Spraying Systems Co.
Capabilities, SprayDry® Nozzles and Tank Cleaning Nozzles
September 20, 2012

Presented by:
Tim Oberg
Jon Barber
Spraying Systems Co.

- World leader in spray technology
  - Established in 1937
  - Wheaton, IL USA
  - High quality global brand
  - 50+ major industrial markets
90 Sales Offices Around the World
Spraying Systems Co.’s
SprayDry® Solutions
SprayDry® Nozzle History

- 1930’s - 1940’s (cores and whirlchambers)
  - 1937 Spraying Systems Co. founded
  - 1937 SX spray drying nozzles introduced
  - 1940 First use of term SprayDry by SSCo.
  - 1947 SSTC SprayDry nozzles introduced
SprayDry® Nozzle History

- **1950’s - 1960’s (cores and whirlchambers)**
  - 1950 SX spray drying nozzles introduced
  - 1951 SprayDry becomes SSCo. registered trademark
  - 1954 SB SprayDry nozzles introduced
  - 1957 Tang introduced by General Foods
SprayDry® Nozzle History

- 1950’s - 1960’s (cores and whirlchambers)
  - 1961 Coffee-Mate dairy creamer introduced
  - 1963 AA104 SprayDry nozzles introduced
SprayDry® Nozzle History

- 1970’s - 1980’s (cores, whirl and swirl chambers)
  - 1976 Whey powder production developed by Kraft
  - Whey spraying with swirl chamber nozzles continues
  - Dairy industry adopts swirl chamber nozzles
  - 1984 Sugar-Free Jell-O is launched
SprayDry® Nozzle History

- 1990’s - 2000’s (cores, whirl and swirl chambers)
  - 1993 SK SprayDry nozzles introduced
  - 1998 SB-MFP SprayDry nozzles introduced
  - 2001 SK-MFP SprayDry nozzles introduced
  - 2004 SKH and SBH SprayDry nozzles introduced
  - 2010 SV SprayDry nozzles introduced
SV SprayDry® nozzles

- Design features - comparable
  - Spray performance
    - Flow
    - Spray angle
    - Drop size
  - Swirlchamber
    - Maximum free passage
    - 10 different sizes
  - Orifices
    - 181 sizes (0.029"-0.210")
  - Interchangeable (performance)
    - Delavan SDX, SDXIII, Bete TD
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**NOZZLE TYPE OPTIONS**

- Whirlchamber
  - AA104 & SSTC
- Orifice and Core
  - SB & SK
- Swirlchamber
  - New SV
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Emulsion

Surface Tension

Feed Stock

Viscosity

Bulk Density

Encapsulation

Agglomeration

Fluid Bed

Percent Moisture

Particle Size
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- Drop size

### Actual Drop Sizes

<table>
<thead>
<tr>
<th>Size</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>500 µm</td>
<td>One inch = 25,400 µm</td>
</tr>
<tr>
<td>1,200 µm</td>
<td>One millimeter = 1,000 µm</td>
</tr>
<tr>
<td>5,500 µm</td>
<td>µm = micrometers</td>
</tr>
</tbody>
</table>

Data is based on spraying water under laboratory conditions using the Phase Doppler Interferometer (PDI). All values are computed using the procedures as outlined by ASTM (Standard E799).
Nozzle Selection Resources

- Literature
  - Catalog 695
  - Technical Manual 402
  - Other
Overview

- Tank cleaning nozzles for dairy powders
  - Effective cleaning
    - Designing the system
    - Start with the proper nozzle
  - Factors affecting cleaning effectiveness
    - Temperature, time, concentration
    - Spray impact
  - Selecting the right tank cleaner
    - Numerous options
    - Application examples in dairy industry
Tank/Tower Cleaning

- Effectively clean all interior surfaces of tanks and towers by
  - Automating cleaning
    - To eliminate any residue and bacteria while maintaining all industry requirements

360 degree spray coverage from automated cleaning
How to Obtain Effective Cleaning

- Design an automated system that will
  - Clean
  - Maintain
  - Sanitize
- The system must also
  - Prevent malfunctions or contamination that would alter the safety, identity, strength, quality or purity of the finished product
- Start by selecting the proper tank cleaning nozzle
Factors Involved in the Cleaning Process

- Impact Force
- Temperature
- Time
- Chemical Concentration

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Temperature

- Decreases the bond between soil and surface
- Decreases soil viscosity
- Increases soil solubility
- Increases chemical reaction rate (may allow for shorter cycle time)
Cleaning Time

- Duration that cleaning solution is in contact with equipment surface
  - How much time do we have to clean
- Factors that influence duration
  - Chemical concentration
    - Correct type of cleaner for soil removal
  - Impact force
    - Water pressure
    - Flow rate
    - Nozzle selection
  - Temperature
    - To maximize reaction rate of cleaning solution
Chemical Concentration

- Cleaning & sanitizing
- Varies based on chemical selected, type of soil and surface to be cleaned
- Concentration normally reduced as time and temperature increase
- Lower concentration means less chemical is used and cost is reduced
Impact Force

- The physical force of the cleaning solution on the surface of the tank wall
- Increased impact can reduce:
  - Cleaning time
  - Cleaning solution
  - Solution temperature
- $I = \text{Constant} \times \text{Flow} \times \sqrt{\text{Pressure}}$
  - Increase flow to increase impact
- Select high impact tank cleaners
Impact Force

Nozzles Commonly Used in Spray Dry Industry

Low to High Impact

TankJet® 63225E
TankJet® 28500
TankJet® D41800E
TankJet® 65
TankJet® 80
TankJet® 360

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Tank Size

- Need to know dimensions of tank/tower being cleaned
  - Diameter
  - Length and width
  - Opening sizes
- Internal obstructions
- Drain sizes
Nozzle Mounting

- Automated tank cleaning
  - CIP – clean in place
    - Permanently installing a tank cleaning device
    - Completely automated system
    - Multiple cycles
  - Portable tank cleaning – moving a tank cleaning device from tank to tank
    - Insert tank cleaner in for cleaning, then remove
    - Portable pump or fluid delivery system
Types of Automated Tank Cleaning Nozzles

Stationary

Motor Driven

Fluid Driven (Reactionary and Turbine)
Stationary Tank Cleaning Units

- Advantages
  - Simple, reliable construction; does not contain any moving parts
  - Customizable spray patterns
  - Spray balls available for 3A (sanitary) or industrial applications

- Disadvantages
  - Low transference of energy to tank surface
  - High flow rate required
    - Up to 385 gpm (1470 l/min)
  - Limited tank size capability

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Stationary Spray Balls

- Spray dry whey application example
  - 30,000 gallon (113,562 liter) tank
  - Requires 3A due to permanent mounting of CIP nozzles
  - Multiple cycles
    - Rinse (water)
    - Wash (2-3% caustic)
      - 160 to 180°F (71 to 82°C)
    - Rinse (water)
    - Chlorine sanitizer
Motor Driven

- External air or electric drive allows independent control of spray head rotation
- High pressure, low volume
- Advantages
  - Excellent transfer of energy to tank surface
  - Reduced cleaning time and chemical usage
  - Portable
Fluid Driven

- Advantages
  - Higher impact than static nozzles
  - Better overall coverage than static
  - Reduced fluid requirements
  - Reduced cleaning time
  - Some units available in 3A
Application

- Cleaning over-the-road tankers for dairy
  - Dairy plants clean milk tankers
  - Length: 40 ft (12 m) long x 8 ft (2.4 m) diameter
  - Some have multiple compartments
  - Pressure: minimum 80 psi (5.5 bar)
  - Installation: middle/vertical
Application

- Cleaning over-the-road tankers for dairy
  - Tank Cleaner: TankJet® 80 or TankJet 360
  - TankJet 360 provides higher impact
  - However, TankJet 80 preferred
    - Cleaner design for dairy
    - Rinsing is required for most dairy products
    - Impact sufficient enough
Fluid Driven

- Fluid driven rotary tank cleaning nozzles
- High impact turbine driven cleaners reduce mineral deposits
- Advantages
  - Fluid driven (no additional utilities)
  - Over-the-road tanker, spray dry towers and larger tanks up to 100' (30 m) in diameter
  - Customizable
  - High impact
- Flow thru gearbox (no oil)

TankJet® 360
Application

- Cleaning spray dryers in dairy plant
  - Cleaning spray dried powder
    - Baked on at high temperatures
  - Tower dimensions
    - 10-35 ft (3-10 m) wide x 10-60 ft (3-18 m) high
  - Tank Cleaner: TankJet® 360
  - Installation
    - Portable application, removable
    - Nozzle mounted on hose reel and pulley wheel
    - 1 unit, 1 location in tank (center)
Application

- Cleaning spray dryers in dairy plant
  - Pressure: 100 - 125 psi (7 - 9 bar)
  - Flow rate: 70 - 100 gpm (265 - 379 l/min)
  - Frequency: cleaned every 3 - 5 days
Summary

- Effective cleaning starts with proper nozzle selection
- Understand factors involved in cleaning
  - Temperature, time, chemical concentration, tank/tower size and mounting
- Types of tank cleaning nozzles
  - Stationary, motor driven, fluid driven
  - Understand impact of each type
- Many tanks and towers in spray dry industry benefit from automated cleaning
  - Process vessels, storage tanks, spray dryers, tanker trucks, etc
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