

Turboscrubber[®]: Bleach Plant Scrubbing Application

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Company Overview

- Private Canadian company based in Vancouver, Canada
- Established in 1988
- Focused on providing technology solutions, equipment & engineering packages
- NORAM group of companies includes fabrication shops (Axton & Ellett) and a Process Commercialization / Scale-up Facility (BCResearch)
- ~200 people in group (Canada & Sweden).

Pulp and Paper Technologies

- **Cleanflow™** System for Green and White Liquor Filtration
- **Turboscrubber®** Wet-scrubbers
- **Lignoforce™** Lignin Recovery Process
- **PDP-K™** Process for Chloride and Potassium purge
- **Optimum Acid™** NCG Acid Process for Sulfur management
- **IsoFlo™** White & Black Liquor Oxidizers
- **Audits**
 - Na, S & NPE balances
 - Recausticizing Optimization Study

TurboScrubber®

Turbulent Contact Absorbers

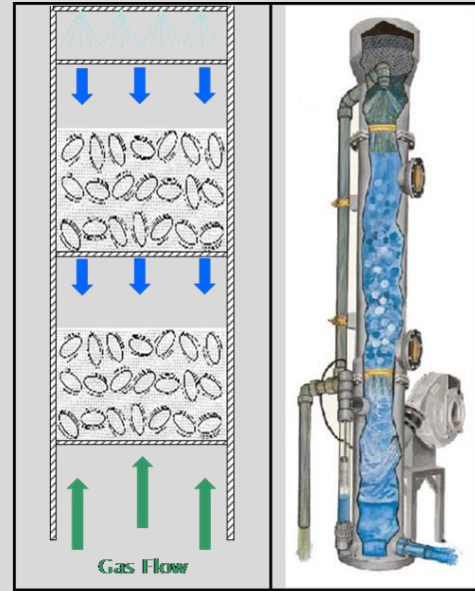
- **Fluidized Bed Technology**
 - Scrubbers, Absorbers, Strippers
- **History**
 - Developed and progressed by FTL and Osprey since 1991
 - Over 400 plants installed worldwide in many various industries
- **Pulp and Paper Applications**
 - AV Group, Atholville, NB, Canada
 - Visy Pulp & Paper, Australia
 - Huhtamaki Group, USA



Turbulent Contact Absorber

Process

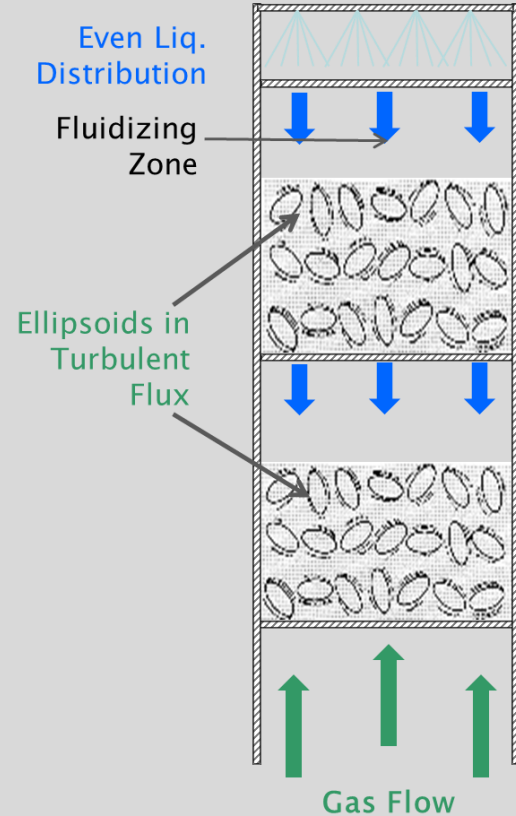
- 3-Phase Fluidized Bed System
- Dynamic Packing Material increases Gas/Liquid contact
- Non-Plugging
- High Mass and Heat Transfer Rates
- Particle removal down to sub 0.5 micron
- Turndown as low as 1:12



Turbulent Contact Absorber

Advantages

- **Unsurpassed Mass and Heat Transfer**
 - High turbulence leads to high mass and heat transfer coefficients
- **Equipment Size Reduction** and can be **retrofitted** in existing packed bed or spray scrubber
- **Guaranteed Blockage Free Application**
 - Slurries, biomass, precipitating systems
- **Multi Use Friendly**
 - Absorption, particulate removal, heat transfer in one unit
 - More energy efficient than combination units
- **Flexibility**
 - Turndown as low as 1:12

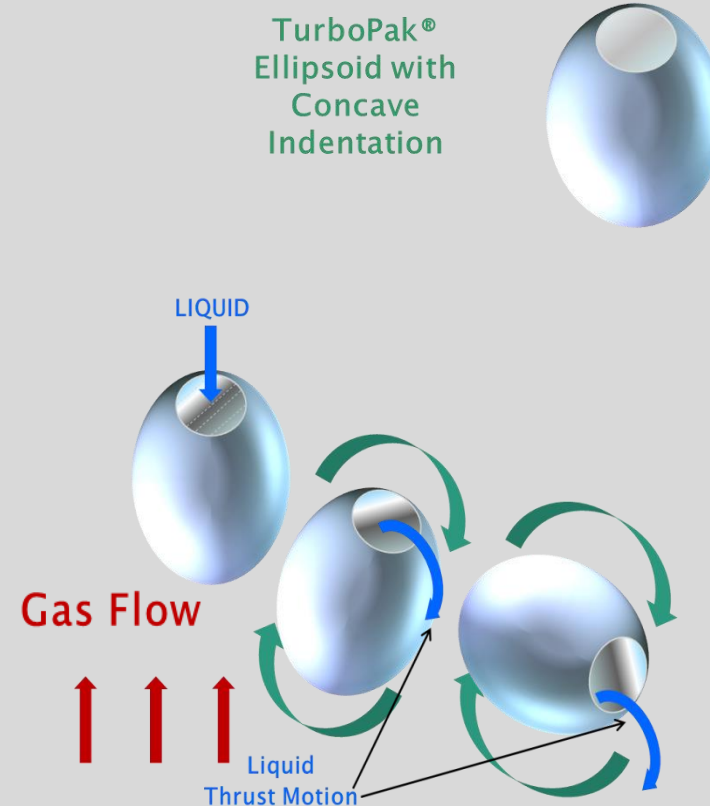


Turbulent Contact Absorber

Dynamic Packing

- MOC: PP or PVDF
- Patented Ellipsoid Shape
- More energy efficient to fluidize
- Indent adds extra thrust to the tumbling motion
- Overcomes issues with sphere shaped packing which lead to unreliable performance
 - Swirl, Sideways Movement
 - Channeling
 - Distribution

TurboPak®
Ellipsoid with
Concave
Indentation



Turbulent Contact Absorber

Pilot Movie



Pulp and Paper Application

Huhtamaki – Waterville, Maine

- Treating off-gas from vacuum forming machine with paper machine white water
- Recovering carbon particles & wax with up to 99% removal
- Heat Recovery up to 2 MMBtu / hr
- Heat Transfer Coefficient $> 150 \text{ kW} / \text{m}^2\text{°K}$
- 2 feet diameter, 14 feet tall



Pulp and Paper Application

Huhtamaki – Hammond, Illinois

- Treating Vacuum forming machine off-gas with water
- Recovering carbon particles & wax with up to 99% removal
- Heat Recovery up to 6 MMBtu / hr
- Heat Transfer Coefficient $> 150 \text{ kW} / \text{m}^2\text{°K}$
- 4 feet diameter, 21 feet tall



Pulp and Paper Application

AV Cell – Atholville, New Brunswick

- Absorbing SO_2 gas in $\text{Mg}(\text{OH})_2$ Slurry
- Retrofit of existing tower
- Improved SO_2 removal to 99.9%
- Reduced pressure drop to ~50%
- Previous shutdowns due to plugging every 2-3 months
- Increased lifespan to at least 1 year between cleaning – annual shutdown





Bleach Plant Scrubbing

- ClO_2 in the bleach plant's exhaust gases are absorbed and neutralized in a bleach plant scrubber
- Increased pressure from environmental agencies and stakeholders to reduce emissions

Bleach Plant Scrubbing

Types of Scrubbers

- **Packed Bed**

- Typically plug every 4-6 months
- Cleaning can take up to 48 hours
- Washer fabric tears have immediate impact on performance
- Require fiber filter on scrubbing medium
- Efficiency depends on chosen packing

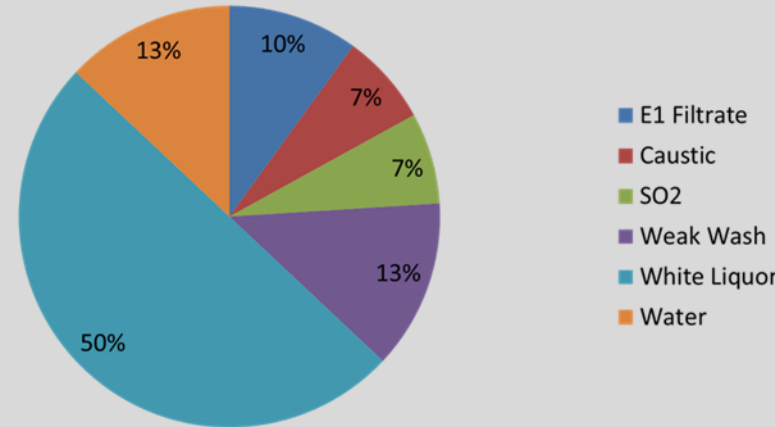
- **Cross Flow Type**

- Highly dependent on size and distribution of spray
- Nozzles prone to plugging with fiber / CaCO_3
- Acid wash of nozzles required

Bleach Plant Scrubbing

Scrubbing Media Used

- Traditionally used scrubbing media are (1994 data)
 - **White Liquor**
 - **Water**
 - **Weak wash**
 - **E-Stage filtrate**
 - **Caustic**
 - **SO₂**



Bleach Plant Scrubbing

E-Stage Filtrate

- **Excellent choice for scrubbing**
 - Freely Available
 - Alkaline
 - Organic Material which can be oxidized
 - Scrubbing also reduces the color of the filtrate
 - Effectiveness determined by lignin content and pH
- **Widely used but fibers create problems for most Scrubbers**

Turboscrubber

Advantages

- **Excellent Option for Bleach Plant Scrubbing Duty**
- **Guaranteed Blockage Free Application**
 - Slurries, biomass, precipitating systems
- **Lower Pressure Drop – More Energy Efficient**
- **Equipment Size Reduction – Footprint and Height**
- **Multi Use Friendly**
 - Absorption, particulate removal, heat transfer in one unit
 - More energy efficient than combination units
- **Unsurpassed Mass and Heat Transfer Rates**
 - High turbulence leads to high mass and heat transfer coefficients



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Questions?