



# Clean Water Technology

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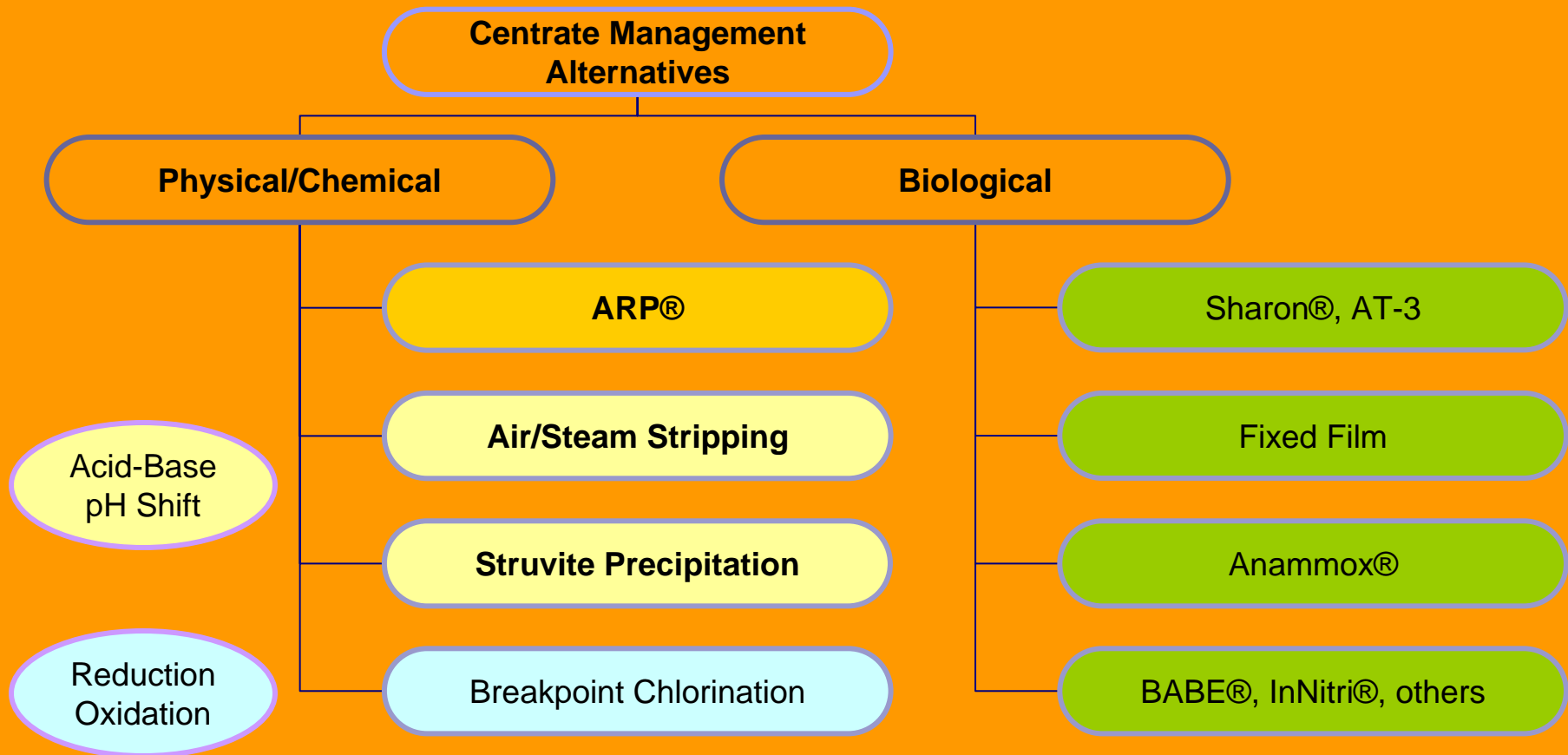


# Ammonia Recovery Technology

- Physical Chemistry - lowest-cost path to removal of ammonia from waste water.
- Demonstrated ARP at DEP's Oakwood Beach WPCP in 1998
- Awards for innovation for ARP
  - International R&D 100 Award 1999
  - Frost & Sullivan Award 2005



# ARP is a Physical Chemical Centrate Treatment



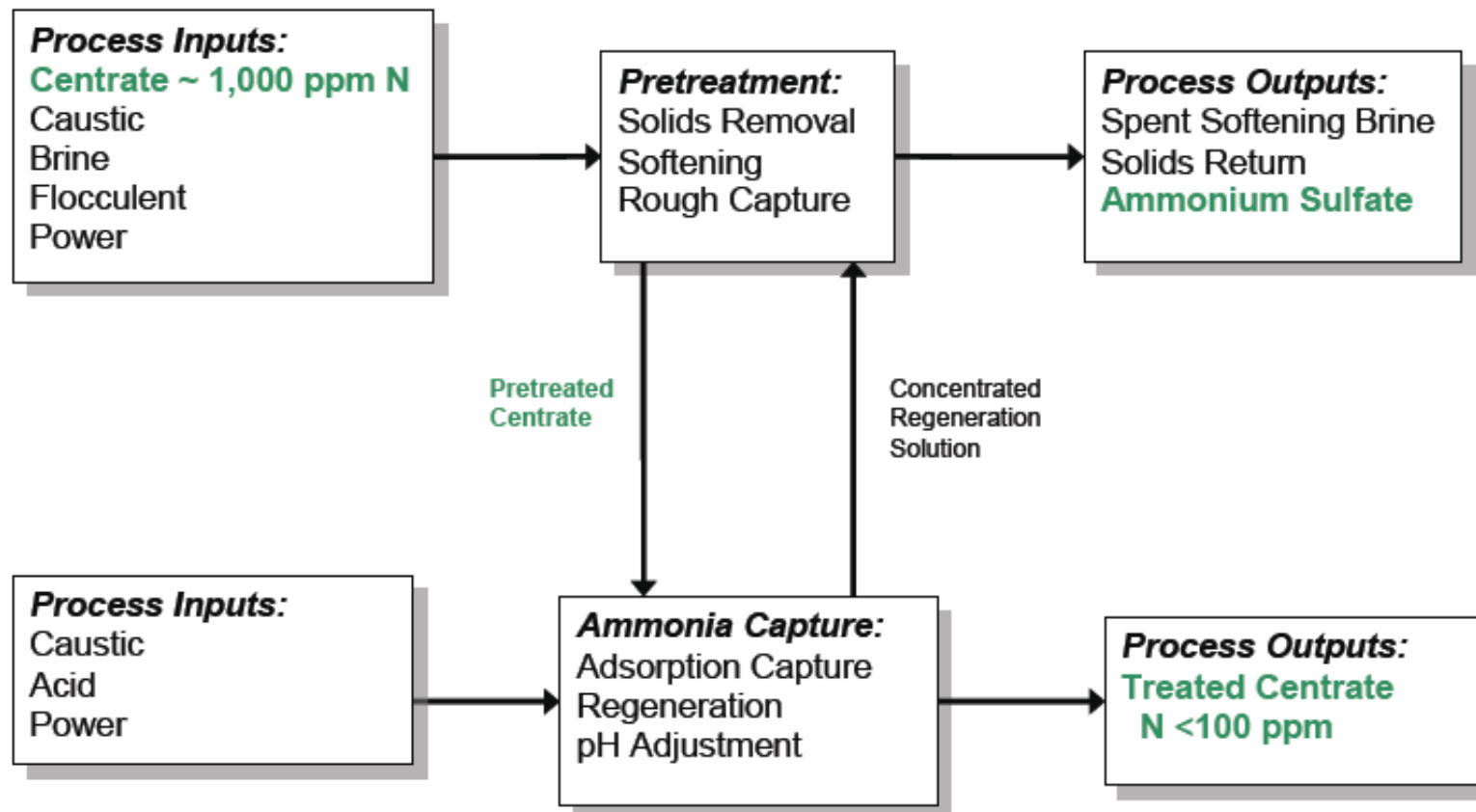
# ARP –Sustainable and Robust

## Components of Process

- Pre-treat Centrate to remove dirt and minerals
- Roughing system to reduce ammonia
- Adsorb remaining ammonia onto resin columns
- Recover ammonia and regenerate columns
- Separate and ship ammonium sulfate product



# Schematic of ARP as Applied to New York City Centrate



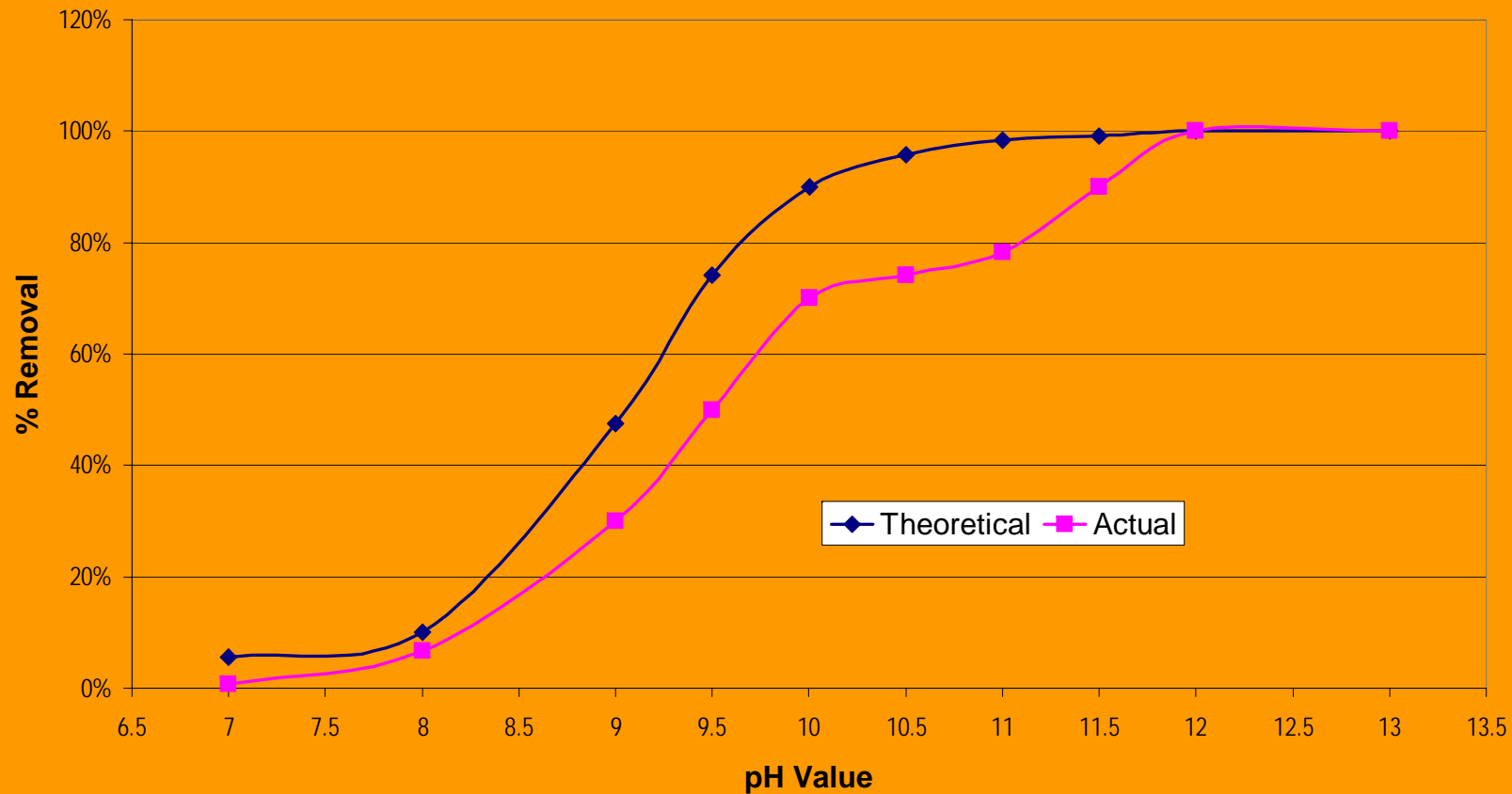
# Assembled Roughing Module



# Vacuum Distillation of Ammonia

## Effective at high pH

Actual vs. Theoretical Removal of Ammonia



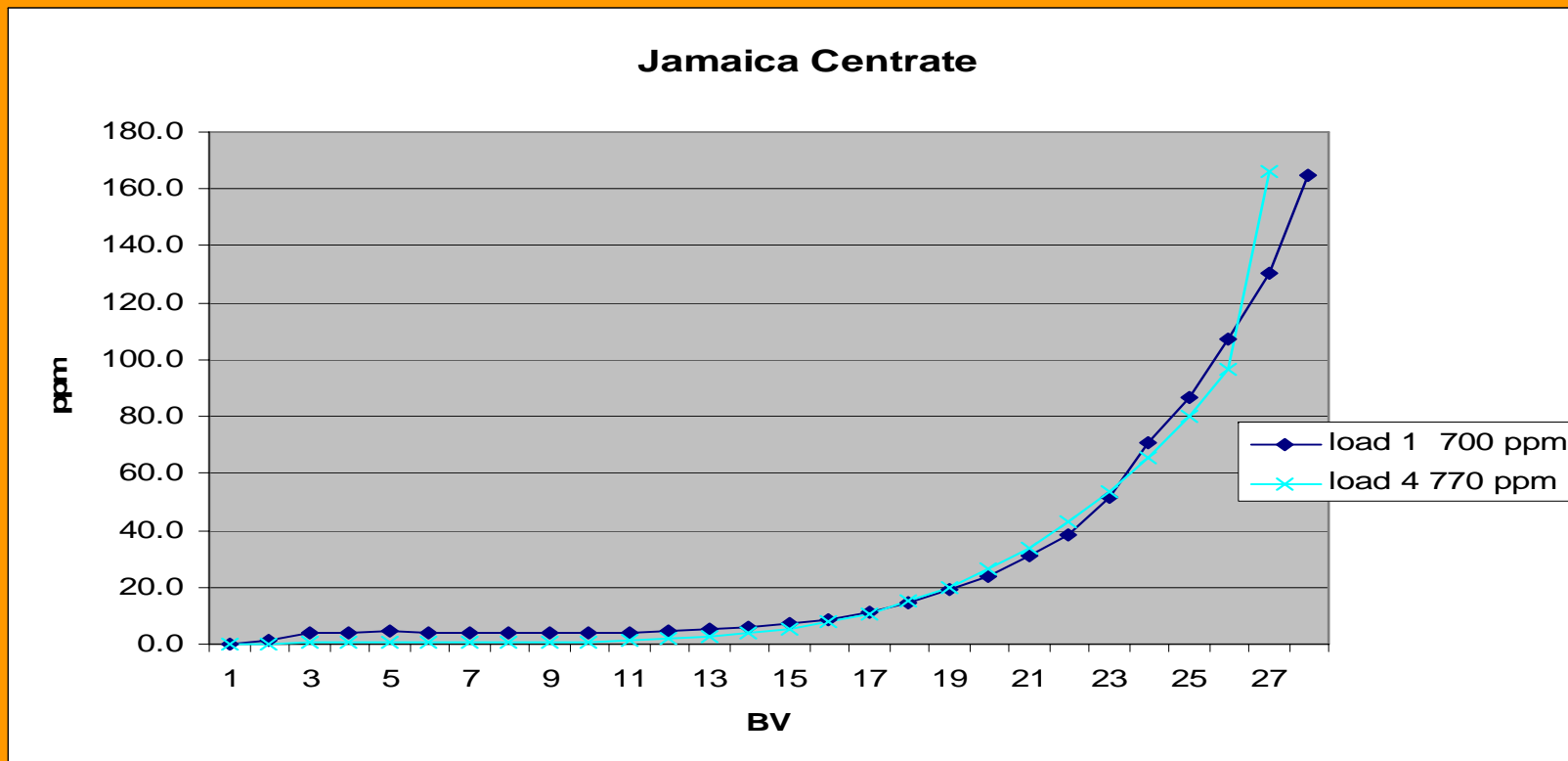
# Assembled ADSORPTION Module





# Saturation Curve for Centrate Sample

Load curve exactly repeats after regeneration  
Better than 95% removal at 27 bed volumes treated



# ARP: a, Cost and Space Effective, Reliable, Sustainable Solution

- About \$3.50 per pound ammonia removed - total cost
- Reliable: no specialized microbial biomass
- Sustainability – beneficial reuse advantages
  - $\text{NH}_3$  recovered for reuse – sale defrays chemical costs
    - Creates greenhouse gas credits
  - No additional sludge produced
- No aeration - energy savings over biological
  - Fewer kWhr/lb + no lb MeOH/lb  $\text{NH}_3$
- Lower space requirement, and lower capital and operating costs than biological

