Fig.4 – General arrangement of the Hurricane cyclone system 24 Hurricane cyclones with Ø1000mm + 24 new V-Type Mechanical Recirculators