HORIBA Instruments, Inc.
Scientific Division

Ian Treviranus

At First Blush:
The Importance of Particle Characterization for Cosmetics

April 22, 2015
What we’ll talk about

• Featured technologies

• Importance to industry

• Application examples

• Q&A
Your interests

- Available technologies
- How to accurately, reproducibly measure nanoparticles
- Best practices
- Zeta potential
- Pastes
- Data interpretation (webinars TR008, TR010, TR015)
Featured technologies

• **LA-960 / LA-300**
  Laser Diffraction

• **SZ-100**
  Dynamic Light Scattering & Zeta Potential

• **CAMSIZER & CAMSIZER XT**
  Dynamic Image Analysis

• **PSA300**
  Static Image Analysis

• **SA-9600**
  Flowing Gas BET Surface Area
LA-960: Laser Diffraction

- Particle size performance leader
- Tenth generation design
- Suspension, emulsion, powder, paste, gel
- Lowest total cost of ownership
- Ultra durable
- 10 nanometer – 5 mm
SZ-100: Nanoparticle Analyzer

- Nanoparticle size & zeta potential
- Low total cost of ownership
  - Innovative, patented graphite electrodes
  - Requires only microliters
- Suspensions & emulsions
- 0.3 nanometers – 8 microns
Zeta Potential: Dispersion Stability, IEP

Measures particle surface charge
High zeta potential = stable
Low zeta = unstable, aggregate
What we’ll talk about

• Featured technologies

• Importance to industry

• Application examples

• Q&A
Why Do We Care?

• **Particle size affects...**
  – Texture/skin feel
  – Color density/tint
  – Smoothness
  – Powder flow/compaction

• **Zeta potential tells us...**
  – Product stability
Particles in Cosmetics

- Any product containing a powder
- Pigments, talc, mica
- Emulsions (creams, lotions)
- Liposomes; simple, complex

- Types of cosmetics containing particles (emulsion droplets)
**Original Foundation: Pan-Cake**

- Foundation and powder in one
- Base was talc (particle), not oil or wax
- Applied with wet sponge
- Patent in 1937
- By 1940 1 in 3 North American women owned & wore Pan-Cake
Create our Own Product

- **Base**
  - Talc, rice powder

- **Pigment**
  - Iron oxide

- **Filler**
  - Clay

- **Glitter**
  - Mica

- **SPF**
  - TiO2

They’re all particles!

Can measure size of all using one system: LA-960
Measure Powders as Powders

- Simplify dispersing
- Quick, easy, clean
- Measure in natural state for more actionable results
- Lower costs

Webinar TE016: Optimizing Dry Powder Measurements
Reduce Solvent Use

MiniFlow

- Fully automated pumping system
- 40 mL total volume
- Built-in ultrasonic probe

Fraction Cell

- 5, 10, 15 mL volume
- Needs only micrograms

Application Note 176: Minimizing Sample Quantity
LA-960 Method Expert

• Unique guided method development
• Easily choose measurement and calculation conditions
• Choose the best refractive index
• Create “one button” SOPs
What we’ll talk about

• Featured technologies

• Importance to industry

• Application examples

• Q&A
Base: Rice Powder

Air Transmittance (R) : 0.3 MPa
Sample Data Acquisition Times (LD) : 5000
Refractive Index (R) : 1.53-0.0i(1.53-0.0i(1.530 - 0.000i))
Iteration Number : 15
Feeder : Auto
Data Name : Rice Powder Max Dry - 01
Model Type : LA950DRY

D(v,0.1) : 5.50291(μm)
D(v,0.5) : 8.54916(μm)
D(v,0.9) : 13.30517(μm)
Iron Oxide – 170 Shade

LA-960 wet accessories
Disperse powder into a liquid
Can measure down to 30 nm

Use ultrasound?
Gold Glitter Powder

Measure wet + dry, choose preferred
Verify correct pressure for dry powder feeder

Wet

- Transmittance (R): 77.4 (%)
- Sample Data Acquisition Times (LD): 5000
- Iteration Number: 15
- Refractive Index (R): 1.59 (1.590 - 0.1000), Water (1.333)
- Data Name: Gold Glitter Max Wet - 01
- Model Type: LA950WET

D(v,0.1): 68.01367 (µm)
D(v,0.5): 99.73002 (µm)
D(v,0.9): 147.47485 (µm)

Dry

- Air
- Transmittance (R): 98.3 (%)
- Sample Data Acquisition Times (LD): 5000
- Refractive Index (R): 1.59 (1.590 - 0.1000)
- Iteration Number: 15
- Feeder: Auto
- Data Name: Gold Glitter Max Dry - 01
- Model Type: LA950DRY

D(v,0.1): 73.44803 (µm)
D(v,0.5): 106.93343 (µm)
D(v,0.9): 156.32506 (µm)
# Mica

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>0.3 MPa</td>
</tr>
<tr>
<td>Transmittance (R)</td>
<td>98.2%</td>
</tr>
<tr>
<td>Sample Data Acquisition Times (LD)</td>
<td>5000</td>
</tr>
<tr>
<td>Refractive Index (R)</td>
<td>1.59 - 1.60</td>
</tr>
<tr>
<td>Iteration Number</td>
<td>150</td>
</tr>
<tr>
<td>Feeder</td>
<td>Auto</td>
</tr>
<tr>
<td>Data Name</td>
<td>Mica Max Dry - 01</td>
</tr>
<tr>
<td>Model Type</td>
<td>LA950DRY</td>
</tr>
</tbody>
</table>

- $D(v, 0.1) = 3.94080 \mu m$
- $D(v, 0.5) = 4.96686 \mu m$
- $D(v, 0.9) = 6.28450 \mu m$
Quality Control / Troubleshoot

Graph Type | Material | Mean Size | Cumulative % on Diameter
---|---|---|---
| | Concealer Lot 1 | 9.49300 (µm) | (7)100.0 (µm)- 100.000(%) |
| | Concealer Lot 2 | 19.51431 (µm) | (7)100.0 (µm)- 92.510(%) |
Kaolin clay

Note: small % below 100 nm, making this a “nanoparticle. Safety concerns?
Sunscreen with TiO2

Powder dispersed in water using surfactant and ultrasound. Note: 14.5% < 100nm Safety concerns?
Measure without dilution

- Concern that dilution in anything but perfect background will change PSD
- Possible solution with Paste Cell accessory
- Small amount of paste/gel/cream between two glass plates
ZnO used in sunscreen
Stability

- Want stable dispersion
- Either suspensions or emulsions
- Suspensions sediment & flocculate
- Emulsions phase separate, creaming or coalescence
Skin Cream

Emulsion w/SPF 15

Mean Size: 0.41213(μm)
Median Size: 0.18935(μm)
Chi Square: 5.313640
R Parameter: 1.6789E-1
D(v,0.1): 0.10214(μm)
D(v,0.5): 0.18935(μm)
D(v,0.9): 0.38762(μm)
Cumulative % on Diameter: (1)0.100 (μm)- 9.155(%)
Liposome Delivery

Liposome approaches skin barrier layer

Liposome fuses with skin barrier layer

Liposome dissolves & releases actives (retinol?)

Penetrates into skin
Retinol Formulation - Delivery

“Retinol contained in the core space of the vesicle which has a mean diameter of 10~50nm”…

Ingredients: Retinol (liposome)

Useful for improving skin health
Liposome Size & Stability

Nanoparticle Size

Zeta Potential

Calculation Results

<table>
<thead>
<tr>
<th>Peak No.</th>
<th>S.P.Area Ratio</th>
<th>Mean</th>
<th>S.D.</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>98.2 nm</td>
<td>29.6 nm</td>
<td>87.6 nm</td>
</tr>
<tr>
<td>2</td>
<td>--</td>
<td>-- nm</td>
<td>-- nm</td>
<td>-- nm</td>
</tr>
<tr>
<td>3</td>
<td>--</td>
<td>-- nm</td>
<td>-- nm</td>
<td>-- nm</td>
</tr>
<tr>
<td>Total</td>
<td>1.00</td>
<td>98.2 nm</td>
<td>29.6 nm</td>
<td>87.6 nm</td>
</tr>
</tbody>
</table>

Cumulant Operations

Z-Average: 90.1 nm

Calculation Results

<table>
<thead>
<tr>
<th>Peak No.</th>
<th>Zeta Potential</th>
<th>Electrophoretic Mobility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-48.6 mV</td>
<td>-0.000355 cm²/Vs</td>
</tr>
<tr>
<td>2</td>
<td>-- mV</td>
<td>-- cm²/Vs</td>
</tr>
<tr>
<td>3</td>
<td>-- mV</td>
<td>-- cm²/Vs</td>
</tr>
</tbody>
</table>

Zeta Potential (Mean): -48.6 mV

Electrophoretic Mobility Mean: -0.000355 cm²/Vs
Multiple Technologies
Summary

• Many cosmetic products either powder (particle) based, or contain powders
• Widest range of applications measured by laser diffraction
• DLS for nanoparticle size and zeta potential
• New web page to help determine best fit for diffraction vs. DLS
• Quantify sub-100 nm with either technology
We’ll be attending NYSCC

• Annual suppliers event May 12-13
• Edison, NJ ← HORIBA has an office there
• Booth 714
• Say hi! to Mitch & Dan
Thank you

Omoshiro-okashiku
Joy and Fun

감사합니다

Cảm ơn

ありがとうございました

Dziękuję

धन्यवाद

Grazie

Merci

谢谢

ขอบคุณครับ

謝

ขอบคุณครับ

Σας ευχαριστούμε

アシーグ

谢谢

谢谢

Tack ska ni ha

Danke

 большое спасибо
www.horiba.com/particle

Ian Treviranus
Product Line Manager
ian.treviranus@horiba.com

Talk to us, ask questions
labinfo@horiba.com

Receive news of updates
View application &
technical notes (170+),
webinars (70+), white papers.