FPInnovations

Ensuring the Safe Occupational Handling of Cellulose Nanocrystals (CNC)

Brian O'Connor

Workshop: Cellulose Nanomaterials – A Path Towards Commercialization

Location: Washington, DC
Date: May 20-21, 2014

Environmental Assessment of CNC

- Comprehensive series of fish testing conducted

  Nanotoxicology, 4(1-4), 255-270 (2010).

- Successful submission under Canada's New Substances Notification Regulations:

  Canada Gazette Part II. Nov. 21, 2012, p. 2457

- Occupational Health and Safety evaluations

  Nanotechnology Environmental Health and Safety: Risks, Regulation and Management (Second Edition), Elsevier, M. Hull & D. Bowman, Eds (2014, in press).

FPInnovations

Toxicological Test Results for CNC

OECD Test Name	NCCTM Results
403 Acute Inhalation Toxicity	No mortality or signs of gross toxicity, adverse effects, abnormal behaviours or abnormalities. Based on max. attainable test conc., LC50 > 0.26 mg/L.
404 Irritation/Corrosion	No corrosive effects were observed. NCCTM has a primary irritation index of 0.
406 Skin Sensitization	Found to be non-sensitizing at 1.1 mg/L (intradermal) and 103 mg/L (topical induction and challenges phase).
407 Repeated Dose 28-day Oral	No toxicity was observed at any dose. All parameters (neurological, body weight, weight gain, food consumption) were not different from control. The NOEL was considered to be > 2000 mg/kg/day.
425 One Dose Oral Ingestion	No effects observed at highest concentration tested. Not considered to present a significant hazard if swallowed. LD50 > 2000 mg/kg.
429 Skin Sensitization	Not considered to be a contact dermal sensitizer at concentrations < 10.7%.
471 Bacterial Reverse Mutation	Shown to be not mutagenic up to the maximum concentration tested of 5 mg per plate.
473 In vitro Chromosome Aberration	Did not induce chromosome aberration in cultured Chinese hamster ovary cells at a maximum test concentration of 5 mg/mL.
474 In vivo Erythrocyte Micronucleus	Did not induce micronuclei in the mouse micronucleus test at a maximum tested dose of 2000 mg/kg.

FPInnovations

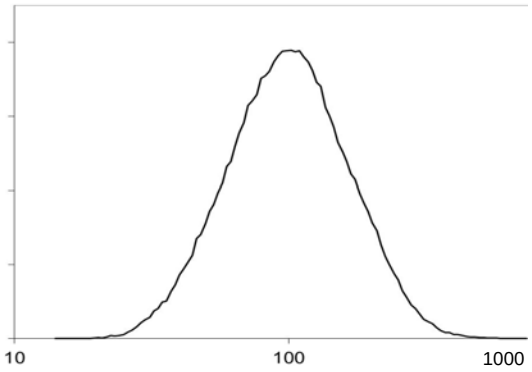
Topics Covered

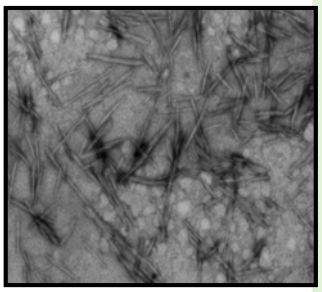
- Properties of CNC in aqueous solutions
- Properties of CNC in solid form
- Two OH&S testing campaigns at CelluForce demonstration plant

FPInnovations

Size Distribution of CNC in Water and as an Atomized Solution

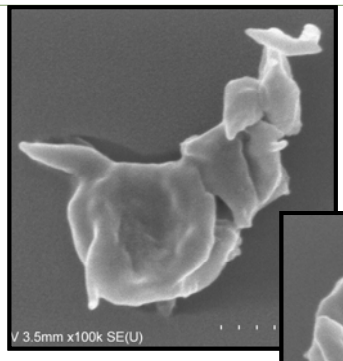
- SMPS scan of a 0.013% CNC solution in water atomized into a 1 m^3 exposure chamber

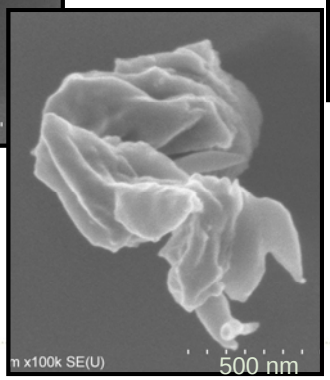


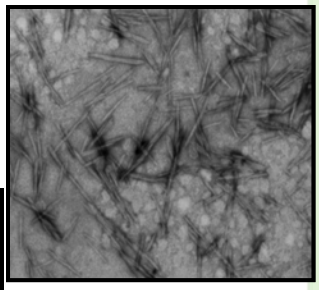


FPInnovations

Fate of CNC in Aerosol Form



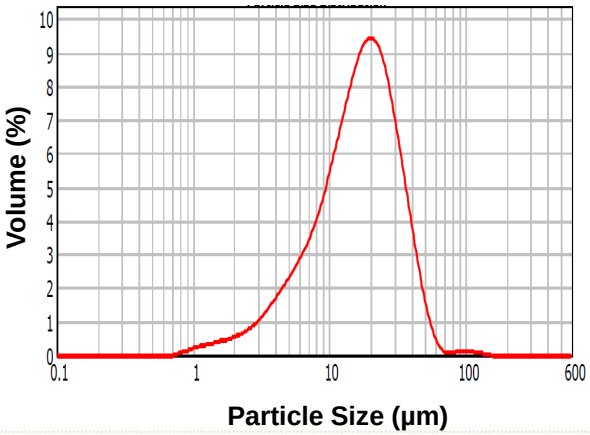


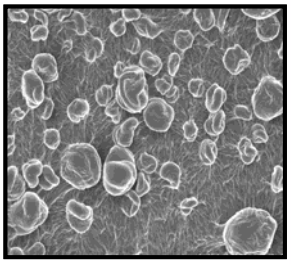


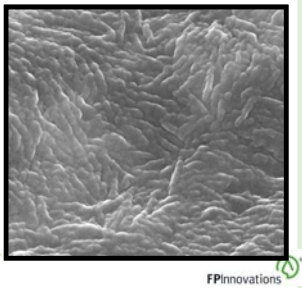
FPInnovations

Size Distribution and Form of Spray Dried CNC

- Measured using a Mastersizer



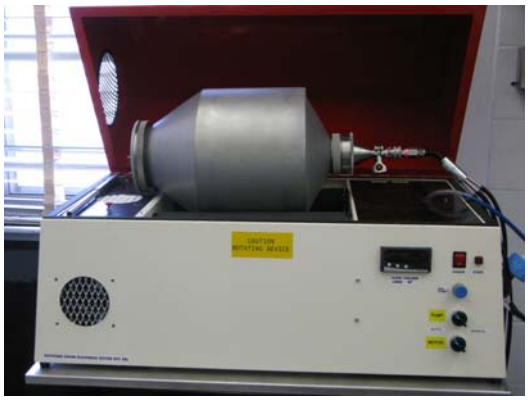




FPInnovations

Dustiness Behaviour of Spray Dried CNC

- Moderately dusty, similar to talc



Dustiness tester (DIN EN 15051)

- Are nanoparticles released during mixing
- NO

FPInnovations

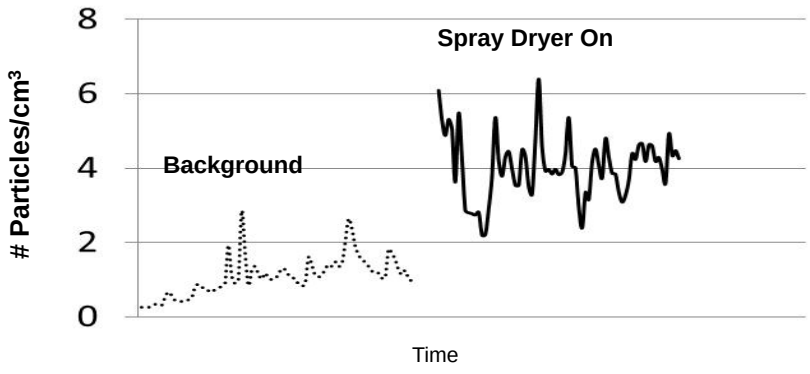
OH&S Measurement Techniques Employed at CelluForce

- Nano particles measured using Scanning Mobility Particle Sizer (SMPS)
- Macro sized particles measured using Optical Particle Sizer (OPS)
- Tests performed at CelluForce
  - April 2012: Normal spray drying operation
  - December 2012: Upset spray dryer conditions

FPInnovations

Normal Operations at Spray Dryer

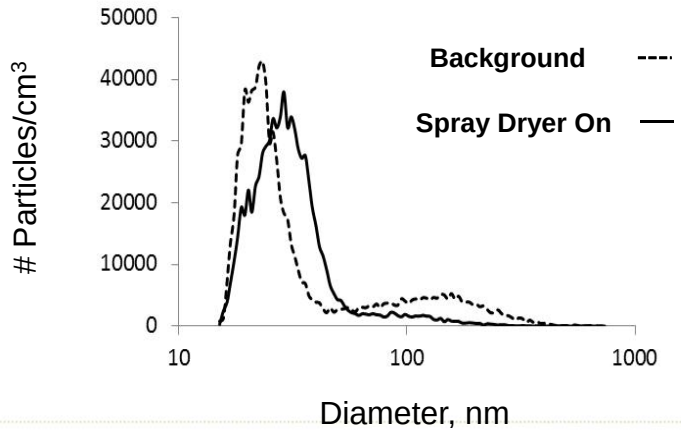
Optical Particle Sizer (0.7-10 µm)



FPInnovations

Normal Operations at Spray Dryer

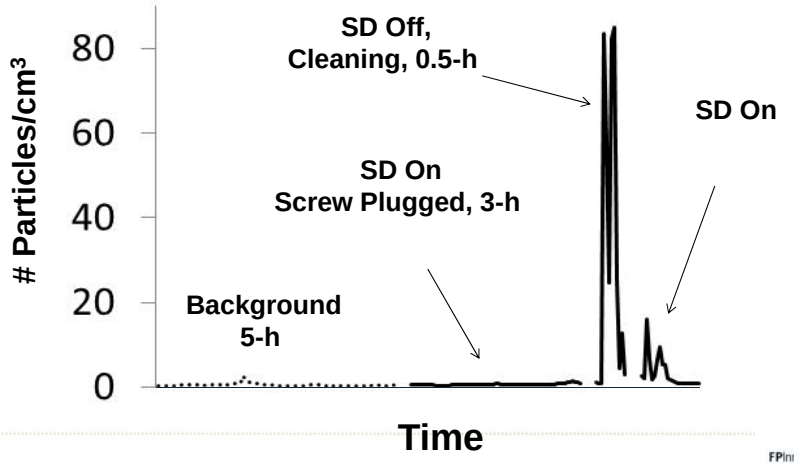
Nano Particles in Air (SMPS)



FPInnovations

Upset Conditions at Spray Dryer (SD)

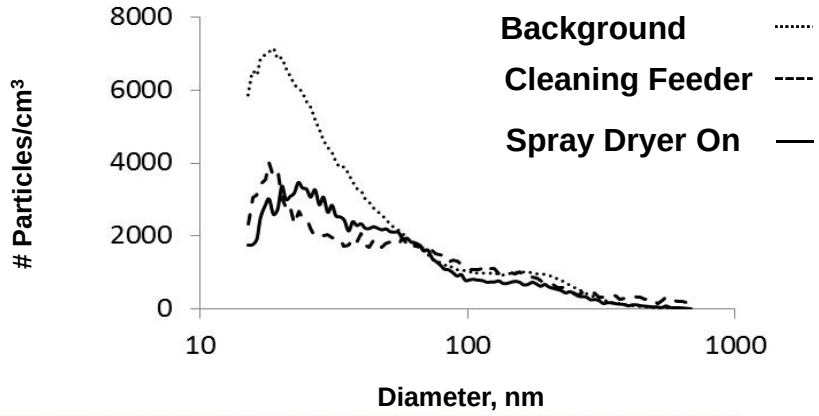
Macro Particles in Air (OPS)



FPInnovations

Upset Conditions at Spray Dryer

Nano Particles in Air (SMPS)



FPInnovations

Summary

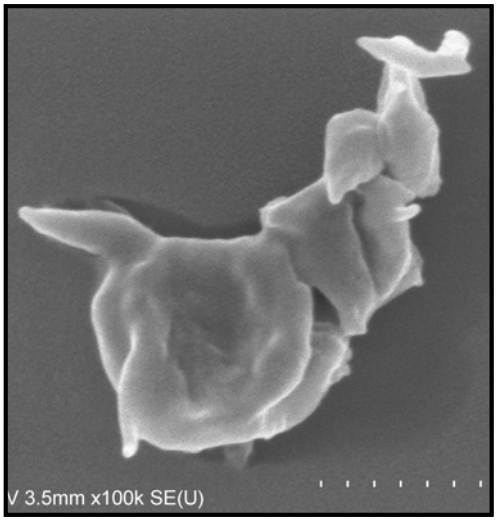
- All environmental and toxicological testing, to date, indicate that CNC is a material of low concern
- Spray dried form of CNC is a stable micron sized powder with a dustiness profile similar to talc
- Indication of an increase in micron sized particulates during spray drying operations
- No apparent release of individual nano sized CNC into the air during normal or upset operating conditions
- Standard PPE equipment should be able to adequately control employee exposure to dust

FPInnovations

FPInnovations®

Thank You

- **Contact Info**
- **Brian O'Connor**
- **514-630-4121**



15