WCA Pegasus Phase 1 Summary Report

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1. Introduction

The PEGASUS Project was launched in 2020 as a multi-company benchmarking and performance improvement project, designed to help WCA member cement plants close the gap between their plants and industry best-practice. In the first round of data collection, 10 WCA members participated, including 90 integrated lines and 31 grinding stations, representing a total of 107 million tpa of clinker and 108 million tpa of cement production.

2. Overall Results

Phase 1 of the PEGASUS Project included extensive virtual project meetings with participating plants, three rounds of data collection to ensure correct and aligned data, and thorough analysis to produce a comparative benchmark across different operations, particularly looking at energy consumption and CO2 emissions. 22 KPIs were considered and some of the key results are shown below:

		Average	Best
Clinker SPC kWh/t clinker	Overall	58.4	43.2
	Ball Mill	67.7	58.0
	VRM	57.7	45.1
	Roller Press	52.6	43.2
Cement grinding SPC kWh/t cement kWh/t	Overall	32.5	25.4
	Ball Mill	35.0	26.7
	RP + BM	32.8	29.5
	VRM	31.5	25.4

		Average	Best
Clinker SHC MJ/t clinker	Overall	3,174	2,781
	4 Stage PH	3,427	3,139
	5 Stage PH	3,167	2,860
	6 Stage PH	3,073	2,781
CO_2 emissions KG/t	Clinker	857	720
	Cement	677	560

3. Common Issues and Difficulties

The issues below were experienced by a majority of lines and could be suitable topics for a members forum or other knowledge sharing.

- **Limited automation**
  - No energy management system
  - Lack of integrated data platforms and related analysis
  - No Advanced Process Control
  - Related issues in management, skills and behavior
- **ID and other fan power consumption ID**
  - Fan mechanical efficiency
  - VSD
  - Design of preheater (pressure drop)
  - Operating practices

- **High bag house pressure drop**
  - Kiln Exhaust Fan SPC: > 2kWh/t,(Best 1.3, Highest: 4.5+)
  - Choice of filter bags
  - Equipment function (design, filter velocity, material or supplier)
- **High O_2 level at main stack (Best 4.9, Highest 10.8)**
  - Operating practices
  - Maintenance
- **High power consumption**
  - Process and equipment function
  - Operating practices
  - RM cyclones pressure drop
  - Equipment function (design)
- **Clinker ratio is high**
  - Availability of SCMs
  - SCM upgrade technology
  - LC3

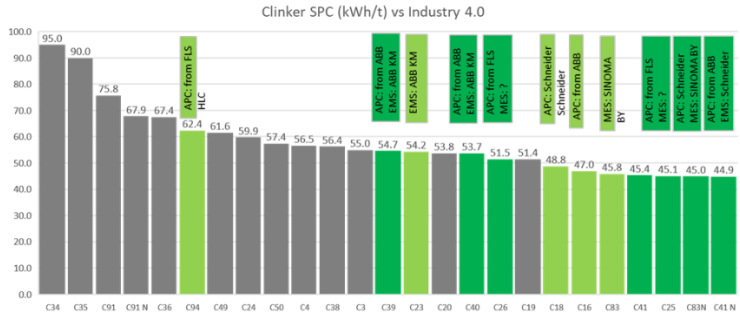
4. Best Practices

The below items show what the top plants do.

- **Process & Function of Equipment**
  - Roller Press for raw grinding
  - 4th Generation Cooler
  - High Efficiency Fans for IDF, kiln exhaust fan, cooler exhaust fan, circulation fan
  - Engineered Drives for all Process Fans instead of damper control
  - Low Pressure Drop for main dust collector bag house ~500Pa
- **Design**
  - Low Pressure Drop Preheater even 6-stage 4500Pa
  - Low Pressure Drop Bag House, filtering velocity 0.8~1.0m/min.
- **Technology (Industry 4.0)**
  - Advanced process control
  - Energy Management System
  - MES
  - Equipment status on-line monitoring system
- **Management and Operations**
  - Reward and recognition of best shift of kiln and mill
  - Mastering fan system efficiency (mechanical, process and drive system efficiency)
  - Air leakage management and control of O_2 at main stack
  - Close control of cement product to avoid over-grinding (Blaine target +/- 10m2/kg)
  - Good control of clinker temperature ex cooler to avoid over-cooling and optimize cooler fans SPC
  - Avoid material blockage and preheater clogging
  - Avoid idle running and minimize low load running

The top 5 good practices that could be shared with others are as follows:

I. The best plants in SPC have all implemented Industry 4.0 tools. They use energy management systems and advanced process control as shown below:



II. Using the latest design concepts and equipment – this could be helpful for companies considering new plant construction. Best practice includes:
    a. 6 stage pre-heater with low C1 pressure drop
    b. Roller press for raw meal grinding
    c. Low pressure drop across the main dust collector bag house
    d. Good control of O_2 at main stack
    e. These factors made Taian CUCC and Luoyang CUCC #1 for SHC and #3 for SPC

III. Replace all major fans with high efficiency fans controlled by variable speed drives. In Sinoma Cement plants, major process fans have been replaced with high efficiency fans with clinker SPC reduced by 2.8 - 6.5kWh/t.

IV. Process mastery including the items noted above

V. Using greater amounts of AFR and SCMs. Naturally enough, the lowest CO2 emissions were at plants with high AFR usage and low clinker factor.

Plans for next Phase
Phase 2: Maintenance and Reliability

This phase has already started and data collection will be completed and validated in September, with the discussion and report to follow in October-November.

Phase 3: Operation, Quality and Industry 4.0

Data collection to be completed and validated by December with the reports in January/February 2021.