INDUSTRIAL ACCESSORIES COMPANY

Process Optimization Methodology

Bob Carter, IAC President

Agenda

- Introduction
- Why optimization
- Survival v. Optimization
- Optimization process
  - Characterizing optimization
  - Control points
  - Reporting
  - Financial update

Introduction

Process of optimization spans any industry with relevance to all

- Understanding paradigm of optimization
  - Daily/shift milestones – vs – sustained performance milestones
  - Operator limits – vs – mechanical limits
  - Design name plate – vs – variable control point maximums
  - Expectations – vs – reality
  - My way – vs – your way
  - Maintenance now – vs – another day
  - Train/retain employees – vs- churn and burn
- Managed change –vs- management chaos
- Operate/control/measure/analyze/trend
- Optimize what exists → engineer for change
- Company culture and data are keys to optimizing

Input Characterization

Audience participation, raise your hand when called

- Attendees having financial or investment ties to frac sand operations
- Actual site operators of frac sand mines
- E&P company representatives
- Equipment suppliers
- Construction or EPC contractors

Understanding When/Why To Optimize?

Define goals, financial objectives for optimization

- Increase overall profitability of company
  - Increased production and plant utilization
  - Lower cost/ton produced
  - Reduce operating and utility costs
  - Decrease costly emergency work –vs- planned PM and shutdown
- Increased utilization of our time and money
- Increase/retain customer orders
- Increase Employee Retention and Productivity
- Identify and maintain a competitive advantage
- Improve financial markes perception of company
- Maximize overall product yield of mine stockpile

Optimization Challenges

Operational

- Daily goals/objectives unrealistic - continued feeling of failure
- Material feeding the plant or final product demand has changed, but nobody quantified the impact and aligned the expectations.
- “Shoot the messenger” mentality – people don’t speak up
- Heavy turnover of people – loss of intellectual knowledge
- Management directive to push beyond mechanical limits
- Reward structure for instantaneous –vs- sustained achievements
- “The next shift can deal with it”, “why would I tell them my secrets”, “just keep running” or “dam the torpedoes” mentality

Optimization Challenges – cont.

Sales/Management

- New daily production record is new monthly standard – sold
- Timing of orders is logistically impossible
- No sales/production planning meetings. (I.e., screen changes and shutdown for product mix changes not factored into production)

Financial

- Randomly cut maintenance/capital spend and increase production targets
- Randomly reduce headcount and maintain production targets
- Eliminate or significantly reduce capital spend

Optimization Process

1. **Acknowledge where you are today as a baseline for improvement**
   - *a)* *Initially*, avoid the shift in focus to where you need to be tomorrow!
   - b) Put a team in the field and gather data and remove “perception” and “gut feel”
     - a) If you don’t have the systems, do it manually or hire a team to **get and analyze the data**!
   - c) Characterize your current operating conditions vs. Original system design
     - a) Note the deviation from standard design and understand these control points.
   - d) Model changes in operating conditions and how they effect the control points.
2. **Identify the areas where you aren’t achieving maximum control point operation.**
   - a) Complete a process gap analysis and develop a plan to achieve existing control point maximum sustained operations.

Optimization Process

3. Develop a stepped approach to implementation, so you can measure success

a) Set and communicate goals for steps to achieve a sustained operation based on optimal performance of the equipment, people and processes today

b) Implement, measure, report, modify, implement

c) Report and celebrate steps in sustained production level increases

4. Adjust capital improvement plan, budget and timeline to increase production beyond control limits

Optimization Process, Recap

1. **Acknowledge** where you are today as a baseline for improvement
2. **Identify** the areas where you aren't achieving maximum control point operation.
3. **Develop** a stepped approach to implementation, so you can measure success.
4. **Adjust** capital improvement plan, budget and timeline to increase production beyond control limits.

Process: Wet Plant Control Point Analysis

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Characterization of input

- Wet plant *fn*(mine feed) - example
  - Understand current design and key “control points” in the system
  - Mine feed variations changes maximum throughput
  - High waste material impacts hydrosizer and clarifier
  - Heavy 100 mesh or 4070 can overload cyclones
  - Heavy fines percentage can impact UFR or clarifier

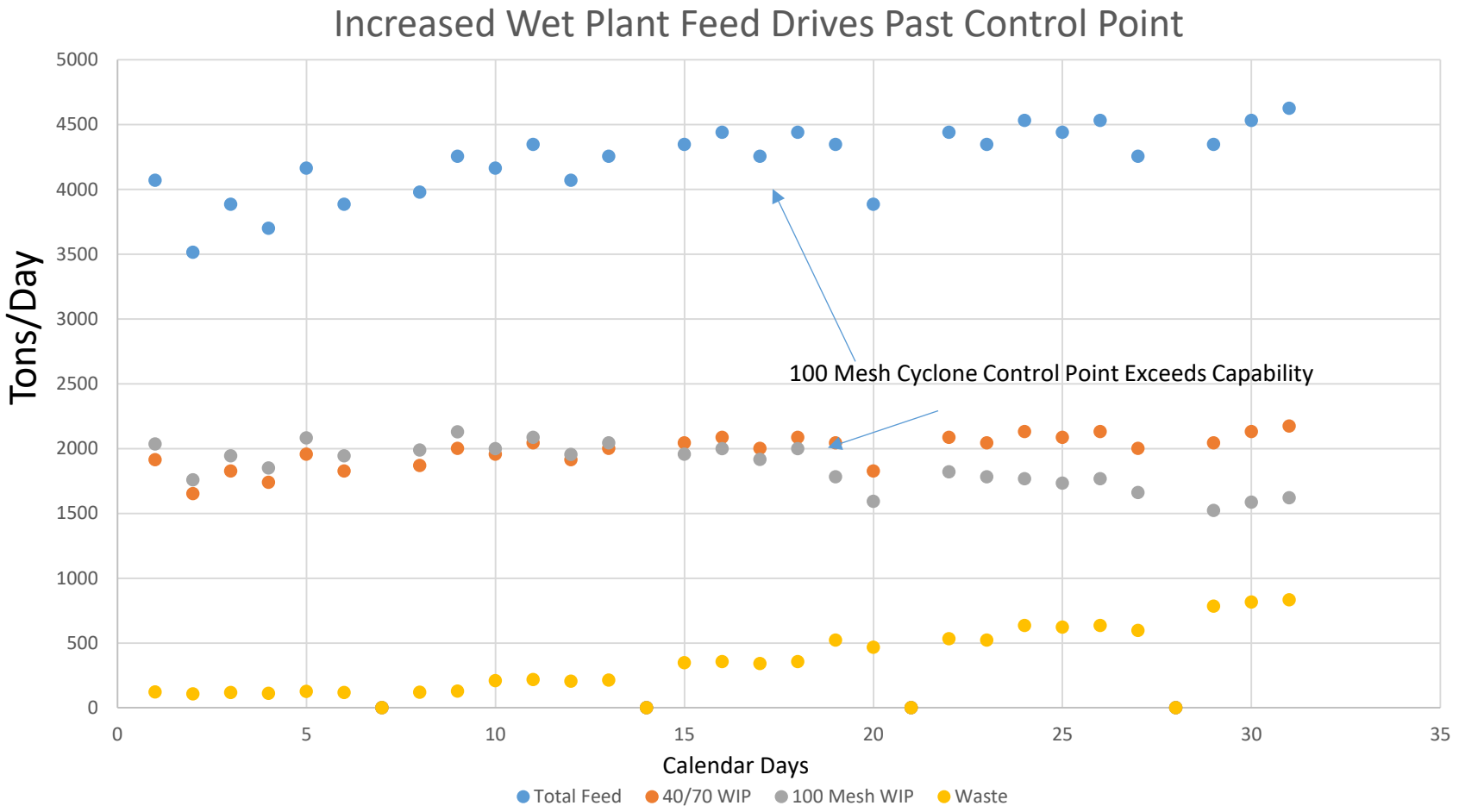
AVERAGE/DESIGN/CURRENT GRADATION DATA

	ALLOWABLE RANGE		EXPECTED		ADJUSTED	Design		ADJUSTED
SIEVE	MIN	MAX	FEED PFD	DE-RATE	FEED RATE	Bore	DE-RATE	FEED RATE
4	0%	10.0%		150%	100%		150%	100%
40	0%	30.0%	11.9%	145%	100%	8.6%	153%	100%
70	20%	42.5%	31.2%	123%	100%	31.0%	123%	100%
140	20%	35.0%	27.6%	119%	100%	30.0%	113%	100%
200	0%	10.0%	4.5%	128%	100%	5.0%	125%	100%
PAN	0%	27.5%	24.9%	113%	100%	25.4%	110%	100%
TOTAL			100.0%		250	100.0%		250
					MAX FEED			MAX FEED

HIGH 140/200			HIGH CLAY		
		ADJUSTED	Sample #1		ADJUSTED
VA-03-17	DE-RATE	FEED RATE	VA-13-17	DE-RATE	FEED RATE
	150%	100.0%		150%	100.0%
3.5%	166%	100.0%	4.9%	163%	100.0%
26.3%	132%	100.0%	27.0%	131%	100.0%
39.8%	88%	88.0%	26.5%	121%	100.0%
11.1%	95%	94.5%	2.7%	137%	100.0%
19.5%	140%	100.0%	38.9%	43%	43.0%
100.2%		208	100.0%		108
		MAX FEED			MAX FEED

HIGH +40			HIGH 40/70			HIGH 70/140		
Sample #5		ADJUSTED	Sample #3		ADJUSTED	Sample #1		ADJUSTED
SC-01-17	DE-RATE	FEED RATE	VA-05-17	DE-RATE	FEED RATE	VA-06-17	DE-RATE	FEED RATE
	150%	100.0%		150%	100.0%		150%	100.0%
41.4%	72%	71.5%	14.7%	138%	100.0%	4.4%	164%	100.0%
32.4%	120%	100.0%	47.6%	90%	89.8%	35.1%	115%	100.0%
8.6%	72%	71.5%	19.0%	98%	97.5%	41.1%	85%	84.8%
1.0%	145%	100.0%	3.4%	133%	100.0%	5.3%	124%	100.0%
16.6%	155%	100.0%	15.2%	162%	100.0%	14.1%	167%	100.0%
100.0%		128	99.9%		219	100.0%		212
		MAX FEED			MAX FEED			MAX FEED

Example: Data Showing Control Point Push



Process: Varying Process Conditions

Dry plant - Define current design and key “control points” in the system

Dryer capability – actual operation to validate capability

- Profile WIP piles on moisture and gradation
- Prove out maximum capacity with varying moisture
- Log data on pressure drops, temperature profiles, etc.,

Screener capability

- Develop data metric across screeners
  - Quality impact *fn* (feedrate, gradation)
  - Screen configuration *fn* (gradation)

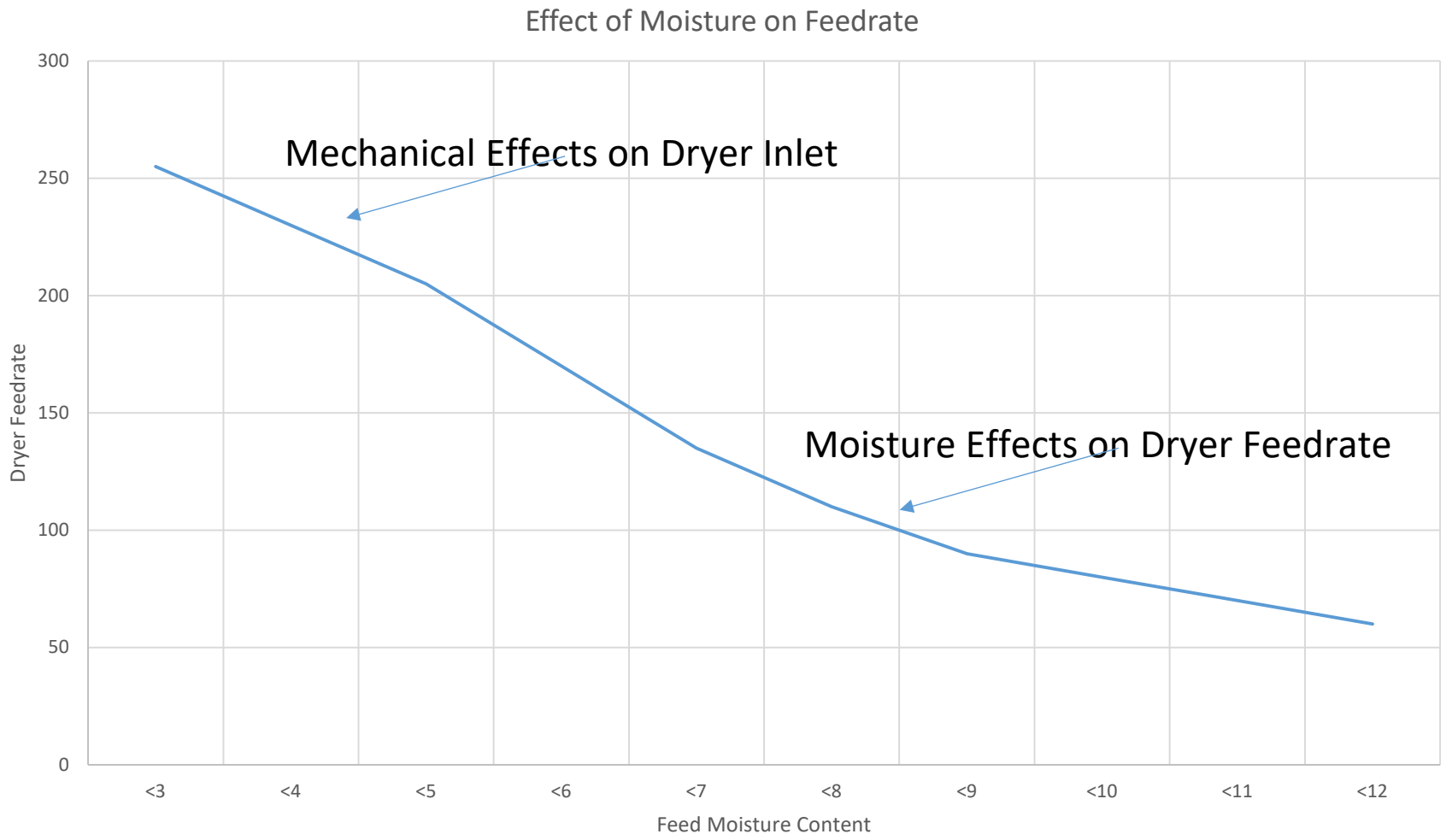
Conveyor and bucket elevator capacity

- Ensure capacities *fn* (feedrate, gradation)

Dust collection

- Waste handling capacity f(feedrate, gradation)
- Pressure drop, dryer negative pressure *fn* (feedrate, gradation)
- ID fan performance curve *fn* (feedrate, gradation)

Example: Moisture and Feedrate



Process: Data Analytics and Metrics

Improved “control point” performance

Process & procedural changes

- Develop analytical tools which optimize production at varying process conditions
- Develop advanced controls package to manage change in process conditions
- Advanced trend and control charts to characterize performance
- Increased instrumentation and lab data.
- Lag time reports to evaluate cause/effect timelines for change.

Re-design and retrofit

- Minimize pinch points with re-design and retrofit
- Develop capital strategy for optimization
- Implement change and measure progress

Measure and report progress at the front line to drive ownership

- Measure and report performance by individual, crew and business unit
- Develop evaluation teams around continuous improvement
- Involve the front line on growth initiatives

Process: Update Financial Models

Implement change in focus and operational methodology

- Target production levels need to be achievable and sustainable
- Identify mine plan and validate actual feed to adjust operating parameters
- Issue production plan around sustained operation at target production levels
- Factor in weather or other known pinch points outside of direct control

Modify predictive models

- Factor improvement in current control points over time
- Reduce costs of utilities and unplanned failure
- Factor in improvement from retrofit and capital improvement processes

Share results at all levels

- Recognize improvement through sustainable objectives
- Retain, train and motivate workforce through success
- Post performance against goal in the workplace

Develop plan to drive to the next sustainable level

Optimization Process

Success comes through steps, focus and commitment. IAC is dedicated to shaping the future through the comprehensive process from design, construction, startup, data analytics, process optimization and long term operational support.

We win together!

For more information, please visit our website and the latest Optimization Webinar from Bob Carter, in association with the Petroleum Connection

www.IAC-Intl.com

http://www.petroleumconnection.com/webinars/frac-sand-webinar-series-february

Frac Sand
Ethanol
Mining & Minerals
Steel
Food & Grain
Petrochemical
Power Generation
Cement
Lime
Iron & Steel
Plastics
Ore Smelting

THANK YOU

INDUSTRIAL ACCESSORIES COMPANY

4800 Lamar Avenue

Mission, KS 66202

800.334.7431

www.iac-intl.com