No Heat Spray Drying Technology

DE-EE0005774

ZoomEssence, Inc.

12/15/14 – 12/15/15

Dr. Charles Beetz, Chief Scientist, ZoomEssence, Inc.

U.S. DOE Advanced Manufacturing Office Program Review Meeting
Washington, D.C.
June 14-15, 2016

Project Objective

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

- Objectives:
  - Emulsion formulation development
  - Industrial atomization development
  - Dryer data acquisition system

- **Traditional spray dryers operate 200°C, while our technology operates at much lower temperatures requiring novel approaches to removal of water to create dry powders.**

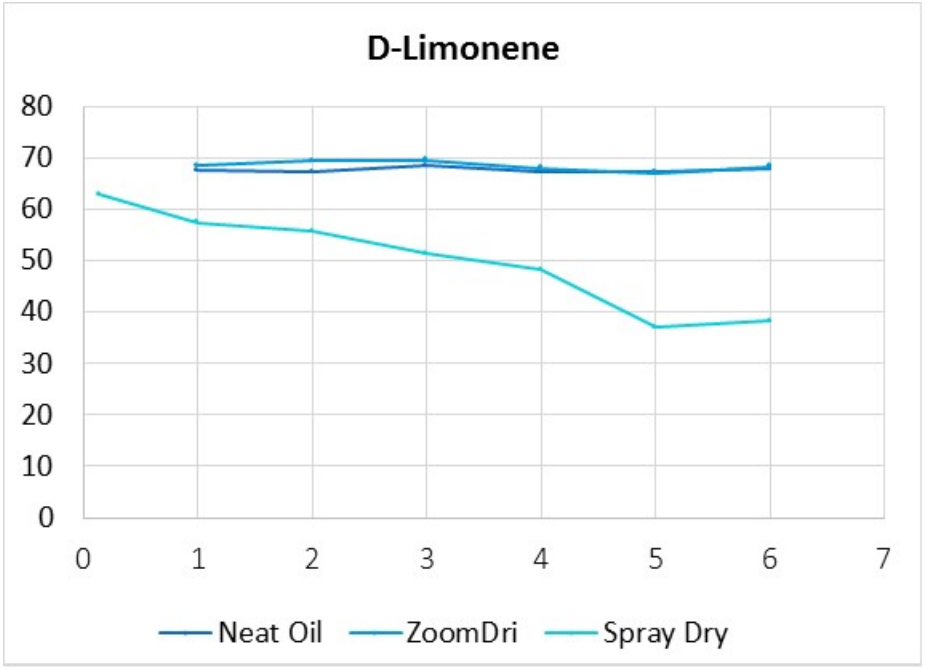
Technical Innovation

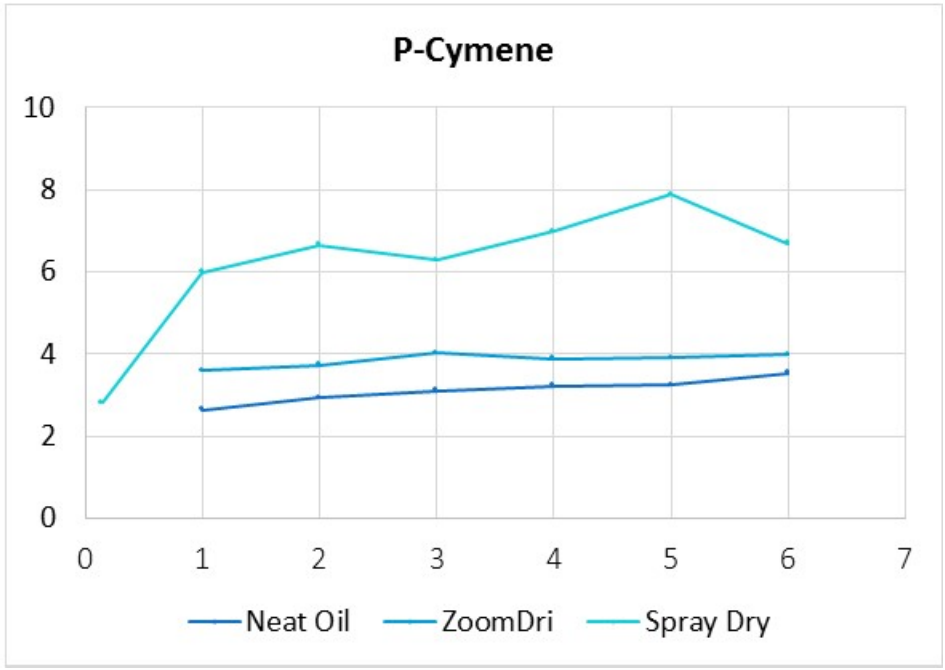
- **Present spray dryers operate at high temperature ~200°C resulting in:**
  - Loss (evaporation) of flavor molecules
  - Oxidation and thermal alteration of flavor profile
  - Low thermal efficiency

- **Our low temperature drying process**
  - Reduced thermal degradation of sensitive compounds
  - Enhanced bulk powder attributes (particle size, density)
  - Greater retention of volatile organics into powder (yield)
  - Higher thermal efficiency

Technical Innovation

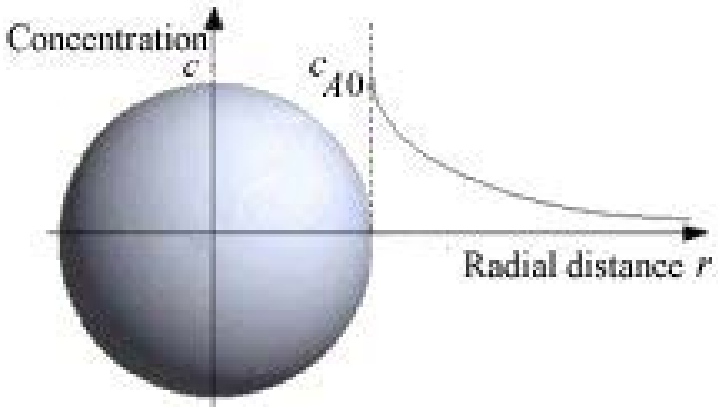
- **Demonstration: High temperature Oxidation of Citrus Oils**
  - D-limonene – oxidized and destabilized in typical spray dry
  - P-cymene oxidative by-product of citral in typical spray dry
  - **DriZoom™ powders retain attributes of neat oil after drying**





Technical Innovation

- **Understanding the physics of evaporation: High Performance Computing**
  - Diffusion in a sphere
  - Ambient water concentration
  - Formulation
  - Particle flight time – new dryer designs



Transition and Deployment

- **Dry ingredients are used worldwide**
  - 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 business

- **Technology is sustainable, energy efficient and green**
  - Consume 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

- Commercial Success:
  - With greater understanding of formulation, over **200 new products have been developed** in 2016 with **51 new commercial launches**
  - FY2015: $7.5 million
  - Q1 2016: $2.65 million

- Formulation and Atomization development:
  - Greater understanding and control over emulsion parameters
  - 120 micron particle size and narrow distribution
  - **Substantially increased throughput within moisture and particle size thresholds**

- Dryer Control System:
  - Improvement in energy efficiency by measurement of process parameters
  - Controls have been established and acquiring data

Project Management & Budget

- **Project is completed**

- **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**

Total Project Budget	
DOE Investment	$750,000
Cost Share	$250,000
Project Total	$1,000,000

Results and Accomplishments (1 slides max)

- Task 1 Emulsion Formulation: Complete
  - Improved understanding of viscoelastic behaviors and correlation between emulsion and bulk powder properties
  - Improved thermal stability and bulk powder consistency
- Task 2 Atomizer Development: Complete
  - Greater control over particle size, distribution and drying behavior
- Task 3 Data Acquisition: Complete
  - Panel installed and recording data for analysis