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Pollution Prevention through the Application of Six Sigma and Lean

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ASQ Lean Six Sigma Conference

Session A4

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Learning Objectives

- Integrate Six Sigma and Lean to enhance effectiveness of process improvement efforts
- Case study of pollution prevention project that also reduced costs, inventory and cycle times
- Leveraging results of the study

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Afton Chemical Corporation

- Manufacture Lubricant and Fuel Additives
- $1.6 Billion Revenue
- Sauget, Illinois Manufacturing Facility
  - OSHA Voluntary Protection Program – STAR
  - Illinois Governor Pollution Prevention Awards

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Six Sigma and Lean–Afton Chemical

- Six Sigma initiatives 1990s focus
  - Quality
  - Cost Reduction
  - Capacity
- Lean integrated into process improvement in 2000s

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Pollution Prevention – Eliminate or Reduce Pollution at the Source

- End of pipe treatment perceptions
  - Less expensive
  - Processes operated as efficiently as possible
  - Process modification may impact product quality
  - Process modification requires outside technical assistance, high cost

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Pollution Prevention Act of 1990

Congress established a hierarchy for improving the environment

#1 Emissions should be prevented or reduced at the source when feasible

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Environmental Protection Agency

- Encourage pollution prevention through source reduction
- Six Sigma and Lean are process improvement methods encouraged by US-EPA http://www.epa.gov/lean/thinking/sixsigma.htm
- Few case studies shared in the literature that utilized Lean Six Sigma with the goal of pollution prevention

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Case Study - 2003 Reduce Copper Emissions

- A lubricant additives process produces a brine containing sodium sulfide
- Sodium sulfide if discharged to sewer would release hydrogen sulfide
  - React with acid in sewer
  - Hydrogen sulfide acutely toxic

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Process Description

- Brine treatment
  - Acidify
  - Nitrogen sparge
  - Copper sulfate
- Copper - toxic to microorganisms present in secondary waste water treatment systems - POTW

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Copper Sulfate

- Approximately 70 lbs of $CuSO_4$ used per day
- Copper has a surface water toxicity reference value of 9 parts per billion
- Metals partially removed through primary treatment at POTW

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Tools of Lean and Six Sigma

- Define: Reduce or eliminate copper emissions at the source while decreasing cost, reducing cycle time and improving safety
  - Key stakeholders included in project definition

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Value Stream Map

- Process Flow Diagram
  - Description
  - Cycle times
  - Value added / non-value added steps identified

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Measurement Systems

- Consistent amount of copper sulfate added per batch
- Assure batch is acidified with pH paper prior to nitrogen sparging
- Assure batch has no residual Hydrogen sulfide with lead acetate paper prior to adding copper sulfate

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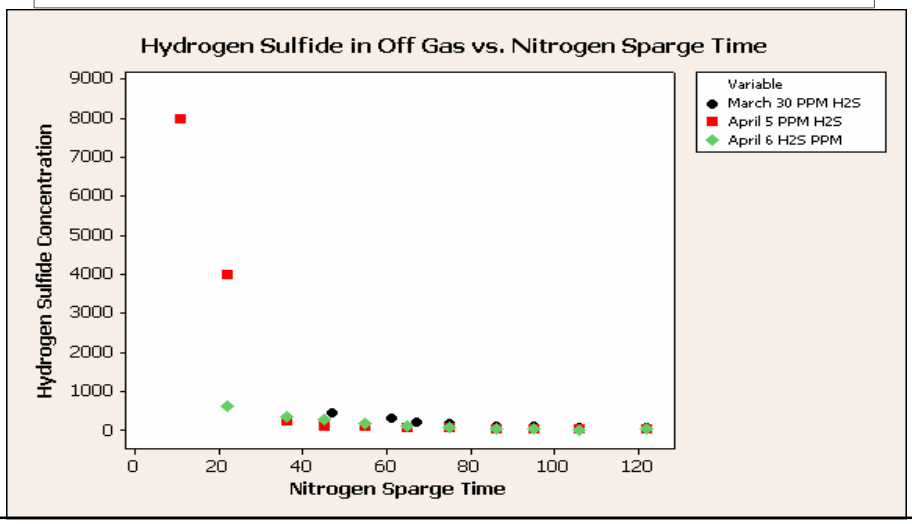
How Long to Nitrogen Sparge?



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5 Whys

- Ask why copper sulfate is added 5 times to thoroughly understand

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Failure Mode Effects Analysis (FMEA)

- Copper sulfate addition non value added
- Nitrogen sparge time optimization
- Critical measures already in place

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Improve

- Copper sulfate eliminated
  - 20,000 lbs of $CuSO_4$ annually
  - $15,000 of expense
  - a potential ergonomic risk
  - inventory
  - process cycle time reduced, increasing capacity
  - POTW receives lower concentration of copper

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Control

- Copper sulfate no longer on site
- No environmental issues in 5 years

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Lean + Six Sigma = Speed and Effectiveness

- Three weeks from project concept to completion

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Leverage

- Approach has been utilized on three subsequent projects with increasing beneficial environmental and cost impact.

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Comments? Questions?

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