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.

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 due to inappropriate boiler operation and inefficient dust collection system (multicyclone). New regulation in Malaysia forces companies to progressively comply with emission limits, starting at 400 mg/Nm^3 nowadays, 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

Malaysian palm industry is an industry with many special features. Usually water tube steam and water boilers are used with a steam flow between 20 and 60 ton/h and burning a mixture of mesocarp fibre and palm kernel shell (PKS) and/or empty fruit brunch (EFB). After the boilers are installed multicyclones to keep the emissions bellow 400mg/Nm^3 corrected to 12% CO_2 (actual emission limit in Malaysia), but many times due to the fact of the very low efficiency of the multicyclones this numbers are easily overcomed. Also the particle size distribution (PSD) is 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 values of emissions of pollutants, Malaysia is one of the countries were these concerns are also increasing. The DOE (Department of Environment), a governmental company responsible for the environment, launched new policies to reduce the current maximum limit emissions in palm oil mills from 400mg/Nm^3 corrected to 12% CO_2 to 150mg/Nm^3 corrected to 12% CO_2 which must be fulfilled by all plants by 2019.

For this project at Kuala Suai Palm oil mill (the first in Sarawak state), after confirming what particle size distribution (PSD) to consider for the case (see Fig.2), 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

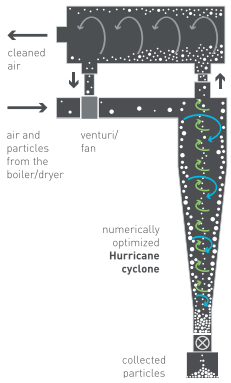

Fig. 1 – ReCyclone MH

Patented ReCyclone® systems are based on numerically optimized cyclone geometries, different from any other in the market (**Hurricane**), and on an innovative recirculation system. With ReCyclones the fine material, leaves the cyclone and enters the recirculator – a straight through cyclone without the conical part. By centrifugal forces, the particles are moved to the peripheral portion of the recirculator and separated from the main gas, which flows through the axis and leaves the equipment to the atmosphere.

In a **Electrostatic ReCyclone**, a DC high voltage is applied to the center of the recirculator by means of an electrode. The ultrafine particles bombarded with ions, become negatively charged, and are attracted by the walls of the recirculator, being recirculated to the cyclone.

Reduction in emissions by more than 50 %, when compared with the Mechanical ReCyclone, obtaining similar efficiencies to those of bag filters.

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]**

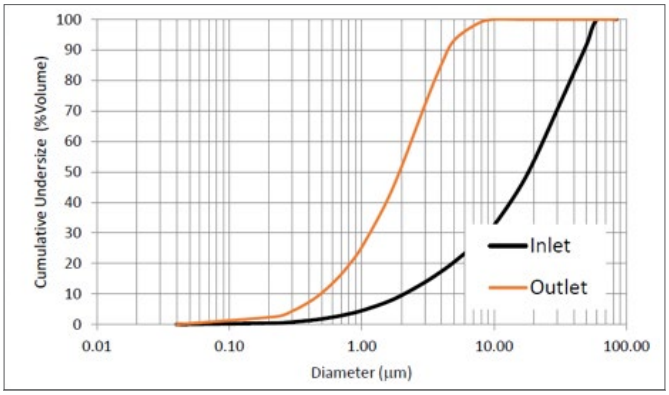

Fig. 2 - Particle size distribution used in simulation

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]**

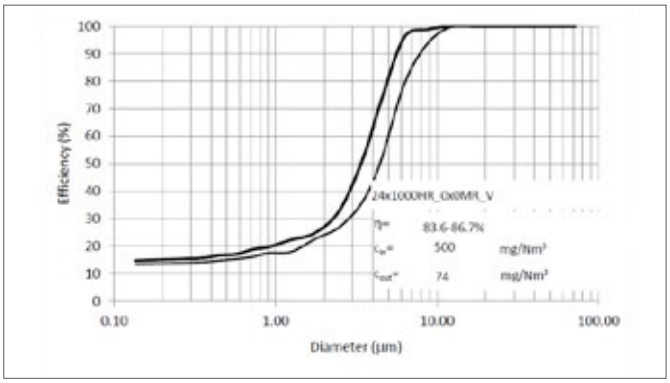

Fig. 3 – Predicted maximum and minimum grade efficiency curves with corresponding global efficiency values

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.

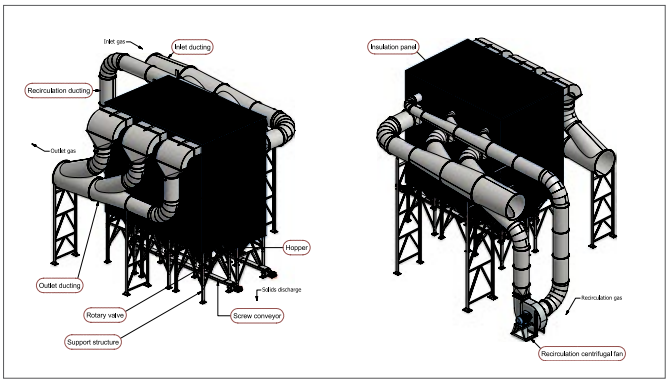

Fig.4 – General arrangement of the Hurricane cyclone system 24 Hurricane cyclones with Ø1000mm + 24 new V-Type Mechanical Recirculators