



# ***Biodiesel Application guide***

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Iliia V. Bahtin



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## **Principal Applications**

- 1. Catalysis
  - Esterification of Free Fatty Acids (FFAs)
  - Transesterification
- 2. Purification – for removal of
  - Soap (alkali salts of fatty acids)
  - Catalyst
  - Glycerol
  - Other impurities



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## **Catalysis**

- Esterification
  - Generally involves use of standard (existing) catalysts
    - Amberlyst 36WET, Amberlyst 70
  - High conversion and good activity proven
  - Amberlyst 36WET in use in industrial scale
  - Launch of a new esterification catalyst in Q3/2007
- Transesterification
  - “Holy Grail” for biodiesel production
  - Existing catalysts generally have low activity
  - Transesterification typically done with a basic catalyst, not acidic



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### Development of the Polymer sorbent

- Removal of K/Na + glycerol from raw Biodiesel
- Economically competitive to conventional process (water wash)
- The sorbent was developed as a ready-to-use product
- Information package available:
  - Biodiesel brochure
  - Users Guide



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### Amberlite BD10DRY Properties

- Hard, insoluble, polymeric beads
- Spherical shape
- Particle diameters of 0.3 to 1.2 mm
- Easily filterable using screens
- Low pressure drop to continuous flow



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### Amberlite BD10DRY Advantages

- Eliminates need for water-wash
  - Water wash results in 1-2% yield loss of biodiesel
- Simple equipment (no need for complicated filtering hardware)
- Removes soaps and catalyst traces
- Reduces water consumption
- Reduces wastewater generation
- Removes glycerol
- Produces in-spec Biodiesel
  - ASTM D-6751
  - EN14214



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### Soap – Cation – FFA correlation

- Soap and other cations are converted to acidity
- Acid value of product will increase
- Following table shows limits of feed impurities that can be treated

Spec.	Soap (as K oleate, ppm)	Cation content (as K, ppm)	Acid Value (mg-KOH/g)
EN14214	2859	349	0.5
ASTM D6751	4570	557	0.8




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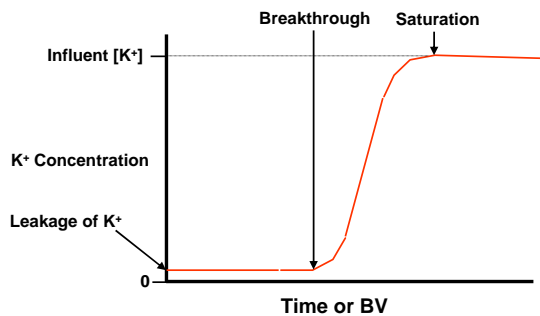
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### Column Breakthrough Profile




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### Soap/Catalyst Removal

- Polymer sorbent can completely replace need for water-wash system
- BD10DRY capacity “Rule of Thumb”
  - 1 kg of BD10DRY will treat 900-1600 kg of Biodiesel, depending on level of impurities
  - Replacement frequency depends on bed size but typically 30 day service life
- Recommended maximum flowrate:
  - 3 L/hour of biodiesel per kg of BD10DRY resin
- A lab testing program will take place at Chauny (Finalisation in 4Q2006) to generate lab data on capacity and impact of operating conditions




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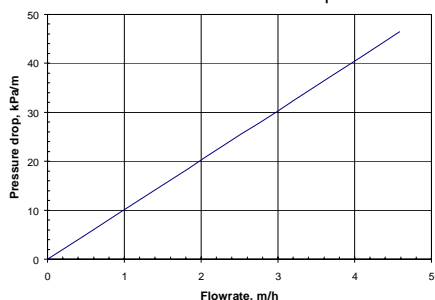
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### BD10DRY Pressure Drop – SI units

Calculated for normal biodiesel purification



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### Dry Sorbent Swelling Values

- Swell (volume increase) vs. Environment
- DRY → Biodiesel 7% swell
- DRY → Methanol 117% swell
- DRY → Water 147% swell
  
- SAFETY NOTE: Important to design vessels with ca. 3X volume of installed resin volume



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### Biodiesel Polishing

- BD10DRY can be used to “polish” biodiesel
- Final purification following conventional water wash
- Due to low impurity level, resin lifetime will be long, e.g., 6 months – 1 year



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### Amberlite BD10DRY Usage Guidelines

- 1 kg of BD10DRY will treat:
  - 900–1600 kg of biodiesel
- Usage rate depends on soap concentration
- Usage rate based only on soap and catalyst removal (i.e., not glycerol)
- Typical soap levels are 1200-2100 ppm (as K oleate)
- Methanol level affects capacity for glycerol




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### Typical Operating Conditions

- No pretreatment (rinse) of AmberliteBD10DRY required
- Normal crude biodiesel feed:
  - Very low acidity (due to excess base catalyst)
  - < 0.3% glycerol
  - If glycerol level is higher, phase separation process needs to be improved




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### Value of Using Amberlite BD10DRY

- The average cost of using Amberlite BD10DRY is <\$0.035/gal (<€0.0073/l), assuming 200ppm cation content
- No water treatment facility required
- Operating and Capital expense are favorable compared to water-wash processes
- Amberlite BD10DRY process is much simpler to run
- Produces exceptionally pure biodiesel; less residual soap than water-based purification process
- Less lost product than water-wash process




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### Lifetime of Amberlite BD10DRY

- The frequency of “rebedding” (replacing the spent resin) will depend on the level of impurities in the biodiesel, the amount of biodiesel treated, and the size of the column
- Our customers typically aim for a design in which the Amberlite BD10DRY resin is rebedded every 4 to 8 weeks
- We can help select a design that best suits the customer needs



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### Waste Amberlite BD10DRY Options

- BD10DRY exhausted from soap/catalyst removal can still be used for glycerol adsorption
- In Europe, disposal of used resin is typically by incineration
- In US, landfill is also an option, in accordance with local, state, and federal regulations
- Landfill cost is typically around \$7/cubic yard in Texas



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### Glycerol Removal

- Glycerol removal completely independent of soap and catalyst removal
- Glycerol, low levels of water, and low levels of methanol removed via adsorption
- Amberlite BD10Dry can be regenerated for glycerol, but not for soap or catalyst
  - Methanol is used for regeneration and recycled back to transesterification reactor (no waste)
- Spent resin for soap and catalyst can be used for glycerol removal



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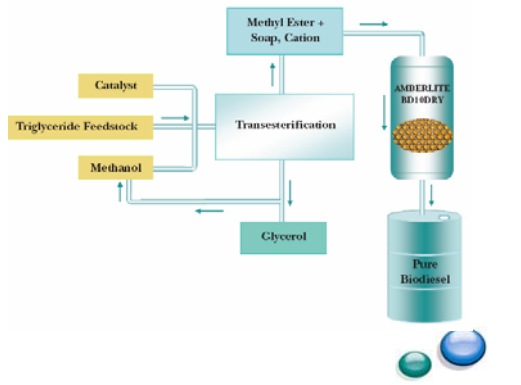
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### Typical Process Flow



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### Typical BD10DRY Columns



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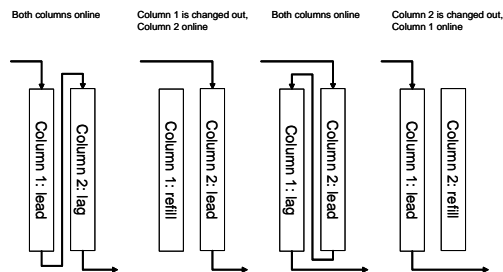
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### Soap Removal Beds - Sequencing



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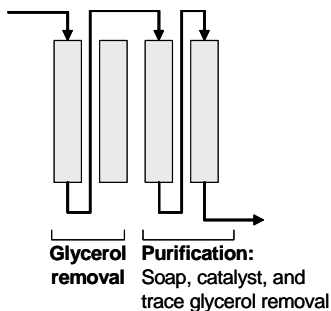
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## Glycerin Removal Beds



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<http://www.amberlyst.com>



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