



Arkea™ and Ammonia Management

CUSTOMIZED ENVIRONMENTAL SOLUTIONS

Contents

- Brief Archaea background
- Ammonia metabolism: new science
- Application of new science

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Archaea Overview

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Archaea

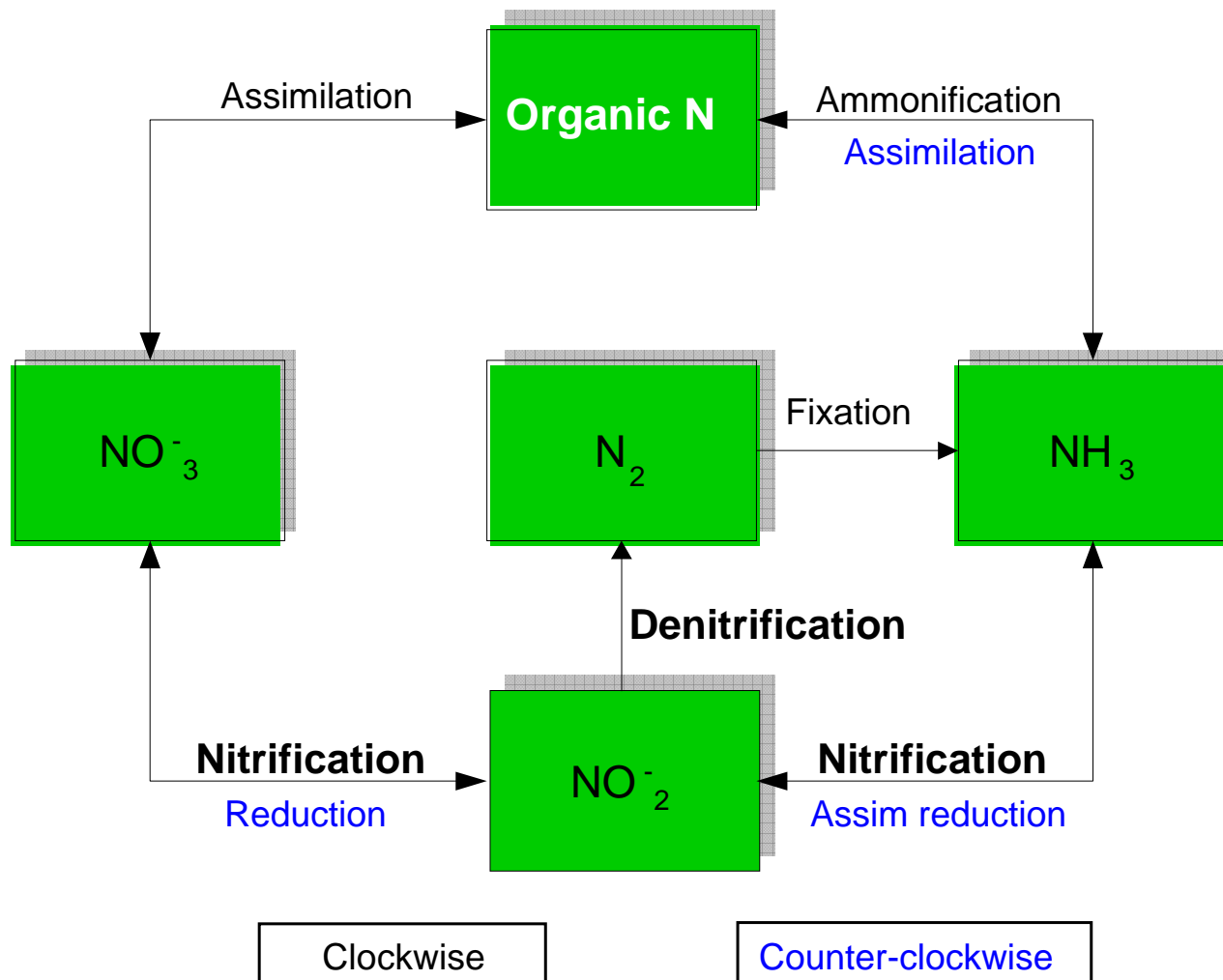
- Microbe, different from bacteria
- 35% or so of biological mass on Earth
- Necessary for carbon and nitrogen cycles
- Ecological shock absorber



New Science

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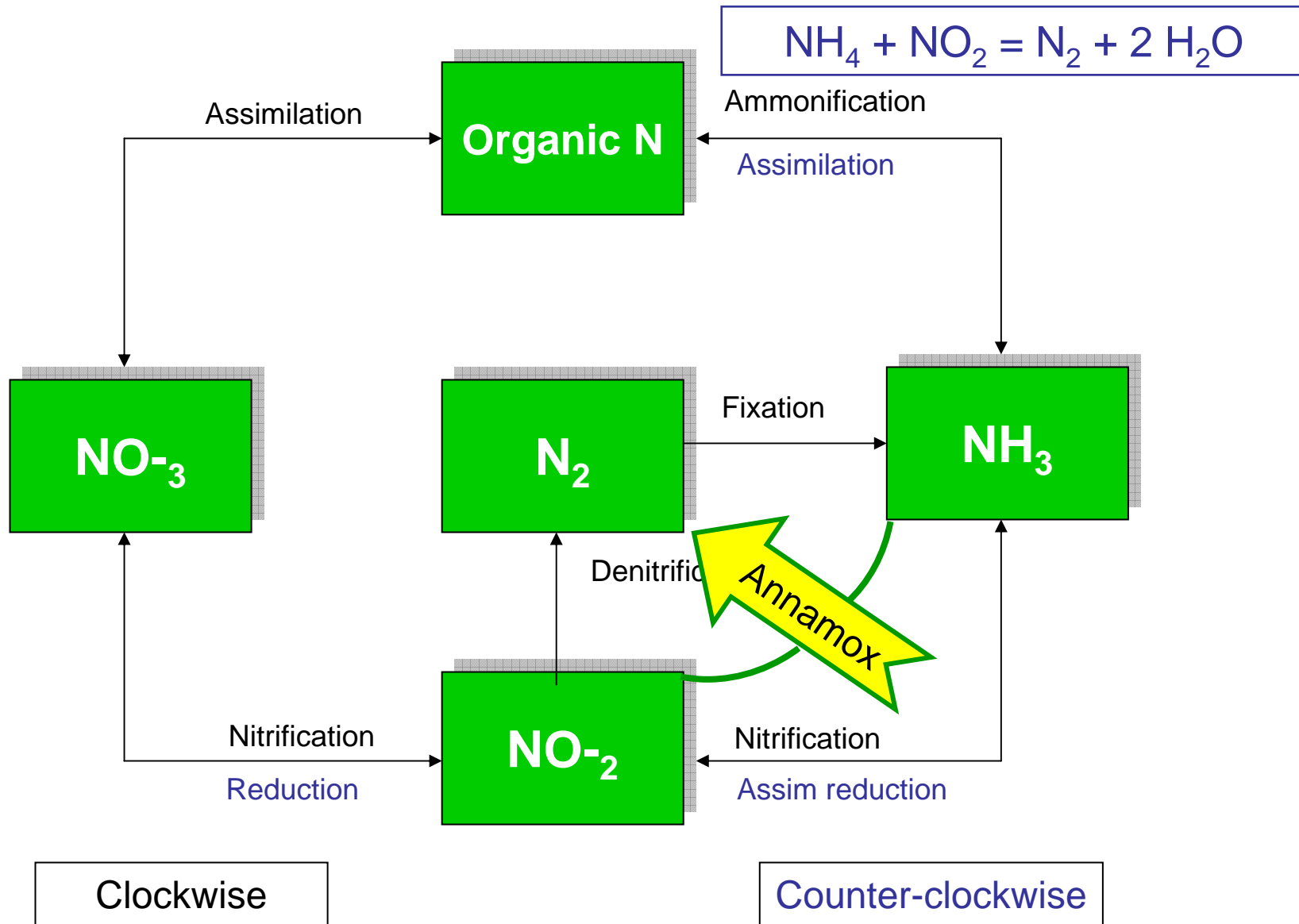
The science of ammonia metabolism: 1890 to 2000



New science since 2000

- ❑ Anammox™ for ammonia breakdown without a source of carbon
- ❑ Archaea ammonia oxidase, nitrate reductase
- ❑ Archaea-autotrophic bacteria syntrophy

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Archaea Ammonia Oxidase

- ❑ Archaeal “ao” 3000-fold more abundant in field studies than bacterial “ao”.
- ❑ Rate of ammonia breakdown, a f (Archaea mass) but not a f(bacterial mass).
- ❑ Archaea “ao” activity range: 25-165 °F.
- ❑ Soil Archaea oxidise ammonia to drive carbon dioxide fixation.



Archaea Nitrate Reductase

- Archaea able to perform all steps in nitrogen cycle.
- Reductive denitrification capability is widespread.
- Sensitive to cation concentration; ex: tungsten.

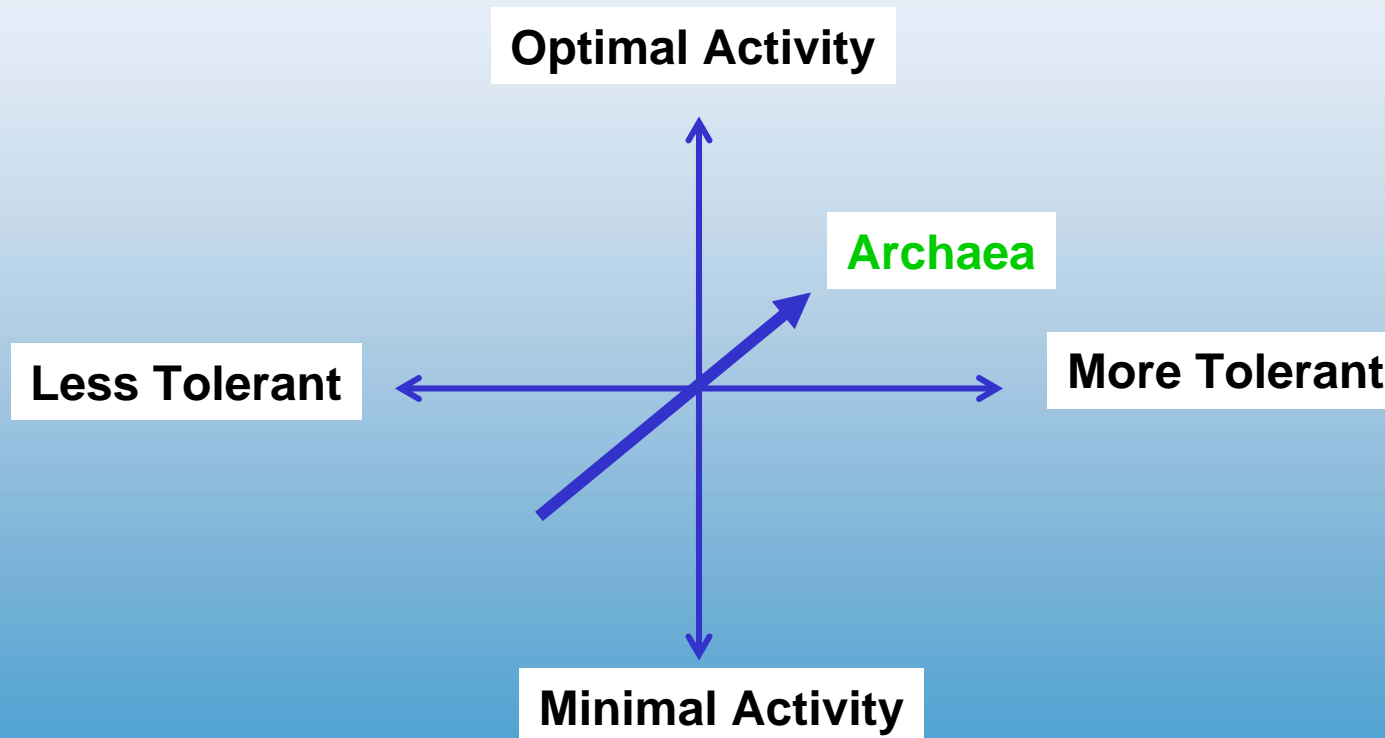


Archaea: Syntrophy

- ❑ Nitrifiers and denitrifiers: “finicky”
- ❑ Syntrophy with Archaea: more robust



In general

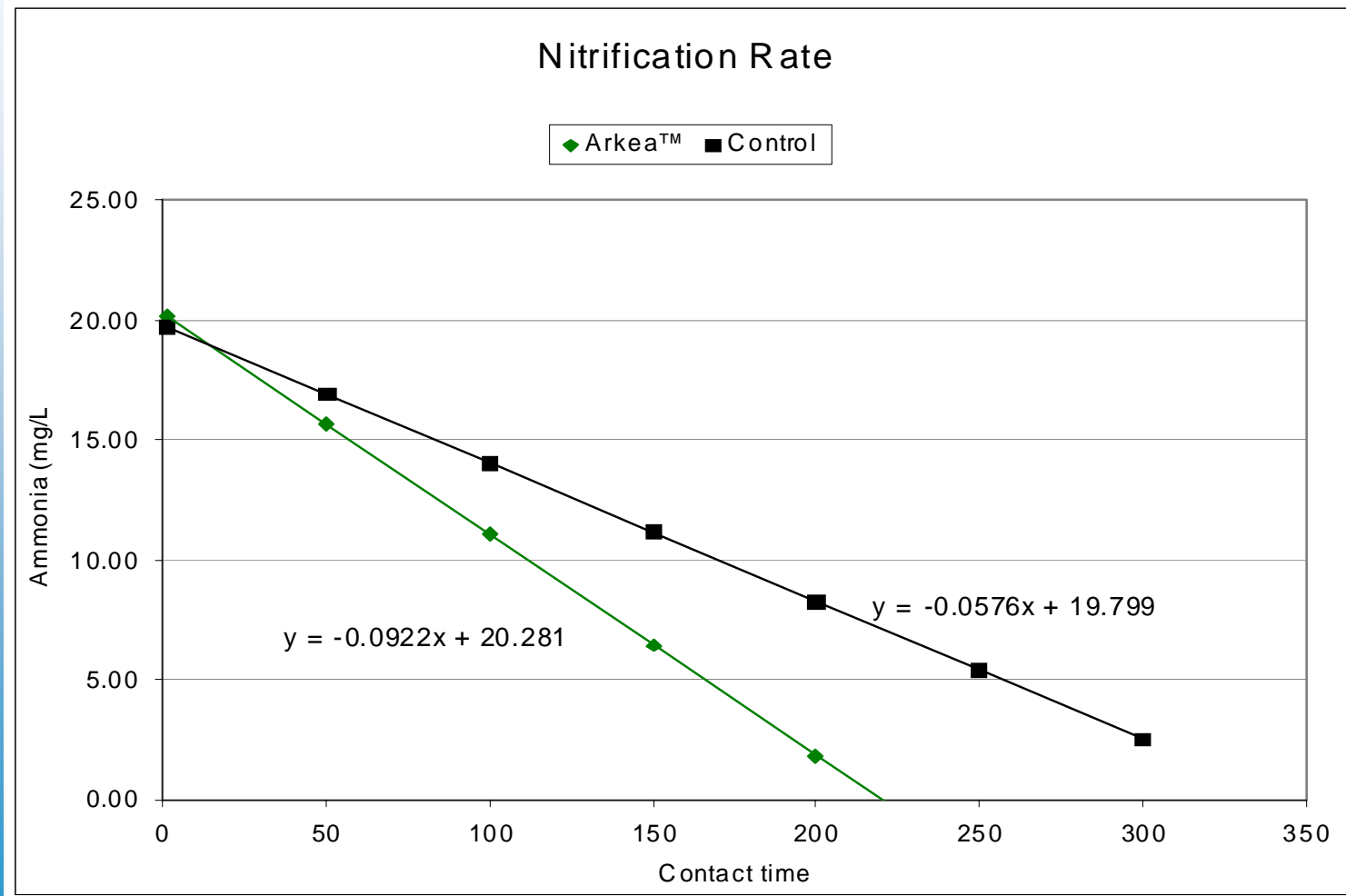




Peer-reviewed Lab

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WWTF Pilot Plant Kinetics

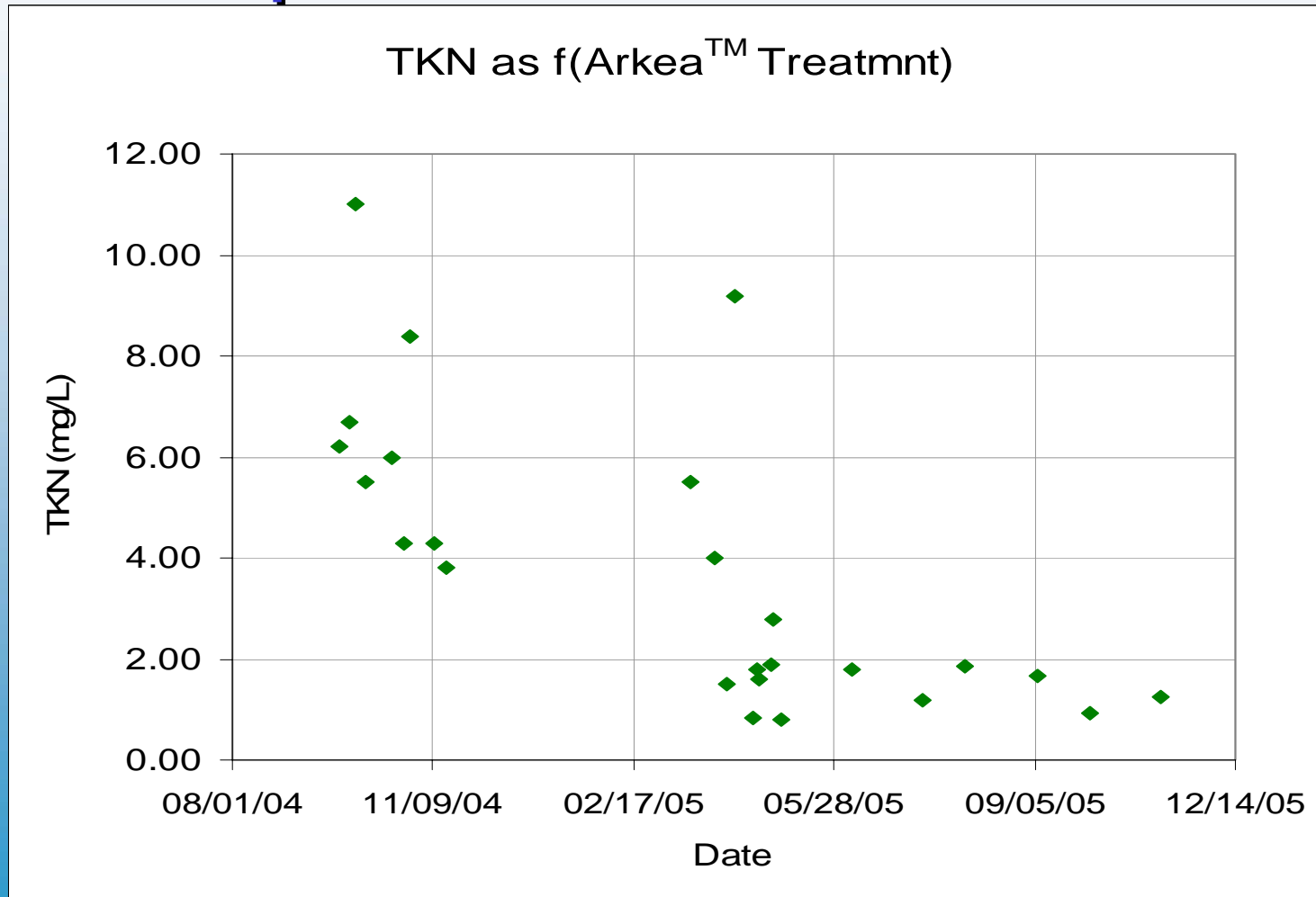




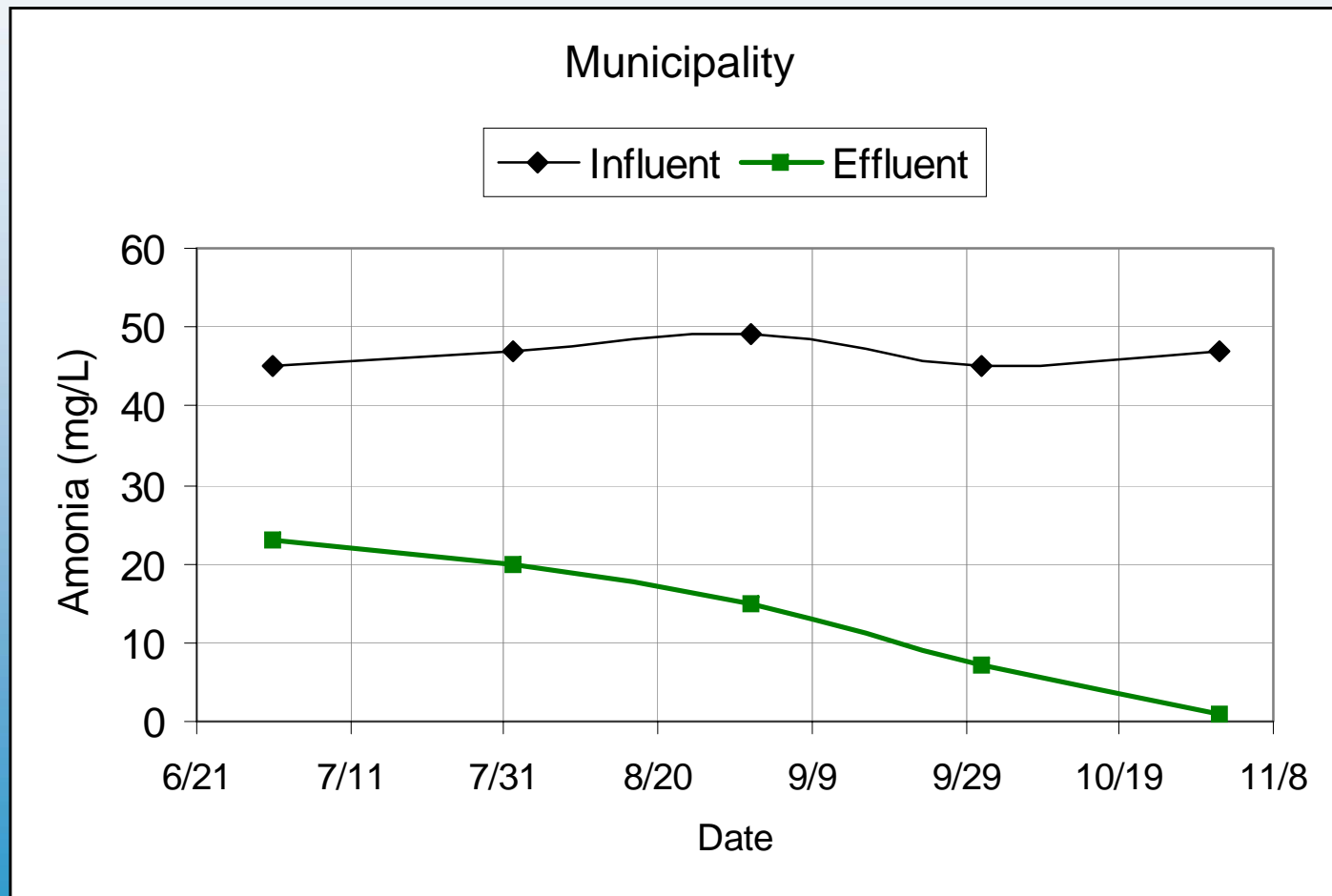
Field Results

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Municipal waste water treatment

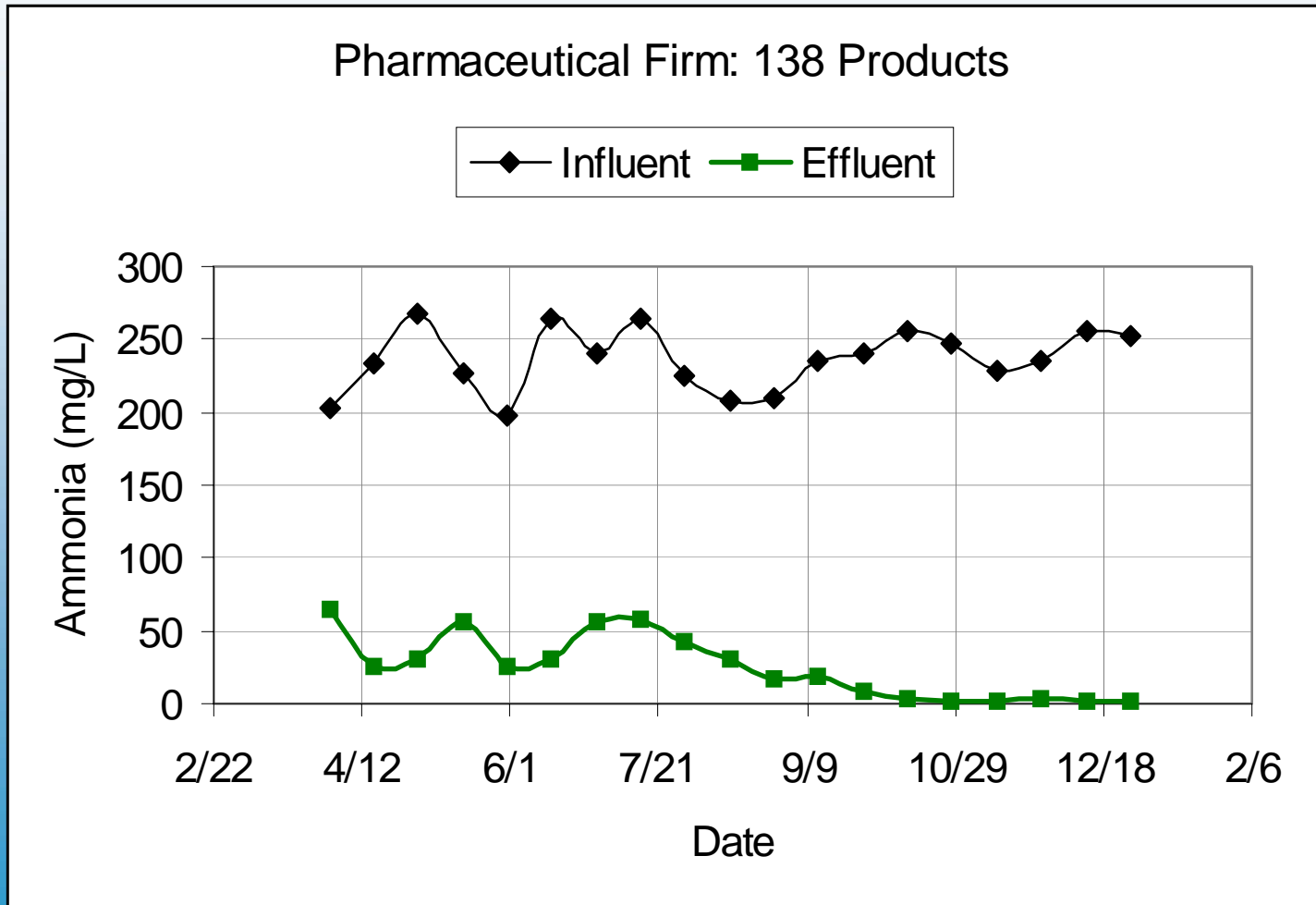


Municipal waste water treatment

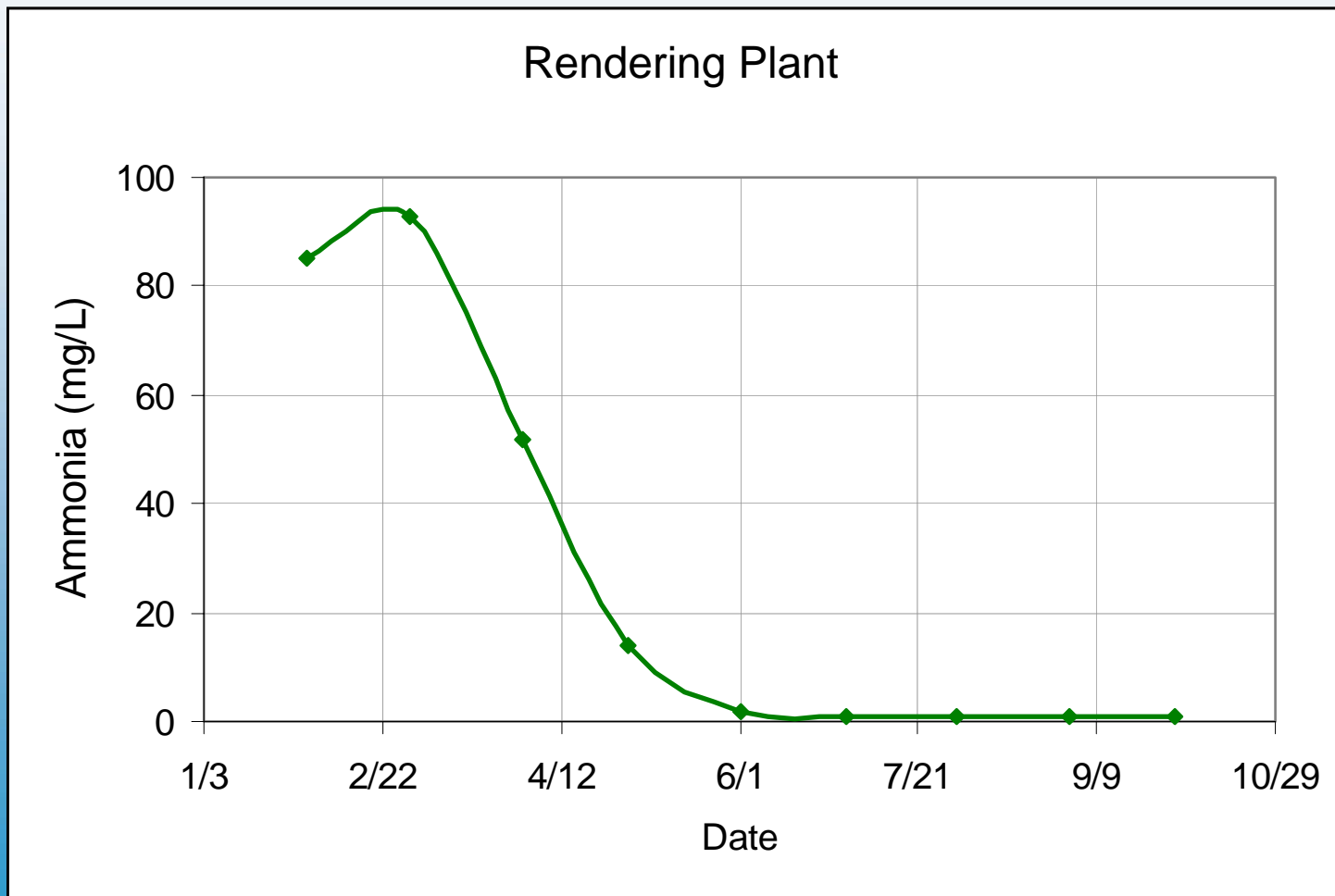


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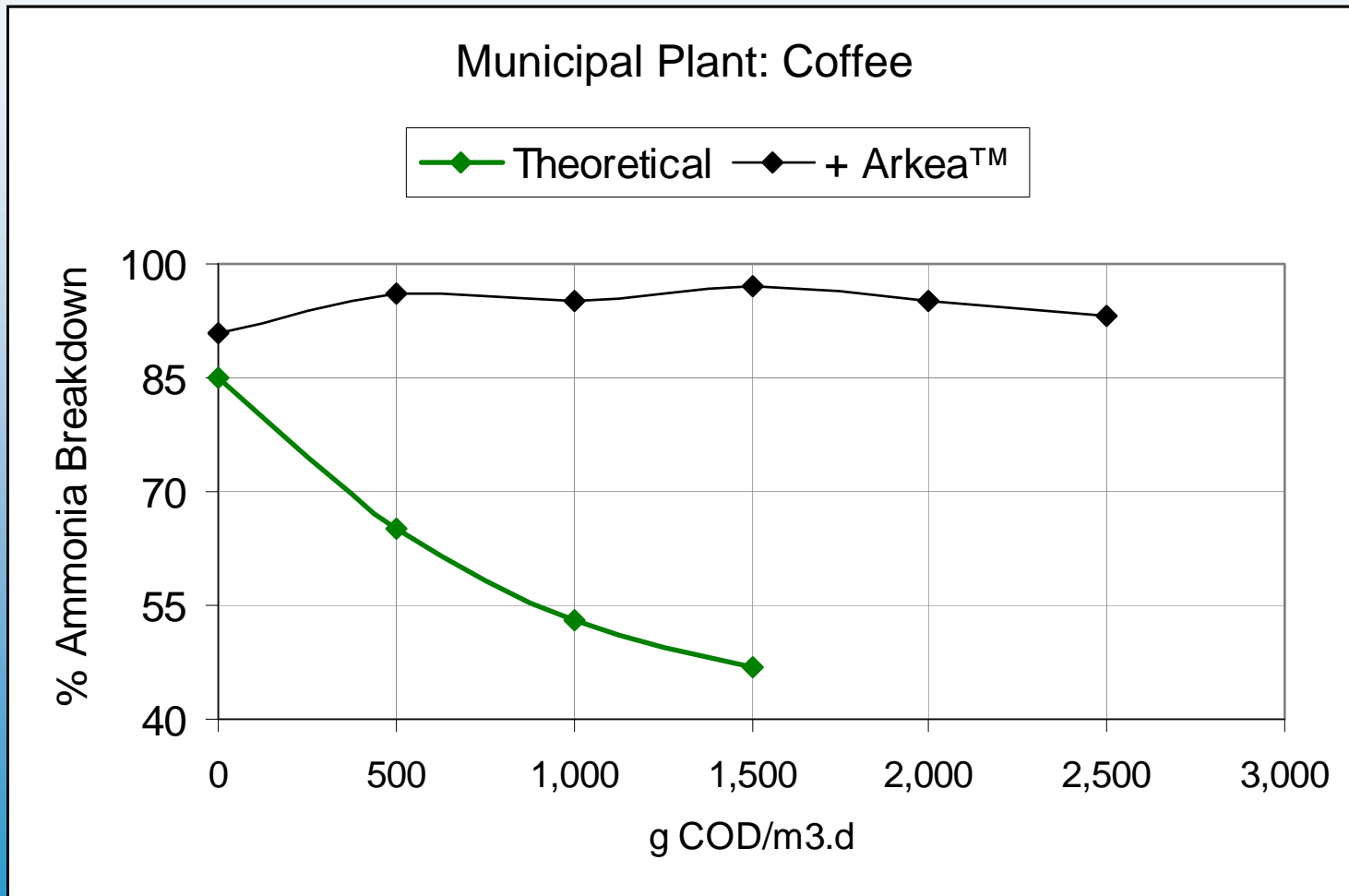
Pharmaceutical production



Rendering plant

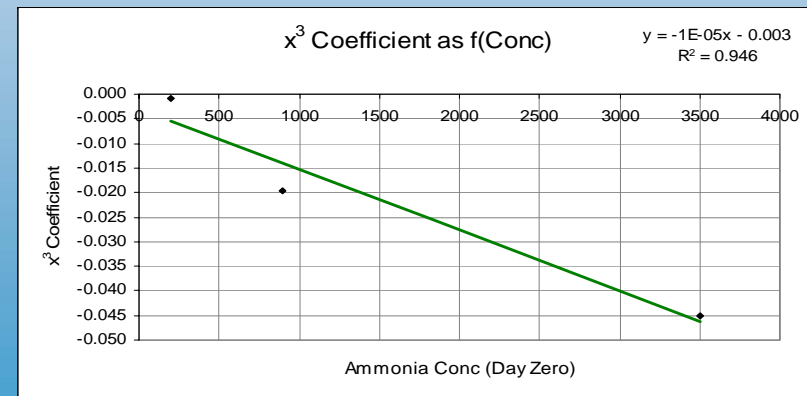
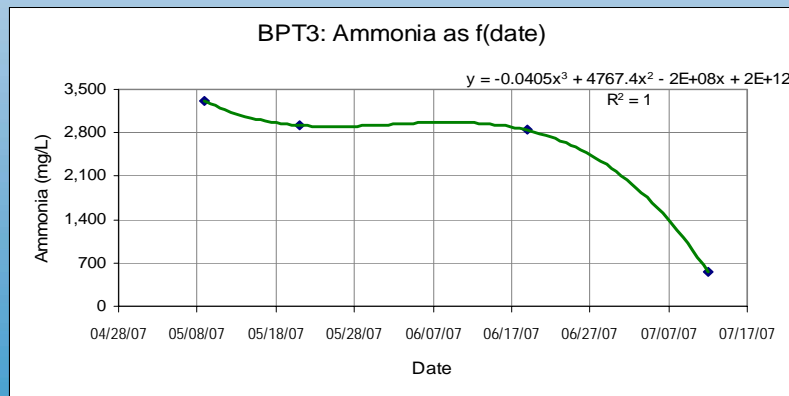
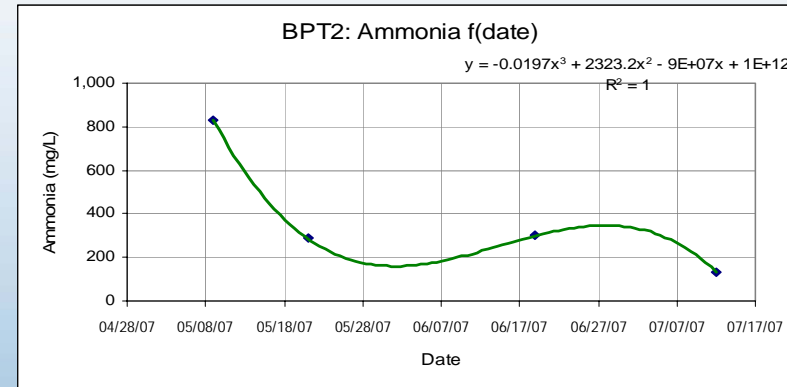
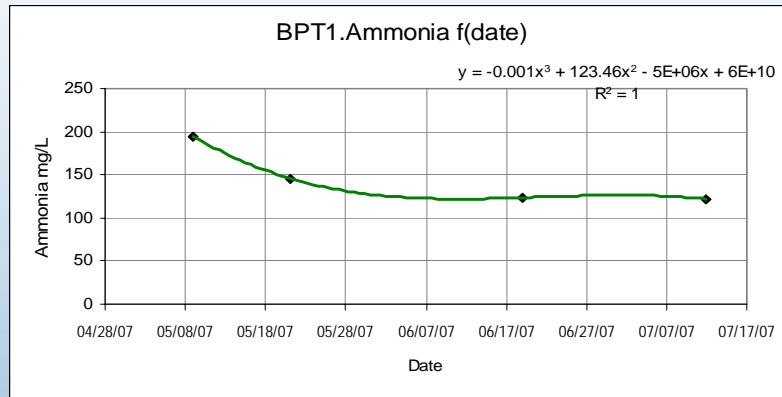


Slugs, Shocks, Overloads



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Ammonia Bioremediation



Archaea & Ammonia: Summary

- New ammonia management capabilities
- Efficient, effective, predictable
- Wide range of applications
- Robust
- Cost-effective
- Low risk profile