A white paper by **KraftPowercon®**

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The effect of Micro-Pulse Technologies power Supply on Electrostatic Precipitator performance

/ Information on Electrical Upgrade with Advanced Technology HVPS

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The performance of many installed Electrostatic Precipitators (ESP's) are not according to the emission level requirements, because of strict emission level regulation. Therefore, ESP upgrade is mandatory for many applications.

An ESP upgrade project is considered as a complex and costly process. Stopping of the application processes as well as hiring of contractors, cranes, and heavy vehicles for ESP Upgrade bringing loss of revenue which is normally related to high costs.

But ESP upgrade focus can be changed from the costly processes such as ESP re-designing and re-constructing to use the right ESP High Voltage Power Supply (HVPS) solution. KraftPowercon (KP) did several projects to prove how a unique solution of the HVPS combination can boost up ESP performance. Now by adding MicroPulse Technology HVPS PulseKraft® or/& High Frequency Switch mode Technology HVPS "SmartKraft" into the KP solution portfolio, ESP efficiency can be even improved further not only for low/medium resistivity dust application but also for high resistivity such Coal Power plant, steel plant.

The selection of the type and size of ESP HVPS is critical and individual for each and every ESP application.

The following project is one of those studies which shows, there is a possibility to highly improve the ESP efficiency by looking into the HVPS.

Here we present an ESP which is large construction with several fields and passes in Coal Power Plant application with high resistivity ashes as shown in the curve below.

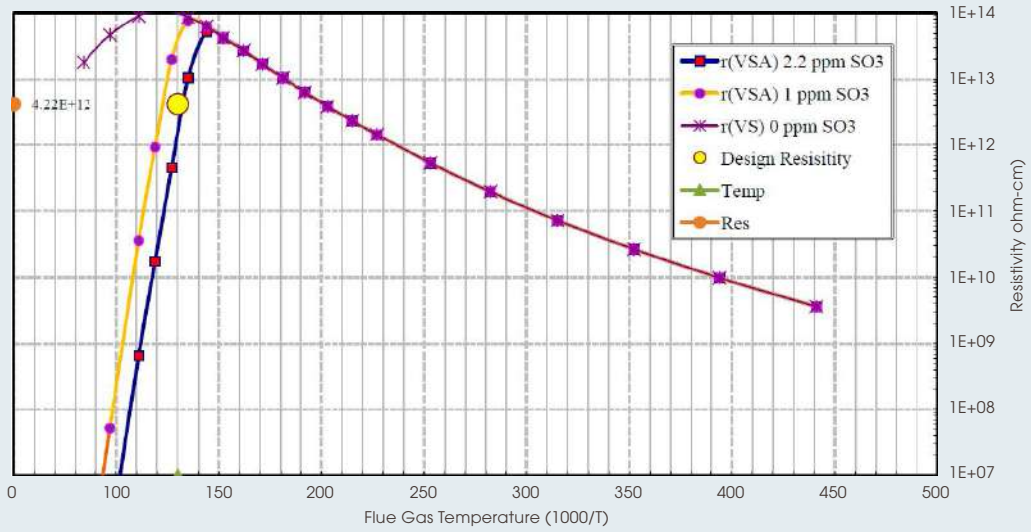

Figure 1: Fly Ash resistivity. (1×10^{13}< actual fly Ash Resistivity <1×10^{14} Ω-cm)

This is one of the most complex and difficult cases to reduce emission level because of Back-Corona presence.

We will show how the KraftPowercon ESP upgrade solution by adding PulseKraft® and SmartKraft (High-Frequency SMPS) on ESP will create a unique combination solution together with existing Single-Phase TR to hit the target emission level and make a low-cost ESP Upgrade.

Case Study of Order executed for 2 X 6 Units ESPs =12 ESPs of 150MW Captive Power Plant (CPP).

Plant information

- Plant Name: Hindalco Industries Ltd - Aditya Alumina Ltd. Orissa at Lapanga. Plants are over 12-14 years old.
- This Case Study is for one of the CPP Unit.
- Plant Type: Pulverized Coal Fired Boiler ESP.
- An Electrostatic Precipitator with 2 Passes/Chambers and 7 fields per Pass/Chambers, 33 gas passages per field, 400 mm gas passage width, Active field length 4.5 m, Active field height 15.0 m.
- Collection area - 62370 m^2 per ESP, 31189 m^2/pass, 4455 m^2/ field.
- Cross sectional area per pass - 198 m^2
- Electrode - Spiral electrode of GE design
- Collecting plate - 735 mm wide plate of GE design
- HVPS solution before the retrofit project: Each field equipped with Single-phase TR Sets 95kV/1600mA
- Emission level while awarding the contract: 100-120 mg/Nm^3
- Emission reduction Target given – less than 45mg/Nm^3 Figure

Figure 2: ESP photo from plant

1) Aspect ratio is the board thickness to the through-hole via diameter

Information on Electrical Upgrade with Advanced Technology HVPS

1st field Single Phase TRs and their Control Cabinets from both the passes/chambers are replaced with SmartKraft's and their inbuilt control cabinet.

Figure 3: SmartKraft Photos

Existing Single-Phase TR Sets are kept from the 2nd, 3rd, 4th and 5th fields as well as their Control cabinets for both passes/ chambers.

2 units PulseKraft® are installed on 6th and 7th fields for both passes/ chambers as well as PulseKraft® Control Cabinet in the Control room replacing Single-Phase TR ones.

Figure 4: PulseKraft® TR and Control Cabinet Photos

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Figure 5: Power supply installation on field 1-6 out of 7 fields. SmartKraft is in field 1 and field 6 is equppied with PulseKraft®

Figure 6: Field 6 and 7 are equppied with PulseKraft®

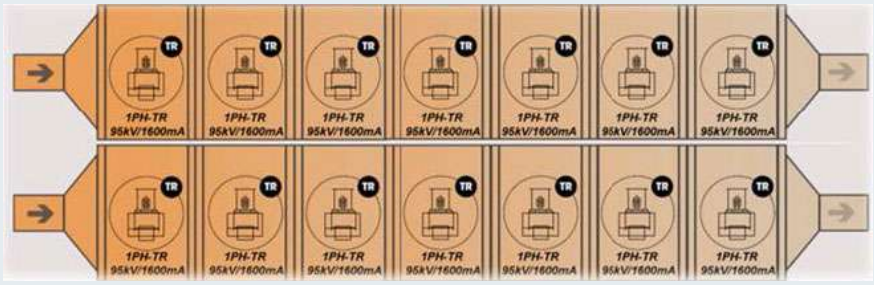
Figure 7: ESP view after PulseKraft® and SmartKraft installation are done.

- Emission level reached to 25-40 mg/Nm^3 which is less than 45 mg/Nm^3. (Measurement of particulate emission was done through iso-kinetic sampling.)
- For Lapanga PG Test values can be furnished.
- Inlet Gas Flow rate per pass - 464940 to 641890 Am^3/hr
- Gas Temperature - 143 to 162 deg C
- Gas Velocity inside ESP - 0.652 m/s to 0.901 m/s
- This value shows by upgrading the existing PS to right sized combination of HVPS solution, more than 65% emission level can be gained. Since the plant requirement was fulfilled no more Emission reduction was not needed to keep the upgrade cost as low as possible. (Impact of Pulses on NOx is not measured)

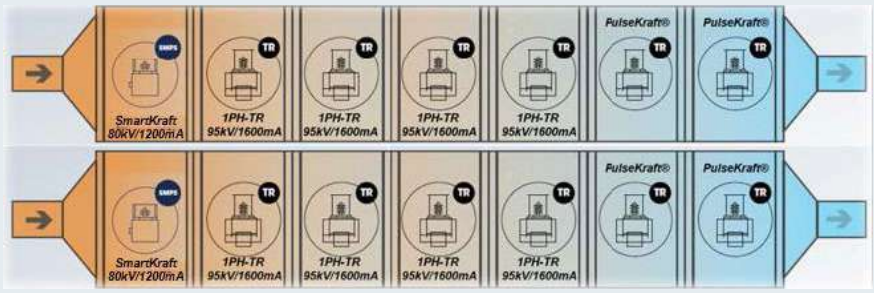
Figure 8: the obvious result of visible smoke at the stacks compared between the ESP which is upgraded by Kraftpowercon ESP solution and the one which is not

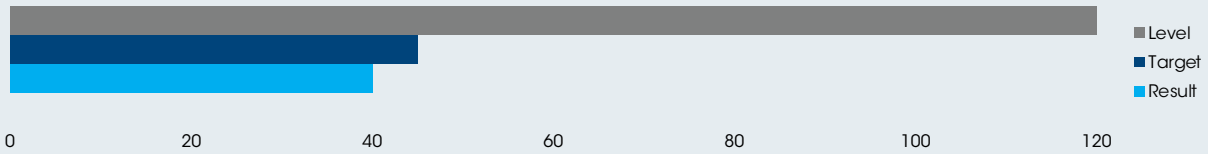
The overall ESP layout and emission before and after KraftPowercon ESP upgrade solution

Before upgrade



After upgrade





Example of PK waveform during the load operation

Figure 10: PK Vesp and I pulse waveform.
Vesp 14kV/1V , Ipulse 100A/1V

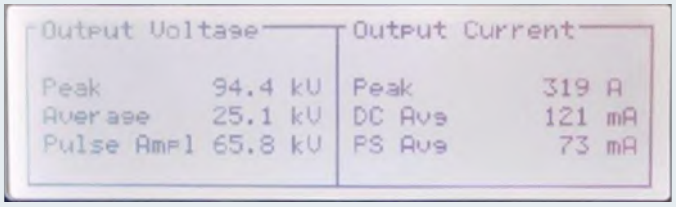


Figure 11: Corresponded controller values
to the figure 10 waveform

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Conclusion and **achievement:**

- In ESP Upgrade project, PulseKraft® + SMPS technology improves ESP emission level significantly.
- There was no need to overengineering to replace all existing single-phase TR. This is the value which is coming from KraftPowercon experience and all done pre-study/ calculation in the preliminary phase of the project.
- This unique combined HVPS solution saves both time and cost.
- By using PulseKraft®, power consumption would be much less in comparison with Single Phase TR which brings ROI.
- There is scope for further reduction of 6 fields are working on existing Single-phase TR Sets. In case we add more PulseKraft® there, it may be possible ESP still gives less than 45mg/Nm^3 even 1or 2 of Single-phase TR Set fields are out of order. However, this needs to be tried.
- Further, for sustainability of performance due to ESP Health (Minor) related issues OR in case the regulations become more stringent i.e. less than 25-40mg/Nm^3, by adding 1 or 2 PulseKraft can sustain / can bring down the emissions level even less.

For more information about our PCB and semiconductor solutions, visit

kraftpowercon.com/industries/electrostatic-precipitators

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