AKXA TECH PVT. LTD.

Digital Transformation and AI *for* Process Optimization

20th June 2024

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About AKXA

COMPANY
Research Driven, Result Oriented, Technocrat Promoted, Founded in 2016, part of 11+ MUSD Group.
(25+ person years of R&D on process performance enhancement techniques & tools)

TEAM
Qualified, Widely Experienced Multi-disciplinary Team of PhDs and Engineers
(100+ person years combined experience in local & overseas companies, optimization projects)

OFFERING
High end Data Analytics, Decision Support, Performance Enhancement Products & Services
(Data driven, AI Algorithm based, Process Monitoring / Diagnosis / Optimization, IoT Tools)

CLIENTS
Tested, Proven and Well Appreciated by Continuous Process Industries
(40+ domestic & international clients, 10 different sectors, 12+ Countries)

Recognized as Innovative Product

Approved by GoI (DIPP 2649)

Collaboration with IIT Madras

Promoted by (35+ yrs of Engg. Service)

Our Core Competency & Skillsets

PROCESS DATA ANALYTICS	MULTI-DOMAIN EXPERTISE	DEVELOPMENT CAPABILITY	MULTI-SKILLED TEAM
❖ multi-space	❖ Process	❖ Algorithms	❖ Process diagnosis
❖ multi-time scale	❖ Operations	❖ Smart Controller	❖ Data Science
❖ multi-physics	❖ Utilities	❖ IoT tools	❖ Modelling
❖ multi-format	❖ Automation	❖ Customized Apps	❖ Simulation
❖ multi-layer	❖ Optimisation	❖ Hardware Products	❖ Project Management

❖ ***Design, develop and build new algorithms, IoT based Products (software applications + hardware) to solve Industry challenges for various sectors***

Industries/Process Plants – Coverage across Sectors

Digital Transformation Services and Automated Decision Support AI / IoT based Products for

Productivity Optimisation, Energy Efficiency Enhancement and Quality Consistency

CHEMICAL, FERTILIZER & PESTICIDE, PHARMA

CEMENT, MINERAL & METAL PROCESSING

PULP PROCESSING & PAPER / BOARDS

GLASS & CERAMICS

POWER PLANTS CAPTIVE / CO-GEN

ANY CONTINUOUS / BATCH PROCESS PLANT

Process Optimization Projects – A Snapshot …

10+
Analytics & IoT products

600+
Assets Investigated

~10%
Energy Savings Achieved

12+
Countries

LUPIN
DCM SHRIRAM
Growing with trust
TITAN CEMENT GROUP
Binani 3B the fibreglass company
BRAJ BINANI GROUP
Coromandel
FUTURE POSITIVE
INSEE
ADITYA BIRLA CHEMICALS Thailand
SAINT-GOBAIN
ITC Limited
FUJAIRAH CEMEN INDUSTRIES
AIS
Asahi India Glass Ltd.
DANGOTE
BOROSIL renewables
VICAT
JSW Steel
vedanta
transforming elements
INTERNATIONAL PAPER
JINDAL STEEL & POWER
ACC
UltraTech CEMENT
IKN
ENGINEERING THE FUTURE
ADITYA BIRLA HINDALCO
LafargeHolcim

Digital Transformation Journey – How AKXA can partner

1) Digitization of paper-based (manual tracking) activities

- *Ex : Log Books, Maintenance check list, Lab reports, Customer Complaints, Contract Workforce Management, etc*

2) Smart Data Acquisition systems for Legacy, Old plants with low digital foot-prints

- *Ex : read data from PLCs, SCADA screens, HMIs, Trend Image based data capturing*

3) AI / ML based analytics for Process monitoring and diagnosis

- *Ex: process fluctuation assessment, controller performance assessment, alarm event management*

4) Algorithm based equipment health monitoring

- *Ex: digital audits, abnormality checks, signal processing for failure prediction, valve stiction detection*

5) Image processing based online monitoring, fault detection

- *Ex: hot/cold rolled steel surface defects, auto analysis of billet samples, in process samples.*

6) AR/VR for improved process efficiency, safety and environmental assessment

- *Ex: cc tv camera based PPE detection, furnace refractory health check, stack monitoring etc*

Products and Service Offerings

Harnessing Data >> Extracting Knowledge >> Creating Value

PRODUCTS AND SERVICES

- Process Monitoring
- Process Control
- Process Optimisation

MONITORING

- Process Variability
- Controller Performance
- Equipment Health
- Sensor Analysis

CONTROLLING

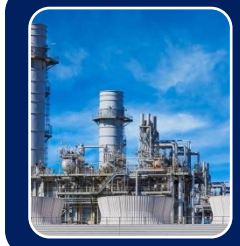
- PID Tuning
- Feed Forward Logic
- Smart Combustion Control
- Supervisory control

OPTIMIZING

- Productivity
- Energy Efficiency
- Equipment Reliability
- Quality Consistency

SUSTAINABLE SOLUTIONS

- Productivity improvement
- Quality consistency
- Equipment reliability



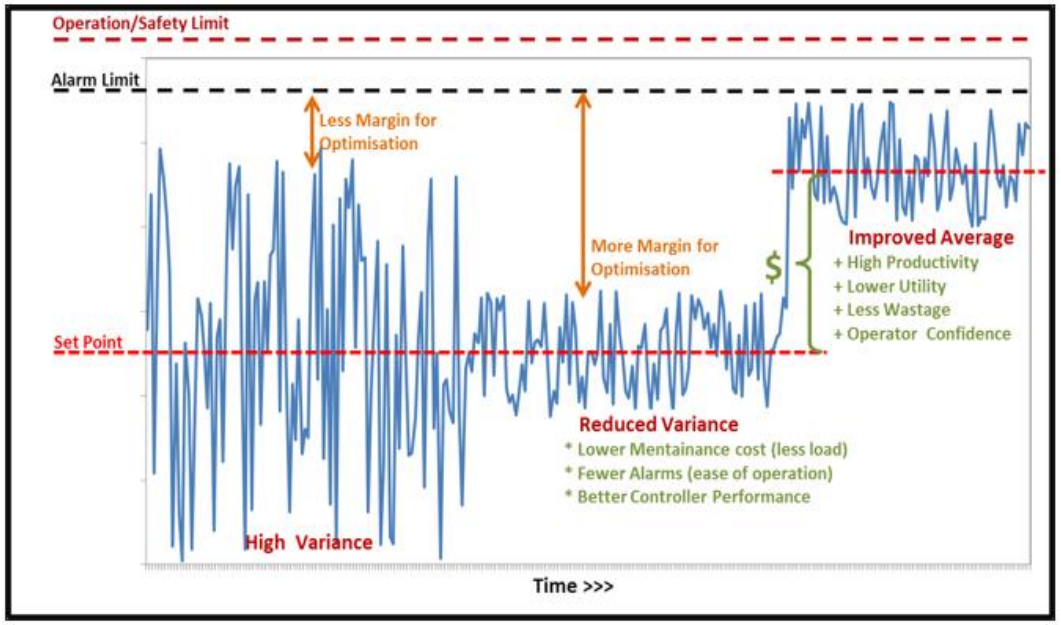
INDUSTRY FOCUS

- Continuous process plants
- Process utility equipment
- Data analytics + IoT solutions

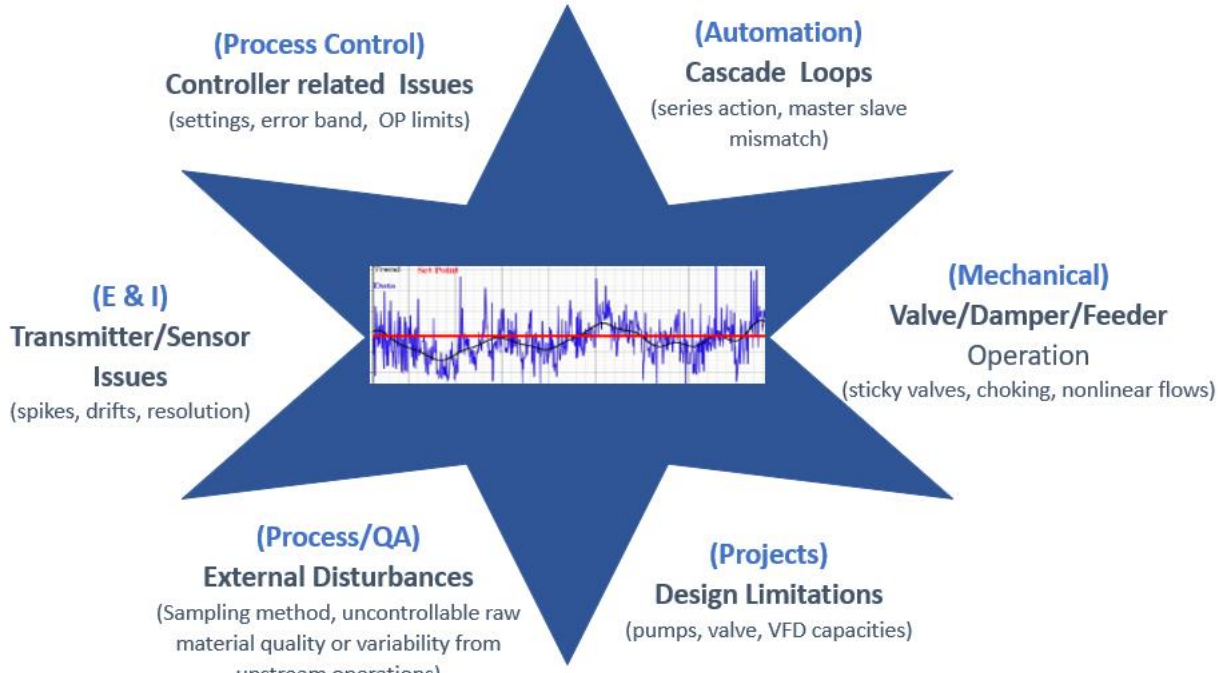
Key Focus Areas – On Process Fluctuations

REDUCE fluctuations >> CREATE margins >> OPTIMIZE processes

High Variance → **Inconsistent KPI** → **Less confidence**

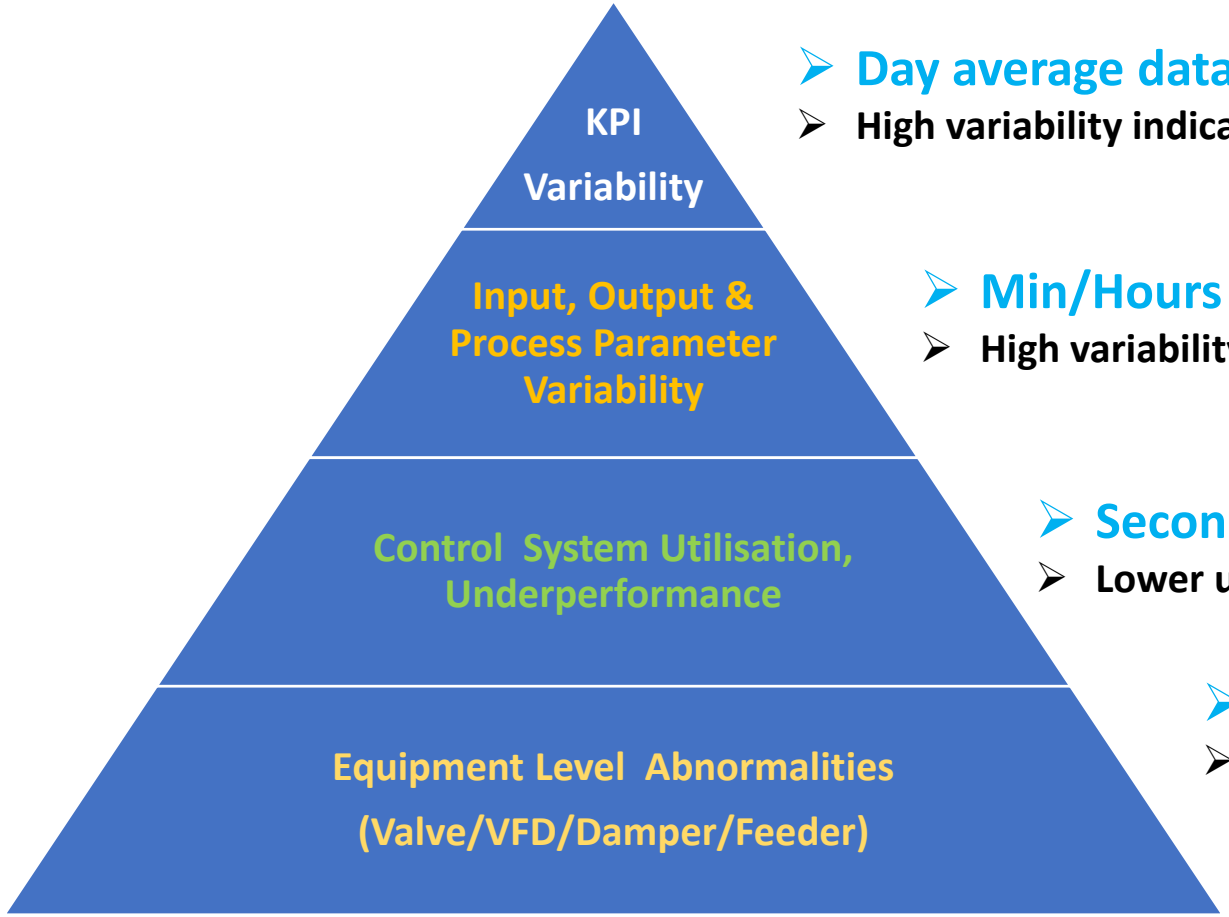


Process Plant Fluctuations – Sources we analyze



Solution Approach

:: FLUCTUATION AUDIT / ASSESSMENT APPROACH ::



- **Day average data** for Key Performance Indicators
- High variability indicates gaps/scope for improvement

- **Min/Hours scale data** for major I/O & process parameters
- High variability gives confidence for further checks

- **Seconds scale data** for PV/SP/OP variables
- Lower utilisation, underperformance establishes reasons

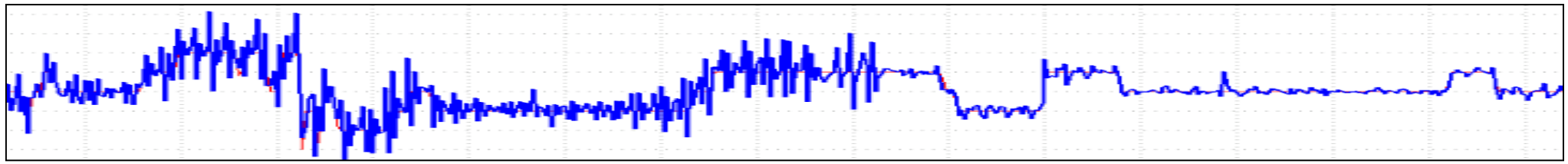
- **Seconds scale data** for Valves/VFD/Dampers
- Control Equipment Limitations, non-linearity and abnormal responses are detected

ALL CONTINUOUS PROCESS | OEM AGNOSTIC | DIFFERENT TIME and SPACE SCALES | STANDARDISED APPROACH | MULTIVARIATE ANALYSIS

Key AI based Product Details

1) OPTIMakx®+deltAKX® Algorithm Based Process Monitoring & Optimization Tool

(For REAL TIME MONITORING for PROCESS FLUCTUATIONS)



WHEN — **Assess**

WHY — **Diagnose**

WHERE — **Prioritise**

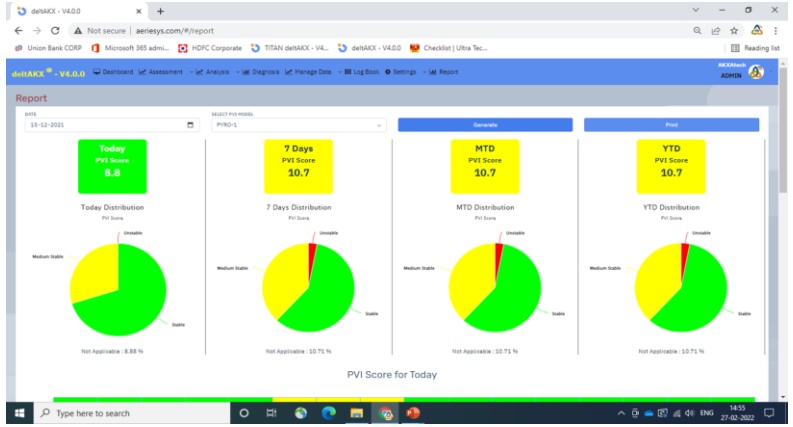
HOW — **Optimise**

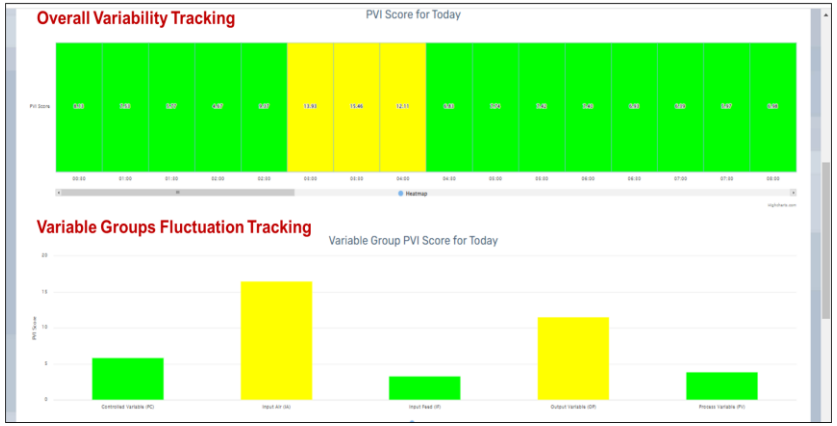
- ✓ Suite of AI/ML and very complex Statistical, Signal processing Algorithms. (*IP developed by AKXA at IITs*)
- ✓ Open Source IT platform, Web Based Application for IoT and Industry 4.0 needs.
- ✓ Automatic data acquisition, assessment , diagnosis and decision support for continuous improvement.
- ✓ Multi-plant, Multi-process, Multi-user configuration for remote monitoring / benchmarking.

- ➢ ***100+*** *installations in India and* ***30+*** *installations in Europe and US in the past couple of years*
- ➢ ***20+*** *different scientific/statistical measures for performance benchmarking*
- ➢ ***15+*** *different root causes diagnosed for abnormal operation/high fluctuations*
- ➢ ***500+*** *variables simultaneously tagged, tracked, issues diagnosed, compared*

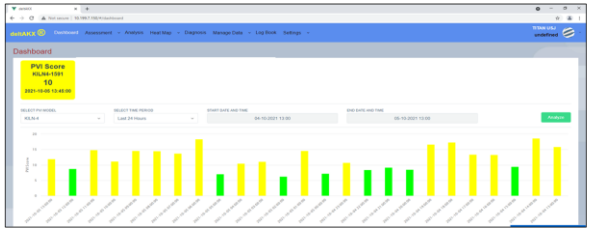
CORPORATE Features: Workflow Annotation, Auto Reporting, Escalation, Super Admin features

OPTIMakx ® + deltAKX ® Algorithm Based Process Monitoring & Optimization Tool

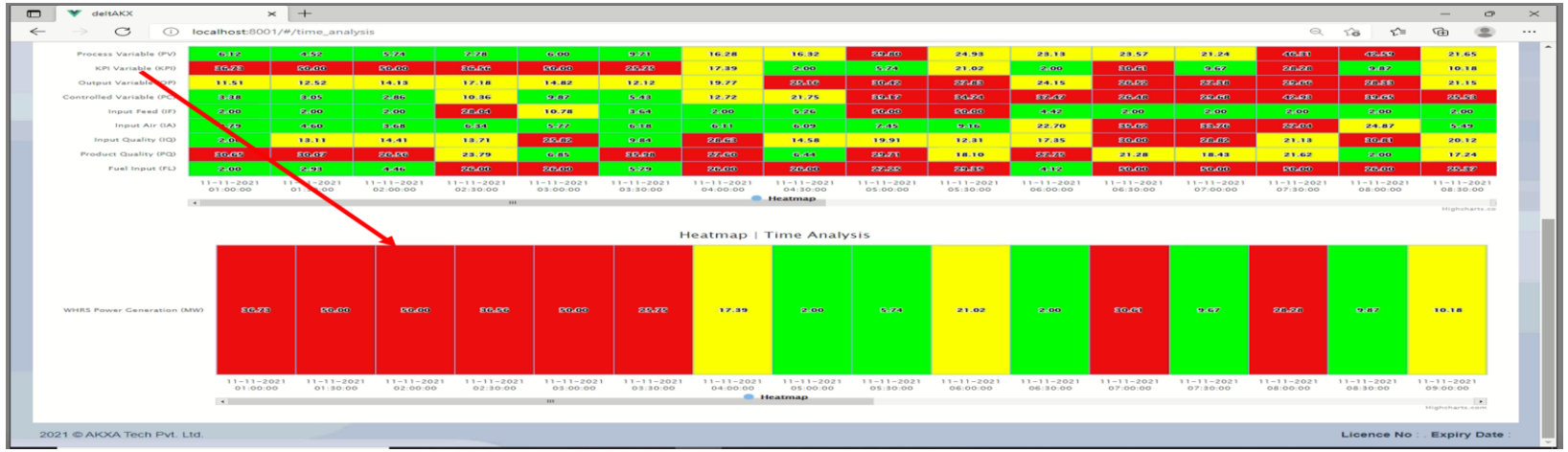




DASH BOARD | ASSESSMENT | ANALYSIS | HEATMAP | DIAGNOSIS | LOG BOOK | SETTINGS



REVIEW | CALIBRATE | KPI



IMPACT OF OPTIMakx ® + deltAKX ® INTERVENTION (no CAPEX required)

SECTOR/AREA	CASE ESTABLISHED	IMPACT
Gas Mixing Station	Auto Utilisation increased to 100% and COG, BFG and MG Pressure variation reduced by more than 30%	**1% reduction in Flaring Gas 74,000 MJ/day ,~ USD 53,000/Yr**
POWER Plants /BOILER	1% Reduction in Heat Rate ~ Fuel consumed/Unit Power	***Fuel Saving Co-Gen Plant lower CO2 emission***
Oxygen/Nitrogen Plants	4% increase in Purity + Lower Utility consumption	***USD 2,00,000 /Yr Savings : for 20 TPD gas plant***
Compressors /VFD	15% lower Electricity + Lower Pressure Variation	***~ USD 20,000 /Yr for Typical 1000 CFM compressor***
Process Plant CONTROLS	25% Reduction in Process Variability and Response Time	***5 to 10% Energy Saving @ Pay Back Period < ONE YEAR***

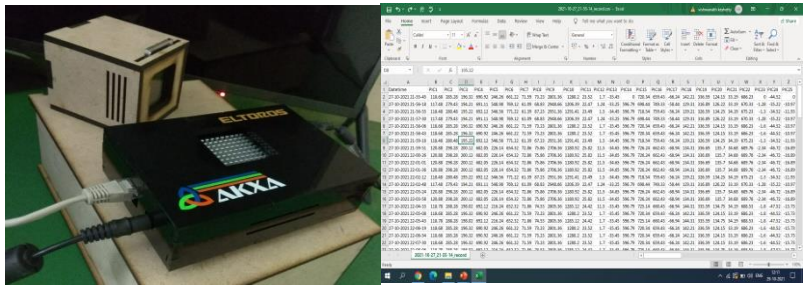
Product Offerings - AI / IoT Based

- Unique digitization and IoT products

2) digitEYES® (*patented product*) :

Unique data extraction (AI based digitization tool)

Acquire data, digitize, record, transmit without touching / connecting to LEGACY servers



3) AKXis:

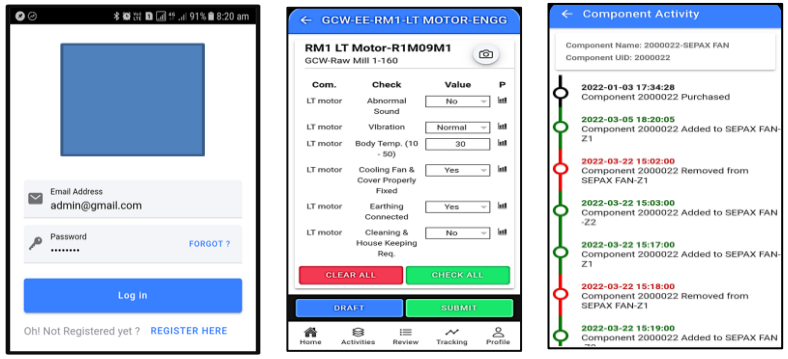
Thermal Expansion sensor

Used for Hot Tanks, Condensate Tanks, Boiler, Furnace, Hot Towers, Vessels

4) digiCHECK / digiLOG :

App based, potable IoT device for routine checklist, log sheets, audit reports, etc

Web based and Local TAB/MOBILE APP based tool for digitizing routine checklist operation with bar code scanning, component tracking and equipment monitoring facilities..
Can be integrated with ERP / SAP



5) LIMS (Lab Information Management System)

App based, management of lab related data which involves standardization, digitization and escalation

Digitizing the local QA data to a standard global digital Template
A local software tool is used through LAN / WAN
Historical QA data is available for plant team to download and use.

Significant contributions for CHEMICAL PLANTS

Process Area

- Reactors
- Distillation Columns
- Evaporation Columns
- Adsorption columns / Absorption columns
- Ion Exchangers
- Size Reduction / Size Separation
- Dryers
- Filtration

Utility / Service Area

- Boilers
- O_2/N_2 plants
- Compressor Room
- Chillers
- WTP_ pH controlling
- Fuel and Energy Savings

Final Control Element's Issues

- Valve Stiction Issue
- Valve Jamming Issues
- Tunning with respect to the type of valves / Size of Valves

Prediction Model Building

- Quality Parameter's Prediction Models
- Soft Sensors
- Breakdown predictions

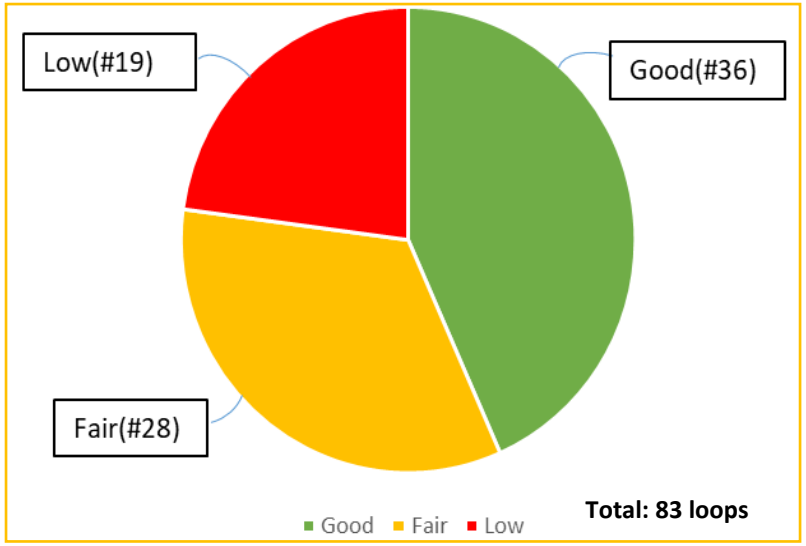
Significant contributions for PHARMA PLANTS

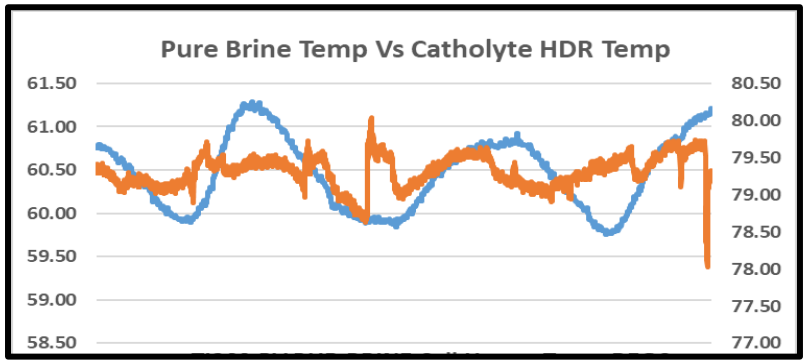
Process Area	Utility / Service Area	Raw Water Treatment Plant	Purified Water Treatment Plant
• Coating Machines • Sanitizers • Dryers • Blister Packing	• Boiler • Air Handling Units • O_2/N_2 plants • Compressor Room	• pH Controller • Chlorine ppm Controller	• pH Controller • Chlorine ppm Controller • Ozone ppm Controller

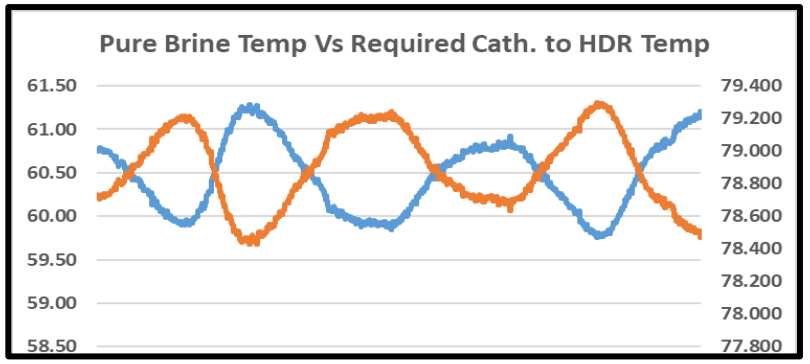
Few of our Case Studies

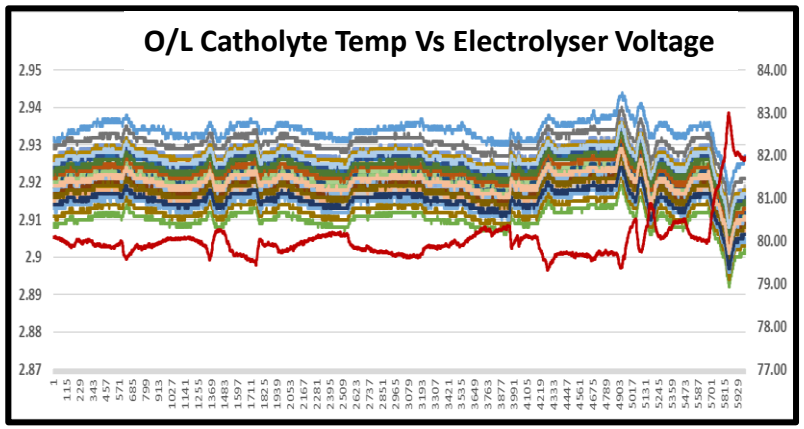
Chemicals and Pharma Sector

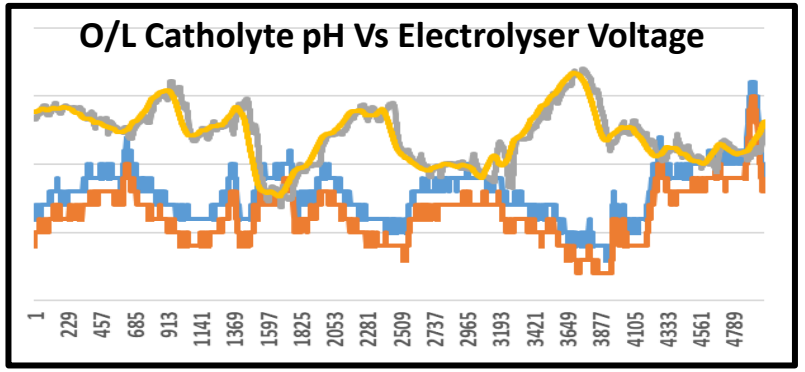
1) Chlor Alkali – Audit Findings Summary

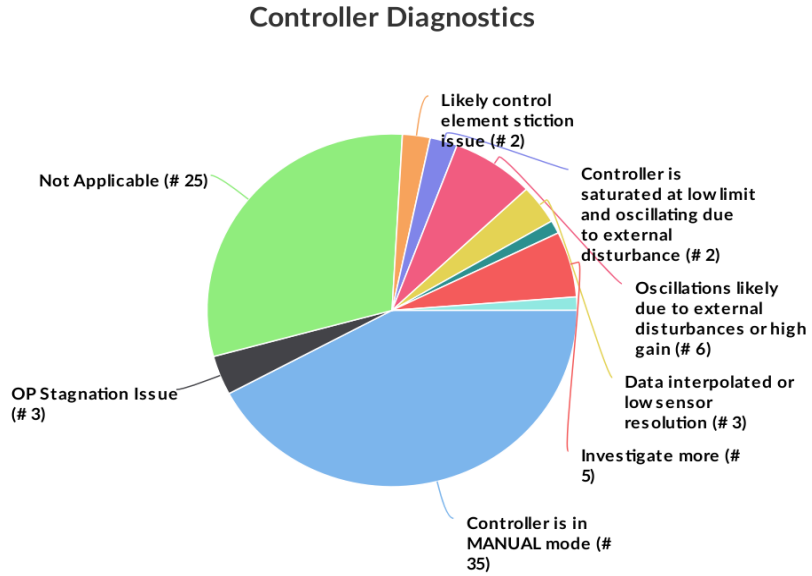








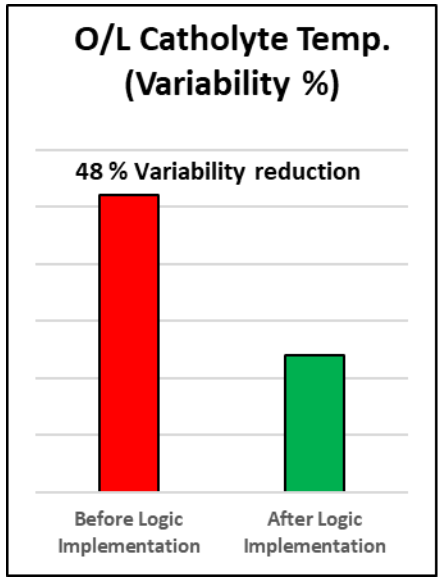


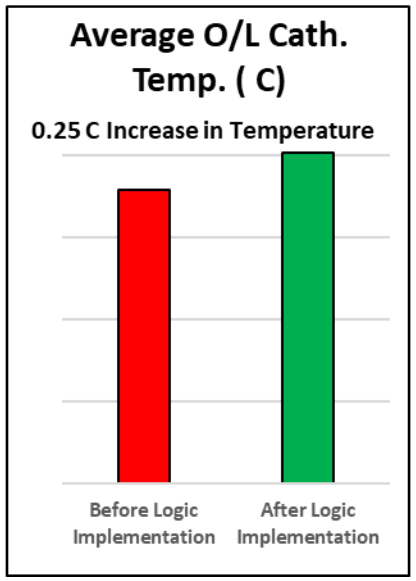


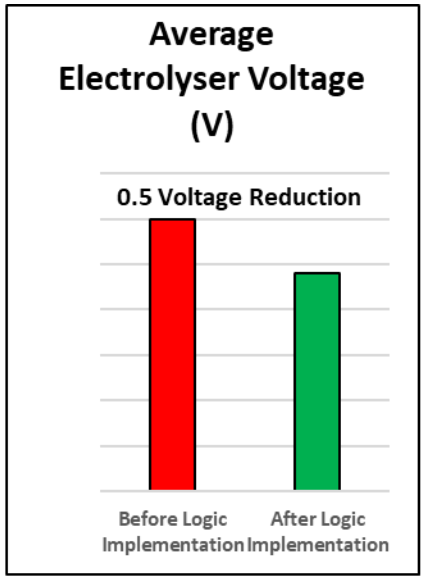
Audit Findings

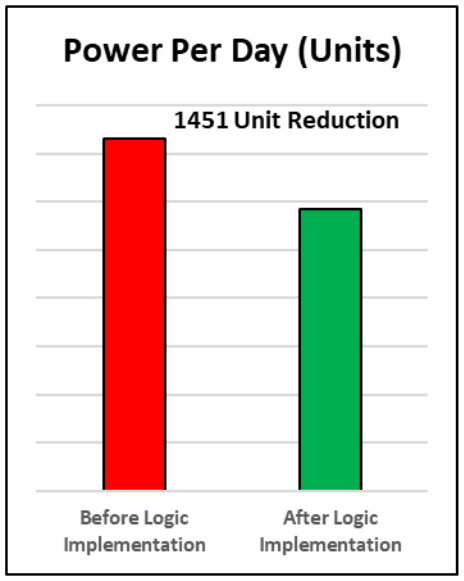
- Around 60% of Loops are Found Low & Fair Performing.
- Around 40% of Loops are Found Good Performing
- Catholyte O/L Temperature has shown a high correlation with Electrolyser Voltage, Catholyte O/L pH, Catholyte I/L Temperature & Brine Temperature.

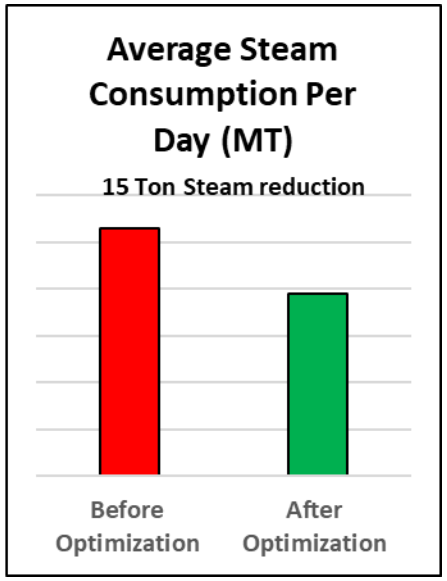
Chlor Alkali - Overall KPI Impact

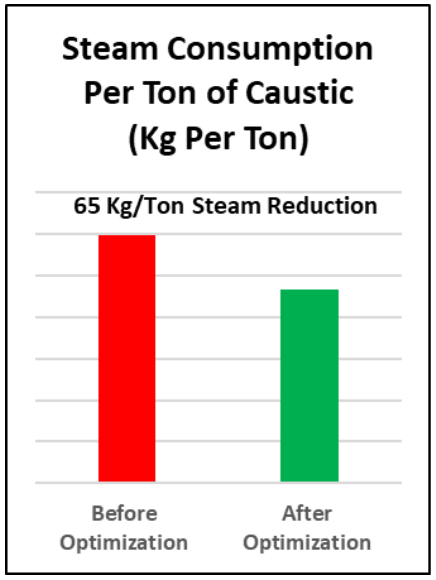


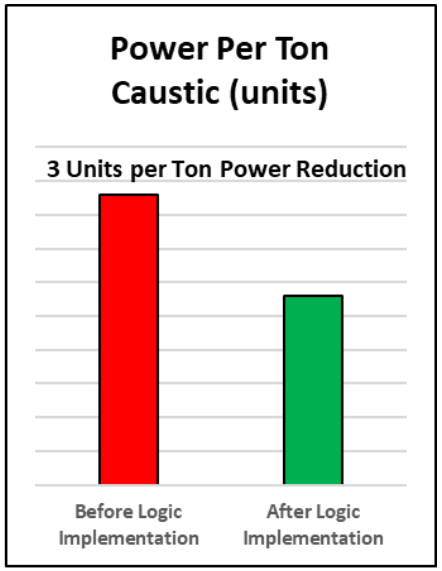












Net Power Savings –
1451 Units Per Day

Net Steam Savings –
~15 Tons Per Day

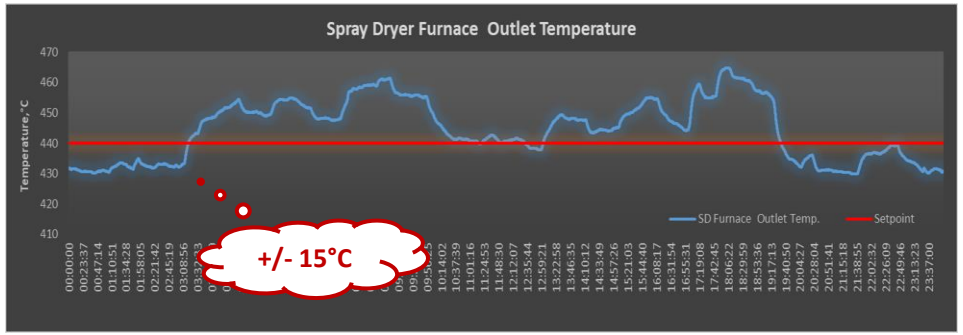
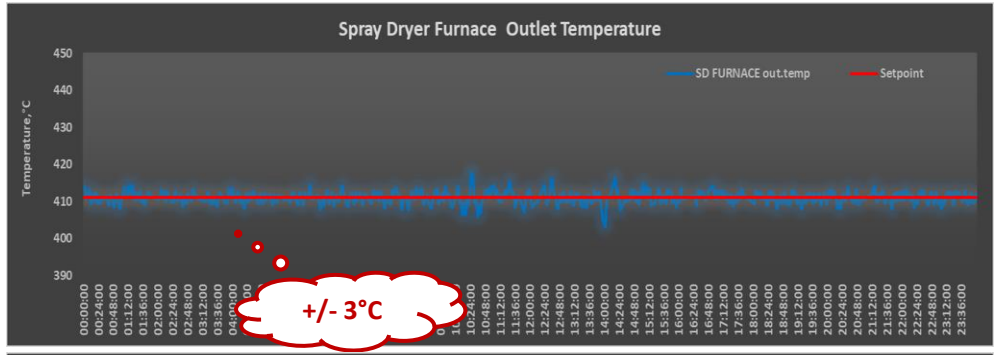
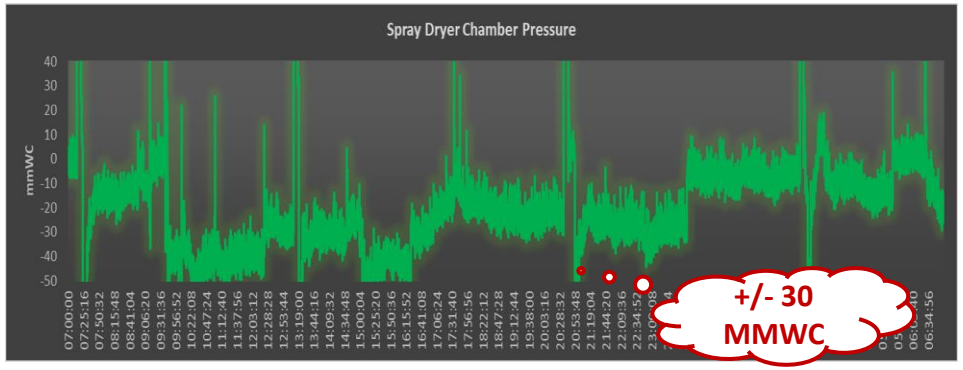
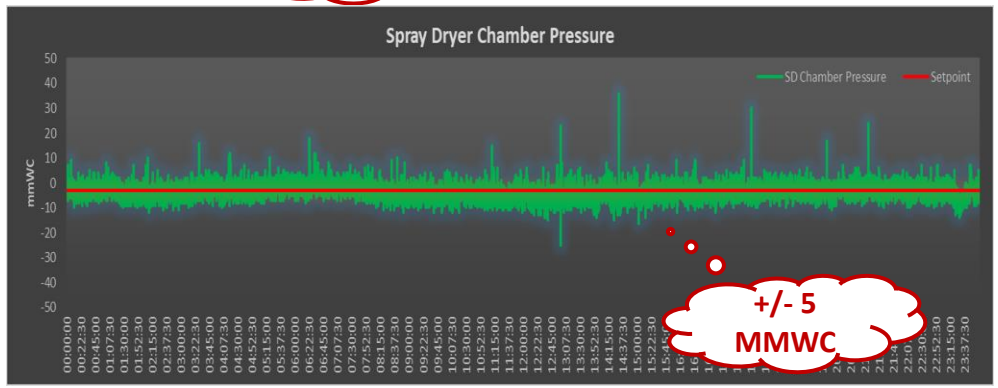
2) Phosphate plant

Dryer Section :

Major Challenges Observed : The Dryer Section Process Fluctuation Assessment AUDIT unveiled the following challenges:

1. **Manual Control of Spray Dryer Critical Furnace Outlet Temperature:**
2. **Continuous Fluctuations in Critical Spray Dryer Chamber Pressure:**

Dryer Section New Logic Implementation and control system optimization :

	Before	After
SD Furnace Outlet Temperature		
SD Chamber Pressure		

Overall Benefits Post OTO activity :

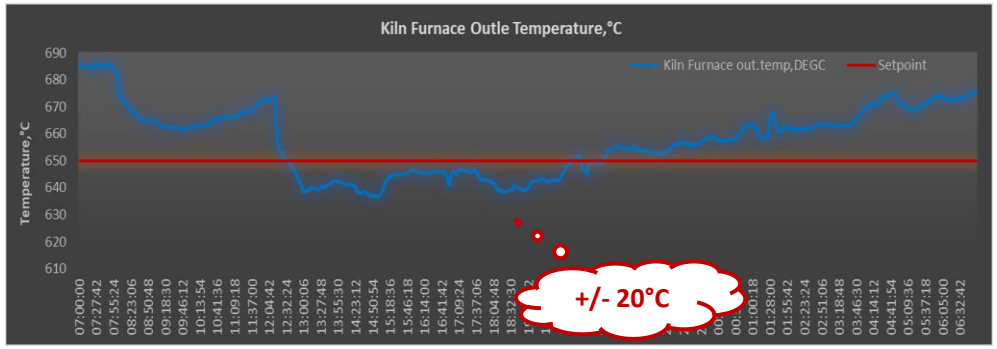
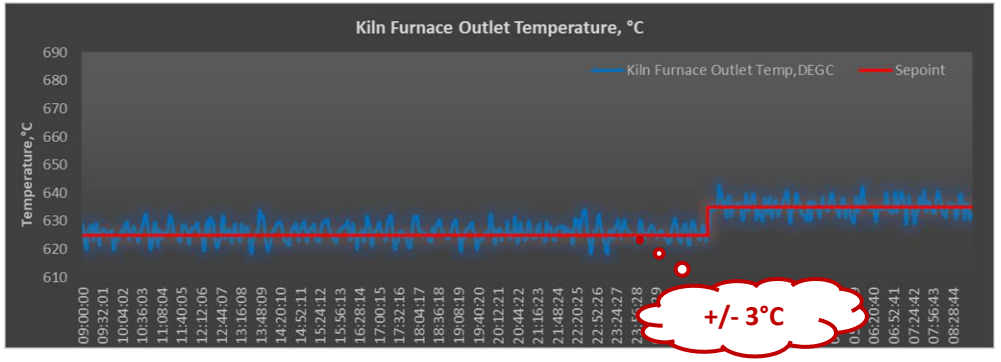
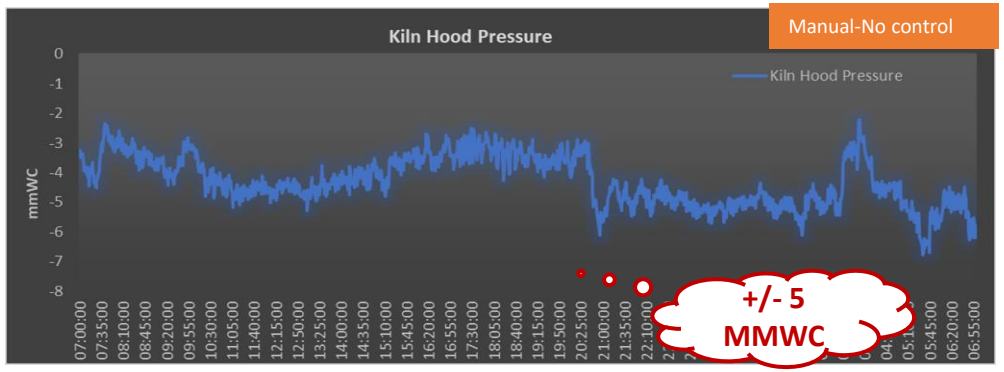
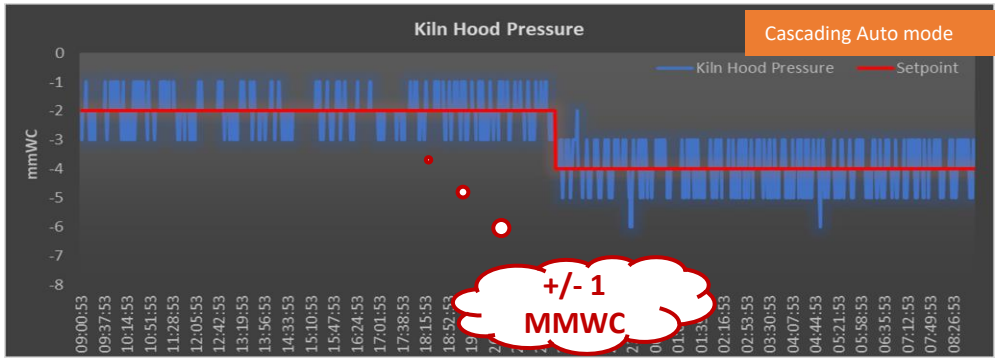
- ✓ Spray Dryer Section Critical Process Variables variation reduced by more than 50%
- ✓ Spray Dryer Furnace Temperature variation reduced by up to 63%, contributing up to 5 % reduced in LPG fuel consumption.
- ✓ Utilizing real-time control adjustments have enhanced process stability and reduced Chamber Pressure Deviation by more than 70%.

Calcination Section :

Major Challenges Observed : The Kiln Section Process Fluctuation Assessment AUDIT unveiled the following challenges:

1. **Manual Control of Kiln Critical Furnace Outlet Temperature :**
2. **Continuous Fluctuations in Critical Kiln Hood Pressure :**

Kiln Section New Logic Implementation and control system optimization :

	Before	After
Kiln Furnace Outlet Temperature		
Kiln Hood Pressure		

Overall Benefits Post OTO activity :

- ✓ Calcination Section Critical Process Variables variation reduced by more than 60%
- ✓ Kiln Furnace Temperature variation reduced by up to 73%, contributing up to 6 % reduced in LPG fuel consumption.
- ✓ Kiln Hood Pressure Variation reduced by more than 60%.

3) Sulphite plant:

Challenges Observed in Sulphite Plant: Sulphite Full Plant Process Fluctuation Assessment AUDIT unveiled the following challenges:

1. **Control Loop Auto Utilization:** Only 55% of control loops were utilized in Auto Mode, with 50% operated manually.
2. **SO2 Absorber Issues:** Abnormal oscillations in SO2 Absorber 1 and 2 levels beyond the benchmark and pH controllers for SO2 Absorber 3 and scrubber had undesired variations and operated in Manual Mode.
3. **Critical Scrubber Density:** Sudden variations impacting the process, operating in Manual Mode.
4. **Crystallizer Issues:** Huge and sudden variations in Crystallizer level due to controller valve saturation. And Crystallizer Heater inlet Temperature variations, operating in Manual Mode.
5. **Rotary Dryer Outlet Temperature:** Variation observed, and cascading loop operated manually.

Onsite One Time Optimization (OTO) Implementation:

- ✓ Changes in the Existing DCS (Distributed Control System) based on detailed Audit Report suggestions.
- ✓ Implementation of new cascading controller logics at the Rotary Dryer section.
- ✓ Manual to Auto conversion and optimization of critical control loops.
- ✓ Reduction of Crystallizer level variation through the development and implementation of new cascading control loops.

Overall Benefits Post-OTO:

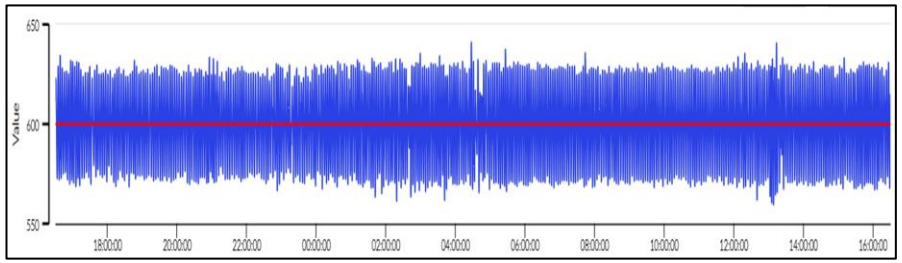
- ✓ Overall Plant Auto Utilization increased to 100%.
- ✓ 63% reduction in Rotary Dryer outlet Temperature variation, leading to a 5% reduction in LPG fuel consumption.
- ✓ Critical control loops (Absorber pH, level, Scrubber Density) operating in Auto Mode with minimal variations.
- ✓ Crystallizer Level and Inlet Heater Temperature operating in Auto Mode with minimum Variations.
- ✓ Observed continuous Product purity above 98% consistently post optimization.

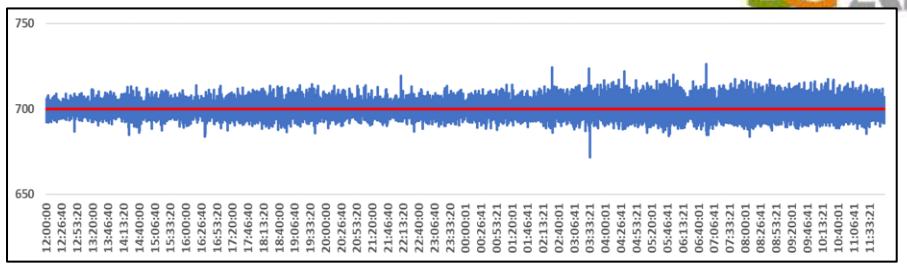
Critical Control loops :

Before

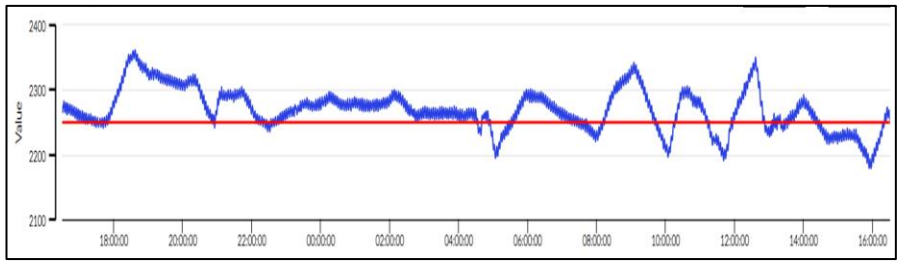
After

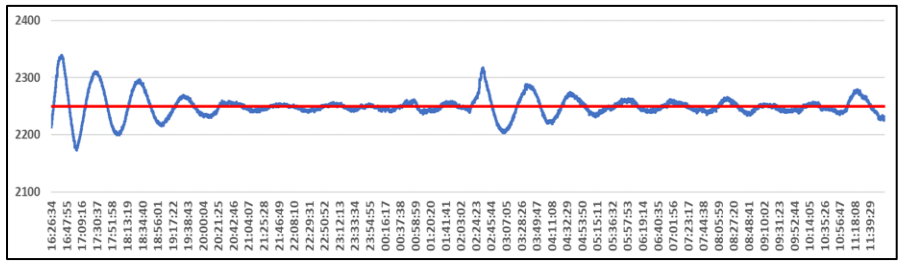
Crystallizer centrate tank level



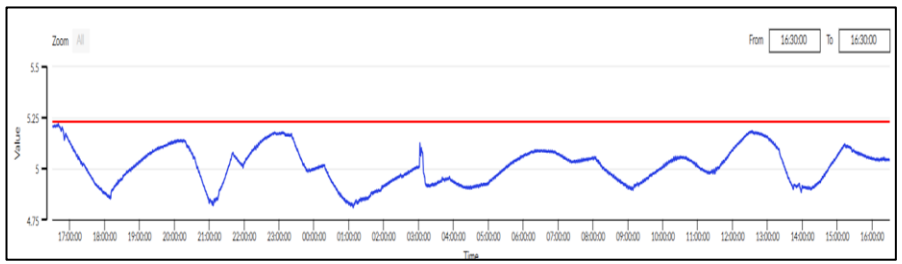


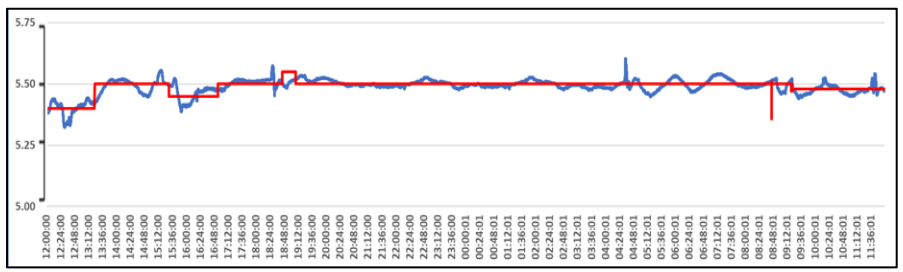
Crystallizer level control



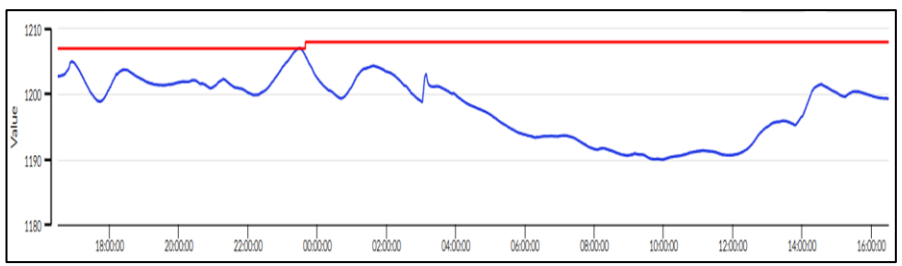


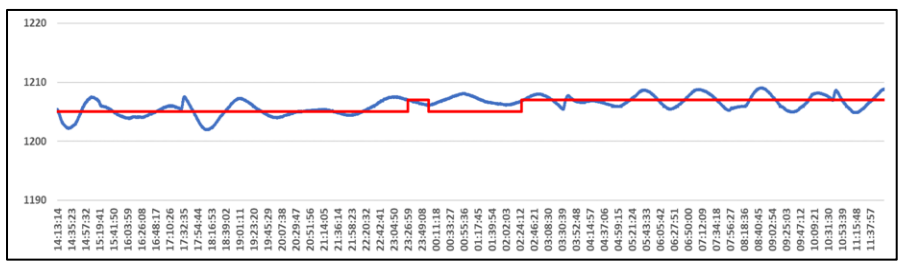
S02 Absorber No-3 PH control



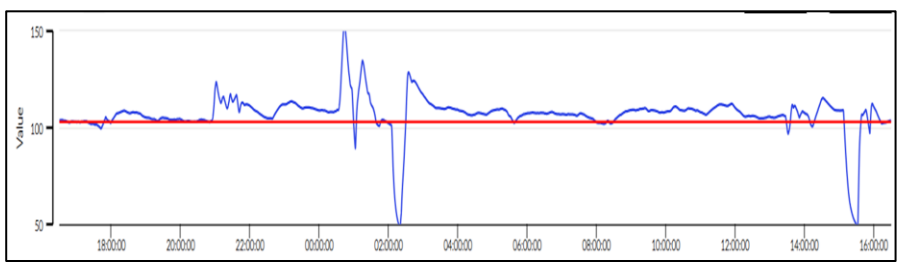


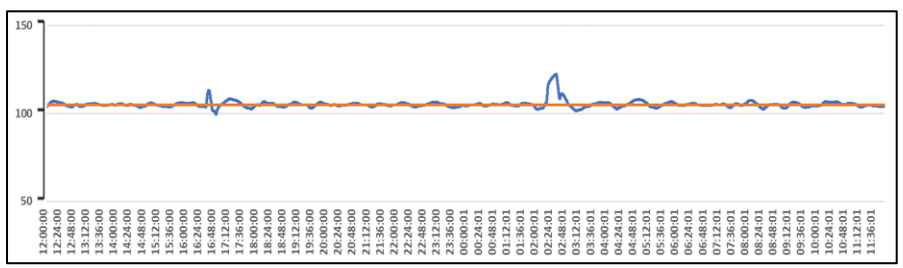
Scrubber Density





Rotary dryer discharge temperature control

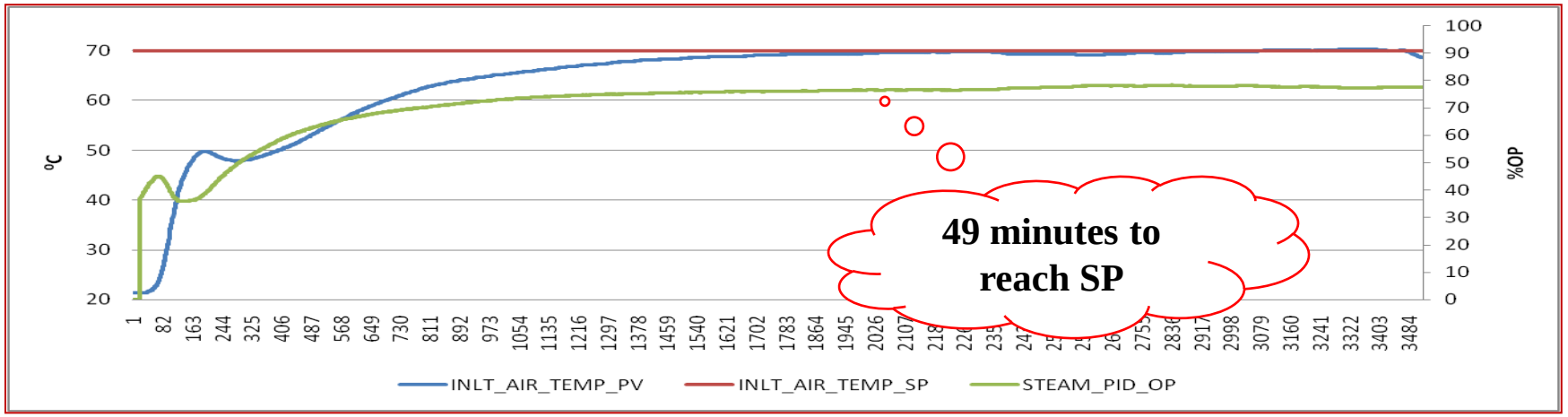




4) Coating Machine – Temperature Regulation

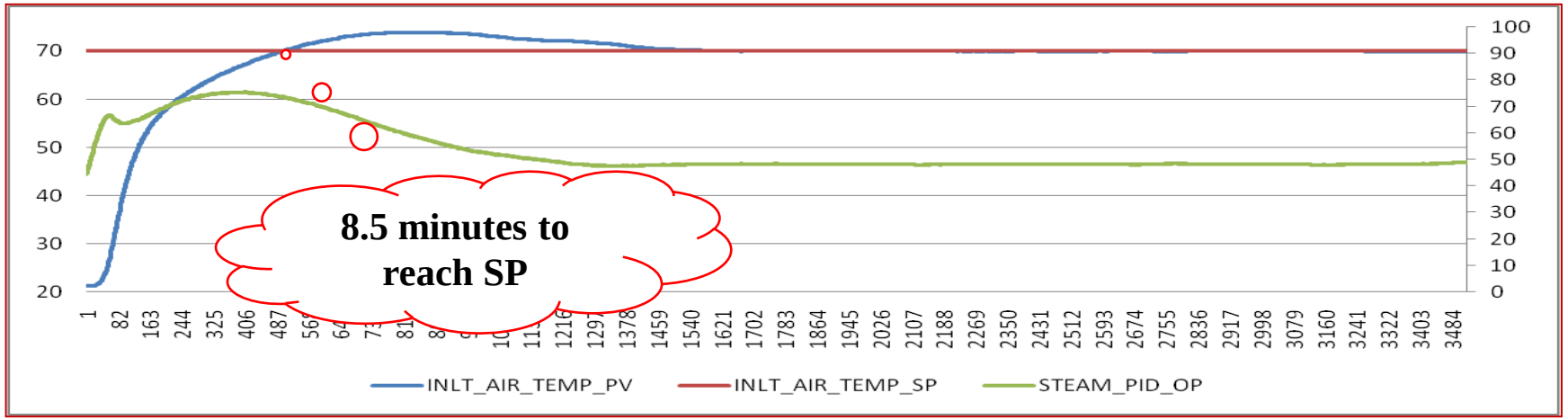
* Pharmaceutical Plant * *(Local Panel Display :: AKXA-digitEYES : video to data)*

>> Optimized Heat Up Cycles on Demand Side (Process Side)..



Before

Abs. Control Error%	5.03
StartUp Time (min)	49



After

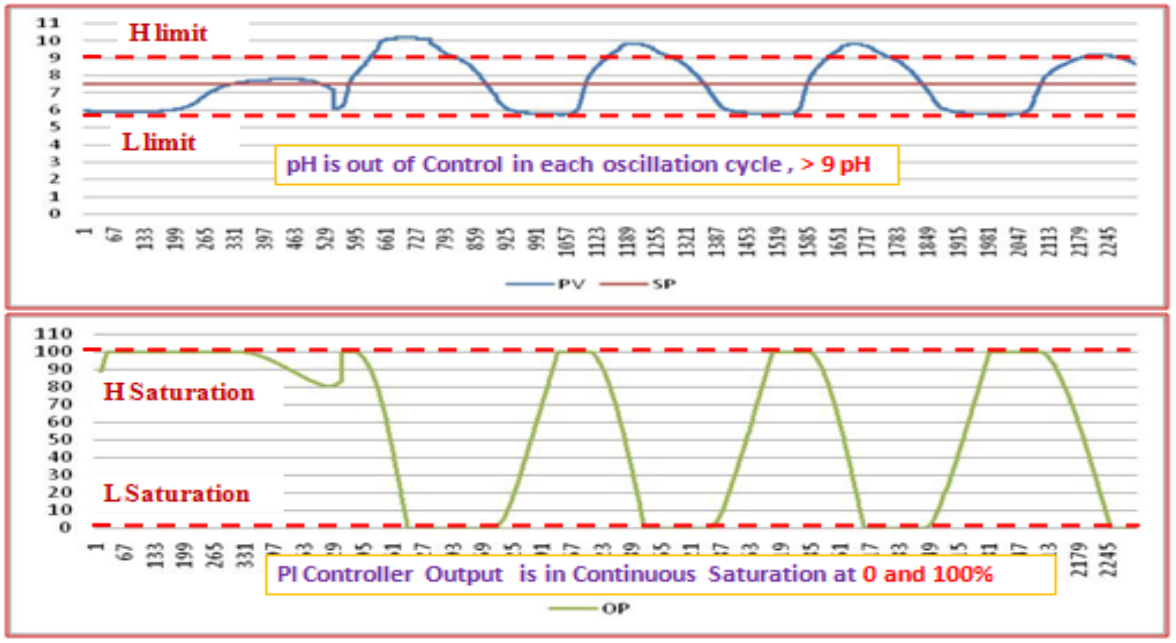
Abs. Control Error%	1.5
StartUp Time (min)	9

34% Lower Steam Requirement during START UP (~6.8 Tons Steam/Day Saving)

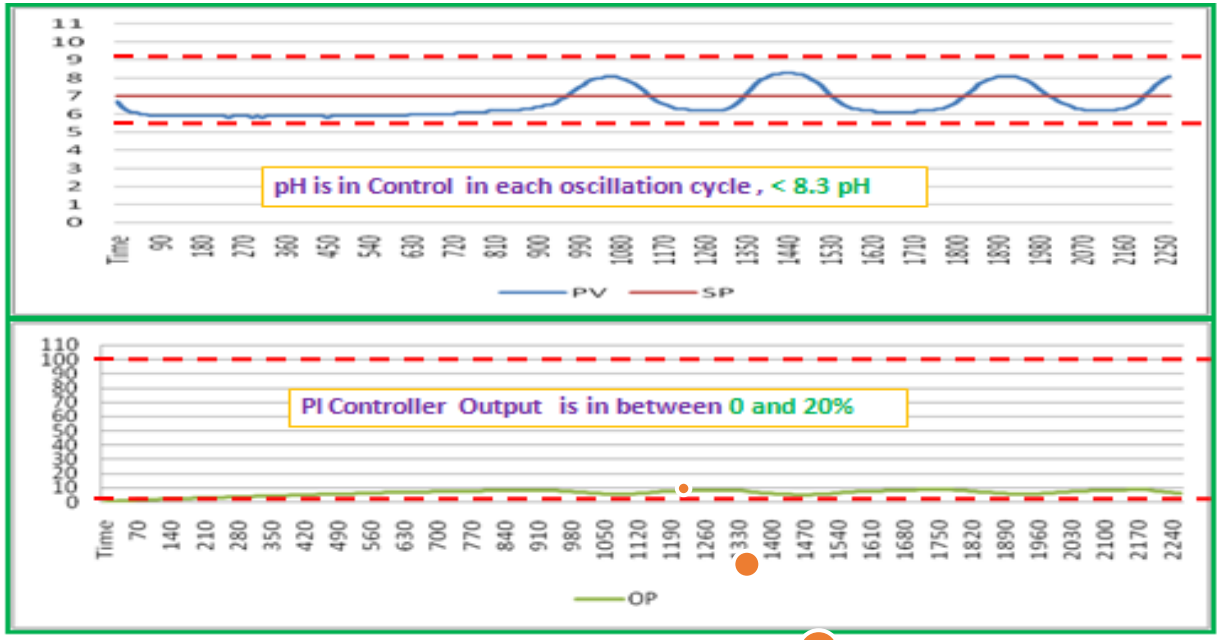
24

5) WTP : pH Control – Before/After Optimization

BEFORE



AFTER



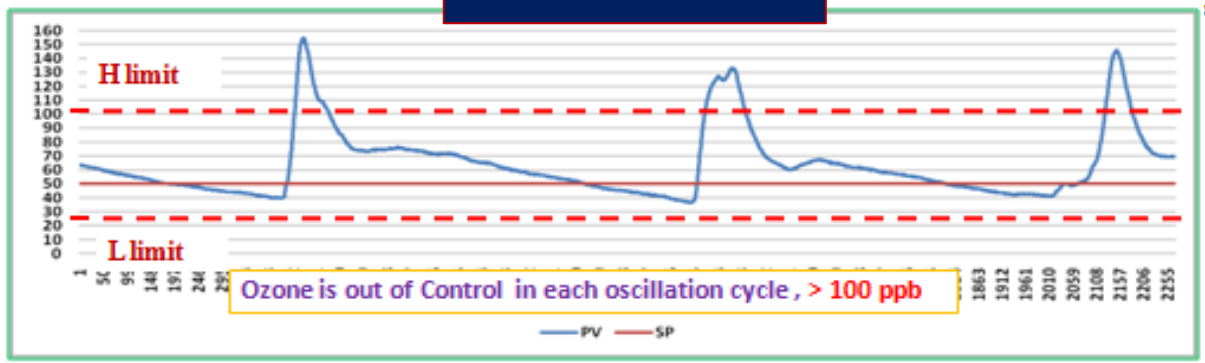
pH Set point 7		BEFORE	AFTER	
		Base Case	Stage 1 Improvement	Stage 2 Improvement
pH	Minimum	5.7	5.8	5.8*
	Maximum	10.2	8.4	8.3
	Average	7.6	7.3	6.9
Controller Performance Indicator	Diagnosis	External disturbance	Not Applicable	Not Applicable
	Avg.Abs.% Control Error	17.8	10.5	10.2
	Total OP Saturation %	48	0	0
	pH Overshoot %	36	12	19
	Out of Control % (6 to 9 pH)	70	23	0
	pH Standard Deviation	1.5	0.8	0.8

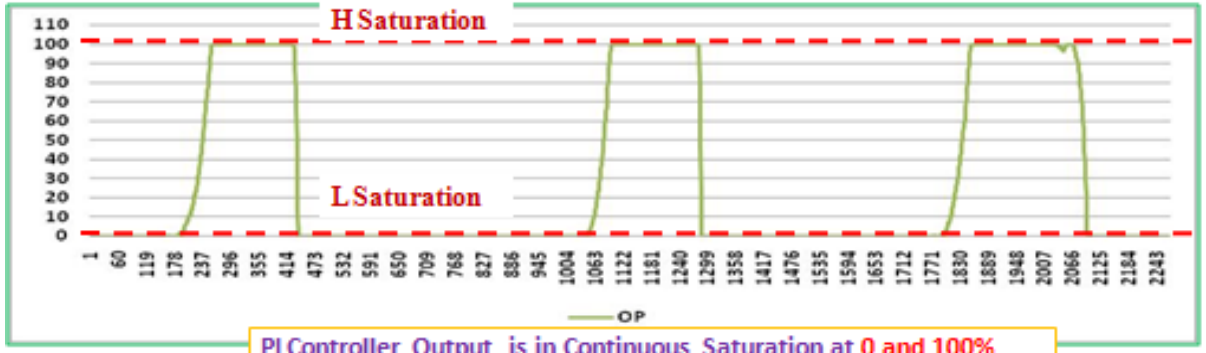
Chemical dosing reduced more than 50%

25

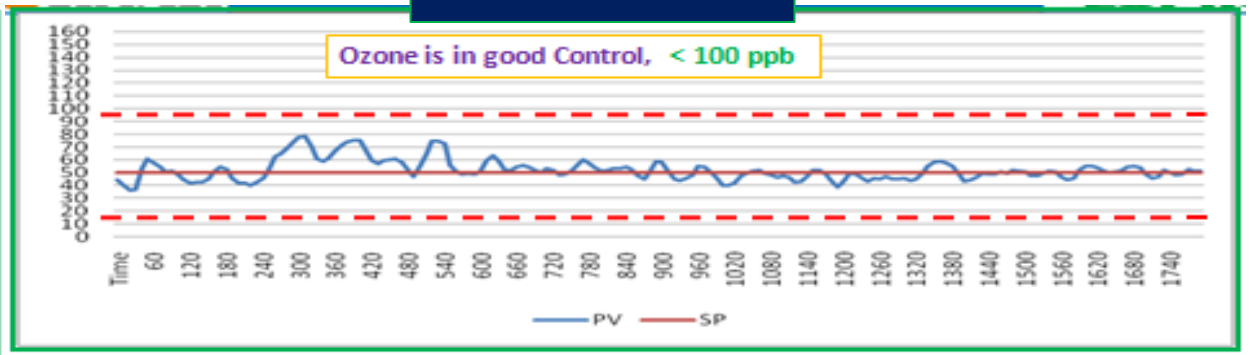
6) WTP : Ozone Control – Before/After Optimization

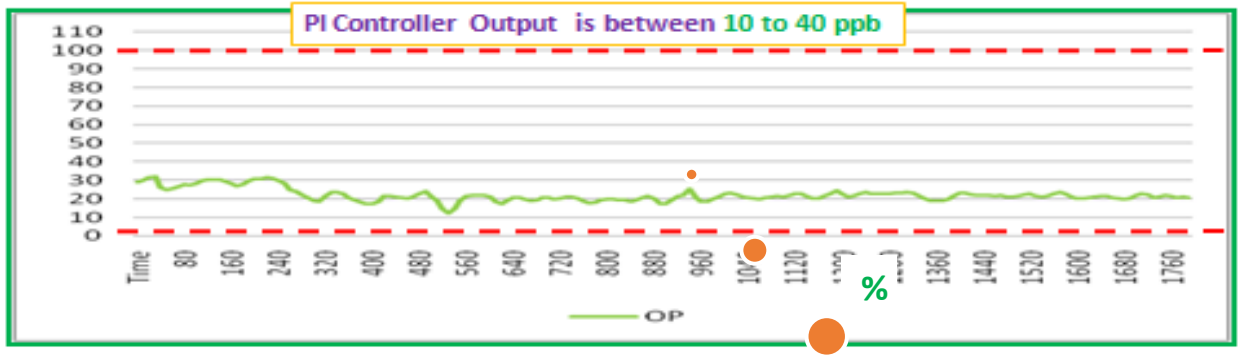
BEFORE





AFTER





Ozone Set point 50 ppb		BEFORE	AFTER	
		Base Case	Stage 1 Improvement	Stage 2 Improvement
OZONE	Minimum	37	31	36
	Maximum	155	78	79
	Average	64	50	50
Controller Performance Indicator	Diagnosis	Controller saturated	Not Applicable	Not Applicable
	Avg.Abs.% Control Error	35	16.8	7.4
	Total OP Saturation %	90	0	0
	Ozone Overshoot %	209	56	57
	Out of Control % (Range limit 40 to 100 ppb)	34	16	0
	Ozone Standard Deviation	23.6	10.7	4.8

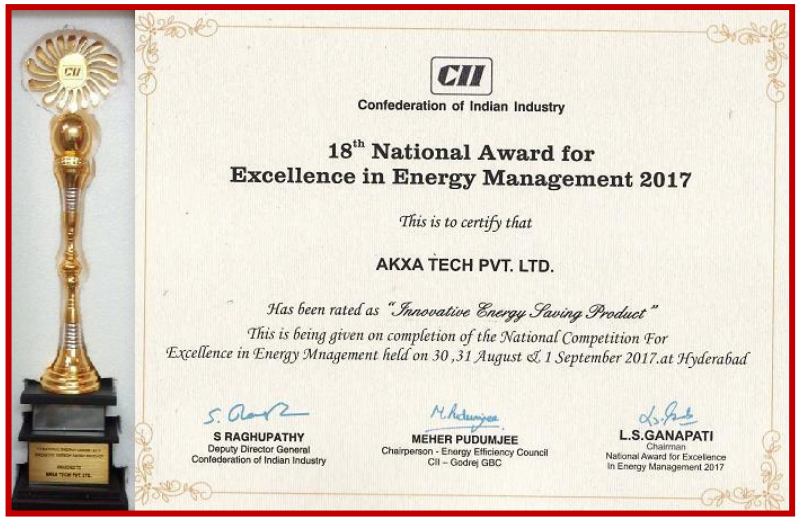
Ozone Cell Life Increased more than 50%

THANK YOU

"Give us an opportunity

to bring the BENEFITS of INNOVATIVE CONCEPTS and IoT based DATA ANALYTICS TECHNOLOGY

to help your PROCESS PLANT increase productivity, be more energy efficient and reduce carbon footprint and costs..."



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