No Heat Spray Drying Technology

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ZoomEssence, Inc.
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This presentation does not contain any proprietary, confidential, or otherwise restricted information.
Project Objective

• Advance research from prototype dryer to integrated pilot system for our ambient temperature spray drying technology

• Several objectives:
  • Improve emulsion formulation
  • Develop an industrialized atomizer
  • Develop a dryer control system

• Challenge is to convert liquids to powders at ambient temperature
  • First commercial market is dry flavors designed to retain attributes of the starting liquid flavor

• Traditional spray dryers operate at 200°C while our technology operates at much lower temperature causing significant reduction in drying power – opens new challenges
Technical Approach

- **Present spray dryers operate at high temperature ~200°C resulting in:**
  - Loss (evaporation) of flavor molecules
  - Oxidation and thermal alteration of flavor profile
  - Low thermal efficiency

- **Our process dries powders at low temperature resulting in:**
  - Avoiding the evaporation or distortion of flavors
  - Higher thermal efficiency
  - Significantly increased manufacturing yield

- **Low temperature approach requires change from existing practice**
  - Requires novel dryer designs for long particle residence times
  - New emulsion formulations
  - New atomization technology
Technical Approach

- Utilization of high performance computation to solve:
  - Fluid dynamics problems of dryer air flow
  - Particle drying - heat and mass transfer
  - Particle trajectories to develop new dryer designs specifically for low temperatures
Transition and Deployment

- Dry ingredients are used worldwide in industries such as pharmaceuticals, food and chemicals to name a few
  - Industries that demand superior retention of high value ingredients
  - Dry form of the ingredient is preferred

- Consumers are the predominant end user in the form of tablets, capsules, dry food ingredients such as flavors, vitamins, milk powder, fertilizer, etc.

- Current high temperature drying causes issues relating to yield, performance, solubility and stability

- Everybody cares, this a disruptive technology that delivers better products at a lower cost
  - Entire population consumes dry ingredients in various forms
Transition and Deployment

• **First commercial application is the dry flavors & food ingredients**
  - CEO of ZoomEssence was former President of a large flavor company

• **Technology is sustainable, energy efficient and green**
  - Consume 60% less energy than current process
  - Improved yield causing need to manufacture fewer pounds of product
  - Avoids air pollution by not evaporating active material
  - Consumes significantly less water
  - Capital cost of the system is significantly less
Measure of Success

- Our process will result in significant reductions in energy consumption in the spray dry industry
  - In excess of 60% less energy needed to deliver 1kg of dry flavor when compared to traditional high temperature spray dry processes

- Commercial adoption by ZoomEssence selling dry flavors and ingredients to both US & International customers

- The low temperature process is more efficient in the use of natural resources such as water, flavors, pharmaceuticals, ingredients, and chemicals – little loss of valuable actives to evaporation
Project Management & Budget

- Project is 1 year in duration

- 3 Tasks Include:
  - Improvement in Emulsion Formulation
  - Continued Atomizer Development
  - Development of a Dryer Control System

- Progress measured by specific milestones and accomplishments with prototype dryer

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<th>Total Project Budget</th>
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<td>DOE Investment</td>
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<td>Cost Share</td>
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Results and Accomplishments

5 months into project

Accomplishments to date:

- Measurements made to date on emulsions and dried powders have resulted in improvements in viscoelastic properties of emulsions – viscosity reduction achieved
- Results in improved atomization – particle size
- Improved drying behavior
- Improvements in thermal stability of dried powders
- New atomizer design in progress
- Companies identified for manufacturing atomizer
- Control panel functions defined, all sensor and control points identified, programming starting