

2010

# Biomass Dryers



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## ROTARY DRYER

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### Purposes

- Chemical
- Pharmaceutical
- Food
- Maize germs
- Powders
- Crystalline materials

### Structure

- Cylinder shell inclined at angle (0-5 degrees)
- Function: conveyor and heating device
- Lifting flights inside to increase contact with surface area

### Cost and Output

- \$122 000 per year to maintain
- 74.8% capital
- 25.2% operational
- Produce 150 kg/h db dried potato cubes

### Advantages

- 80-90% of moisture reduced  
(<http://www.google.ca/patents?hl=en&lr=&vid=USPATAPP12197513&id=tzHNAAAAEBAJ&oi=fnd&dq=rotary+biomass+dryers&printsec=abstract#v=onepage&q=rotary%20biomass%20dryers&f=false>)
- Low maintenance
- Large volume

### Disadvantages

- Can only dry certain volume at a time (not a continuous feed)
  - Slow (10-20 minutes residence time)
- Cannot dry sludge, wet waste, fine grains, any similar materials
- Burns fossil fuel to create heat
- Expensive because use of fossil fuel
- Only 10-15% of cylindrical volume is filled
- High energy consumption, low output

## Companies

### Whiting Equipment Canada Inc. (Swenson dryers)

- Ambient air temp up to 350 degrees F
- Direct heat dryer produced hot air- up to 1800 degrees F

### Teaford

- 143000 PPH water evaporation from 158000 PPH bone dry material

## GEA Barr-Rosin

- Evaporate 30-40 tonnes/hour

## FLASH DRYERS/PNEUMATIC DRYER

### Purposes

- Sludge
- Wet cakes
- Food
- Minerals
- Chemicals
- slurries

### Structure

- Spin flash dryer
  - Horizontal agitator disperses mass that comes in contact with heat to dry
- Cage Mill flash dryer
  - Vertical pin type rotary cages
  - Wet mass fed through center for direct heat contact
  - Rotation disperses feed while drying

### Cost

- Approx. Output of few hundred kg/hour – hundreds of tons/hour
- Approx temp 500-600 degrees C

### Advantages

- 0.5-2 seconds of residence time
- Cylindrical shape and short time = high volume of mass that can be dried
- Ideal for fine grained materials

### Disadvantages

- Not ideal for heat sensitive materials
- Only dries surface moisture

## Companies

### GEA Barr-Rosin

- Use of scrubbers to clean exhaust gas to meet emission requirements
- Elevated drying temperature
  - Flashes off surface moisture, drying gas is instantly cooled w/o increasing product temperature
- 20+ tons of water evaporation/hour
- Inlet air temp 100-650 degree C

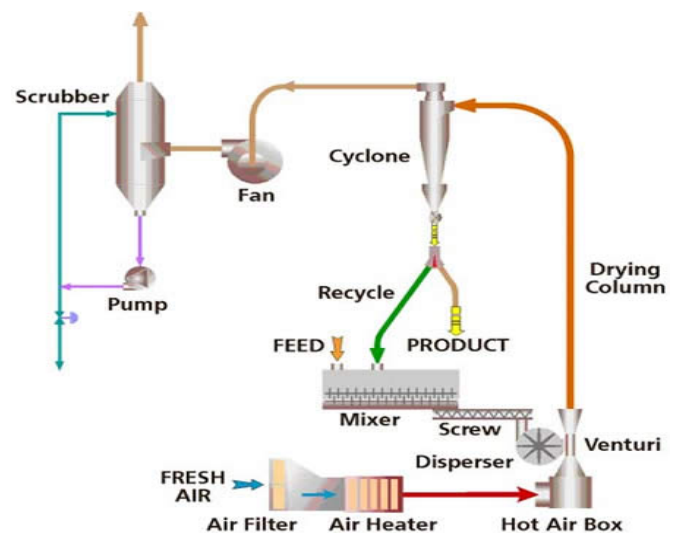


Figure 1 GEA Barr-Rosin Flash Dryer

- Airflow can exceed 120 000 cfm (200 000 m<sup>3</sup>/hour)

Whiting Equipment Canada Inc. (Swenson dryers)

- Available in carbon steel, stainless steel and other alloys

## RING DRYERS (modified flash dryer)

### Purposes

- Sludge
- Food (byproducts)
- grains

### Structure

- Materials' first heat contact is a flash of heat
- Particles pass through rings for further drying (if larger/wet particle, conveyed back to dry again)
- Materials are then conveyed to a second chamber column
- Heated air is moved through column, drying particles
- Particles pass through rings for further drying (if larger/wet particle, conveyed back to dry again)

### Cost

#### Advantages

- Thorough and complete drying
- Short residence time
  - 2 seconds flash dry
  - 4 minutes mixing recycle system

#### Disadvantages

- Many parts to machine and drying process

## Companies

### GEA Barr-Rosin

- Presence of "manifold" or "internal classifier"
- Centrifugal airstream and adjustable splitter blades move heavier, semi dried material back into dryer
- Lighter dryer continues through conveyor
- Selective residence time
- 150 000cfm (250000 m<sup>3</sup>/hr)
- Natural gas, steam, hot oil, flue gases used to operate

## FLUID BED DRYERS

### Purposes

- Food
- Chemical
- Mineral
- Polymer
- Powders/crystals/granules

### Structure

- Air supplied through perforated distributor plate
- Air flow velocity is sufficient to support mass weight
- Air turbulence causes materials to become suspended on a cushion of air or gas
- Solids behave like boiling liquid

### Cost

### Advantages

- Can hold high volumes
- Optimum heat transfer efficiency
- Good mixture
  - Frequent collisions between particles allow for

### Disadvantages

- Not easily operated with all the different parts

### Companies

Whiting Equipment Canada Inc.  
(Swenson dryers)

- Stationary and upright
- Use of feed chute or screw feeder
- Fluidized by gas (nitrogen)

### GEA

- Niro Vibro-Fluidizer
  -
- Size 300 ft<sup>2</sup>
- Temperature up to 1200 degrees C
- High thermal capacity
  - ensures accurate temperature control
  - uniform heat treatment
- 90% heat supplied through steam or circulating fluid
  - Reduction in airflow = reduction in emission, plant size and operating costs

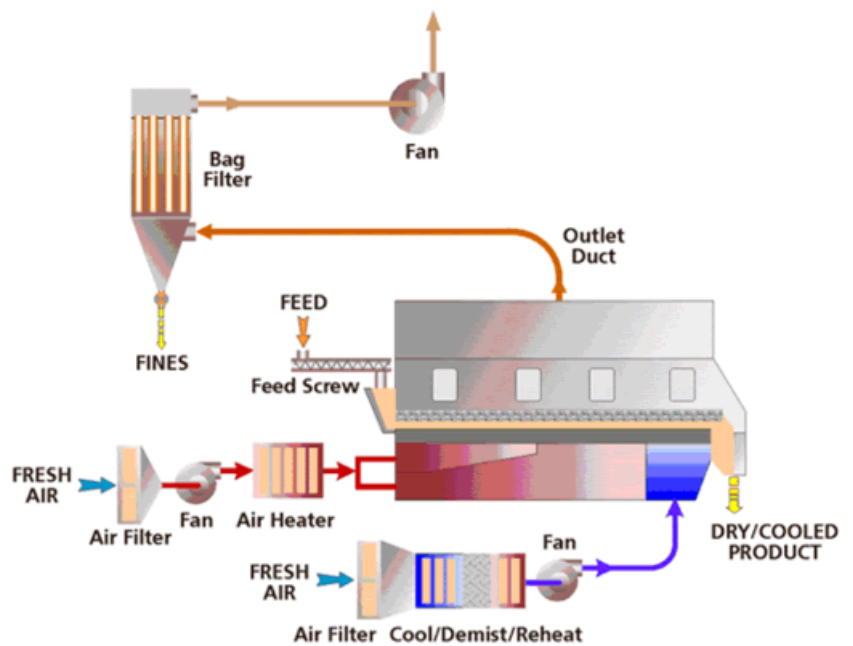


Figure 2 Open system of a Fluid Bed Dryer

## SPRAY DRYERS

### Purposes

- Food
- Pharmaceutical

### Structure

- Atomizes a wet solution into drop lets
- Gas/spray mixing chamber
- Heated air is sprayed at top of cone-shaped chamber
  - Wet mixture comes in contact with heat
  - Dried particles gather at bottom

### Cost

### Advantages

- evenly and thoroughly dried particles

### Disadvantages

- only produces powder solids
- requires adequate droplet and spraying distance

### Companies

#### GEA Filtermat

- requires a longer drying time
- includes conveyor for second stage drying
- air blows downward

#### Whiting Equipment Canada Inc. (Swenson dryers)

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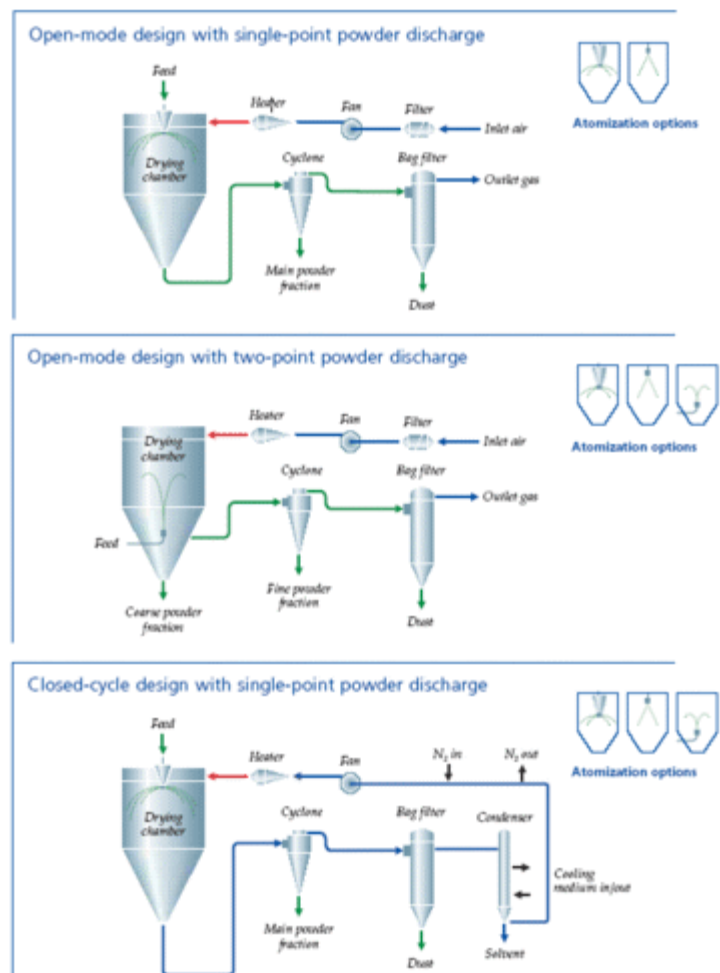


Figure 3 GEA Niro Spray Dryer diagram



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## ARTICLES

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### *From Operating Ease to Operating Costs: Weighing Differences in DDGS Dryers*

[http://www.ethanolproducer.com/article.jsp?article\\_id=3032](http://www.ethanolproducer.com/article.jsp?article_id=3032)

#### **Summary:**

##### Operability and Control

- Rotary (good)
  - continues to run even if there is process problem
    - Material is too wet, sugar content too high, too much material in machine
  - Adjustable temperature for different volumes of mass
- Ring (good)
  - Small volume of material = Produces better quality product
- Rotary (bad)
  - Long residence time = long and hard recovery
    - Especially if volume of mass is high
- Ring (bad)
  - Short residence time = smaller processing size

##### Layout

- Rotary
  - Requires large floor space and concrete foundation, lots of foundation for all part required
  - Not much steel involved
- Ring
  - Steel structure
  - Only fan needs substantial foundation

##### Material Handling and Recycling Systems

- Rotary
  - Long conveyor
    - Dry product deposited on one end, feeder 60-70 feet at other end
- Ring
  - Short conveyor
    - Assist of gravity in process

##### Energy Usage

- Rotary
  - Large diameter seals under suction = leakage
  - Use 5-10% more heat

##### Electrical Usage

- Rotary
  - Rotation of drum to convey product
- Ring
  - Conveys pneumatically and at high velocity
    - Consumes more power

Cost of electrical power is much less  
than heat

## Maintenance

- Rotary
  - Mechanical systems on drum and extra conveyors require regular maintenance
- Ring
  - Only main fan needs maintenance