

Bacterial Assessment of Applied Treated Effluent from Wastewater Systems



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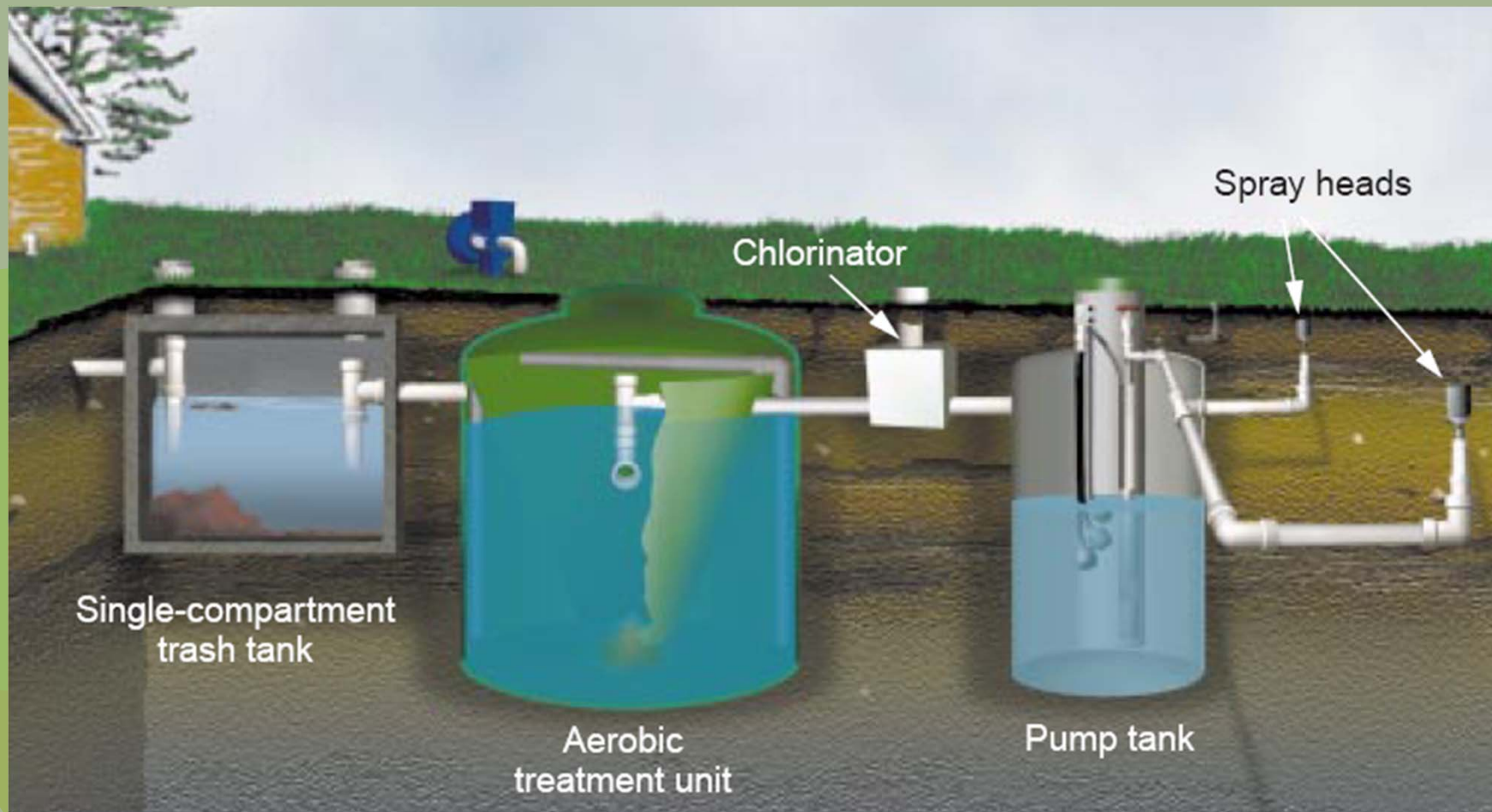
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Aerobic Treatment Systems (ATS)

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https://www.deq.state.ok.us/eclsnw/OnSite/system_maintenance/aerobic.html

Slide 2

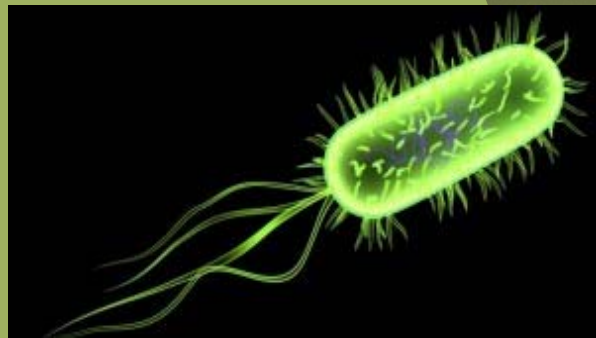
A1

Author, 3/31/2014

Bacteria

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► *Escherichia coli* (*E. coli*)



► Fecal coliform



- <http://www.foodsafetynews.com/2012/06/publishers-platform-non-o157-e-coli-an-alphabet-soup-of-illness/#.UzjUozYo6U>
- <http://www.elitelawyerproject.com/blog/e-coli-poisoning-help-from-a-long-island-personal-injury-law-firm/>
- http://www.filtrex.com/bacteria_removal.htm

ATS Holding Tank Storage

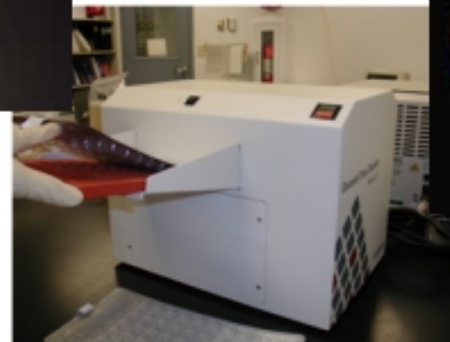
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- ▶ Collection of Samples
- ▶ Stored Environmental Conditions
- ▶ Testing of Samples
 - *E. coli*
 - Fecal Coliform
 - Electrical conductivity (EC)
 - pH
 - Temperature

Mix reagents with sample,
pour into incubation tray



Count yellow cells as
total coliform; florescent
cells as *E. coli*.



Seal, incubate

**Pictures courtesy of Idexx Corp., Westbrook, Maine
Colilert Quanti-Tray/2000®**

Soil Effluent Application

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- ▶ Collection of Samples
- ▶ Packed Soil 1.5 g/cm^3
- ▶ 25.0 mL effluent application
- ▶ Stored Conditions
- ▶ Testing Soil



House → Pre-Treatment Tank → Treatment Tank → Holding (pump) Tank → Land Applied



pH and EC

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ATS Holding Tank Storage

- Calibrations
- Testing
- Recorded



Soil Effluent Application

pH

- 4, 7, 10
- 1:2.5 ratio
- 30 min

EC

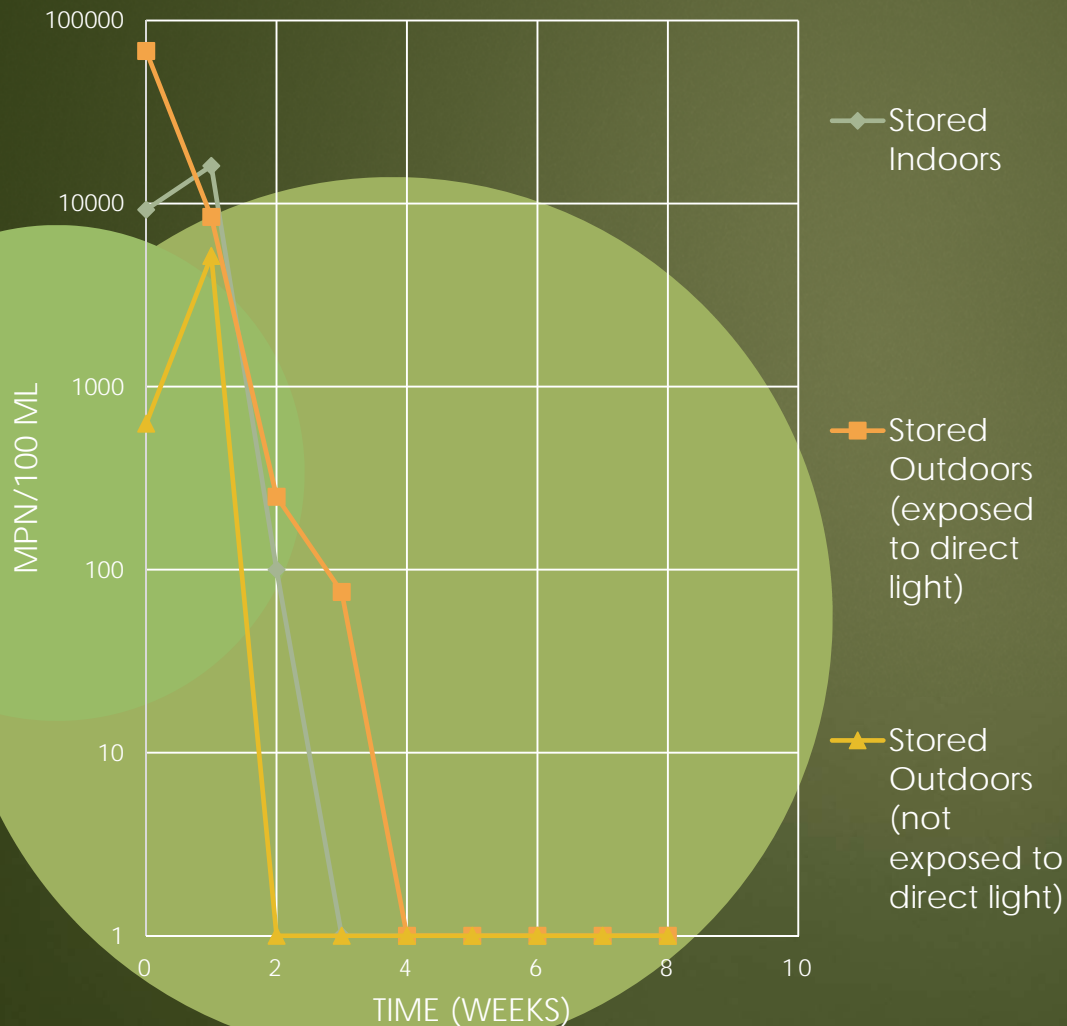
- 1413 $\mu\text{S}/\text{cm}$
- 1:20 ratio
- 2 hr.



ATS Holding Tank Storage

E. coli

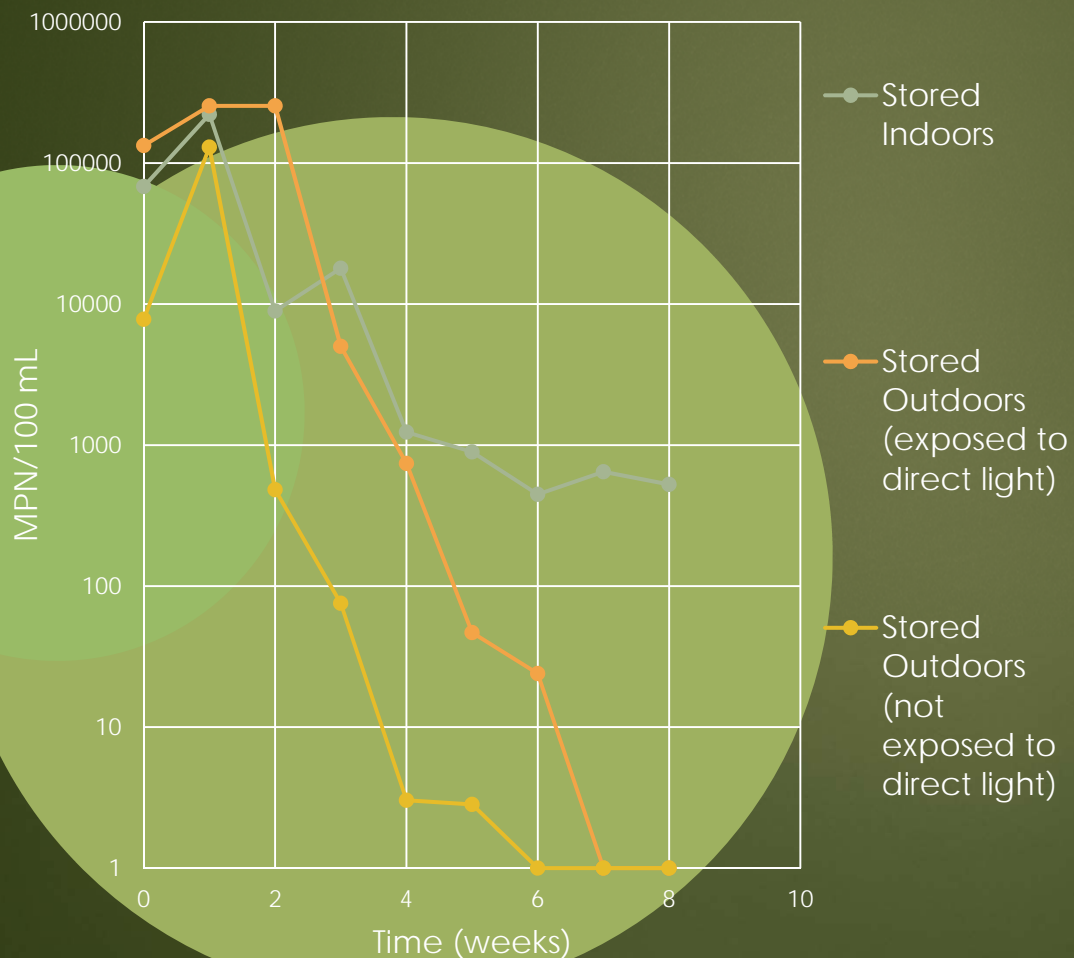
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- ▶ 68,000 MPN/100 mL Outdoors Exposed
- ▶ ~ 9,200 MPN/100 mL Indoors Not Exposed
- ▶ ~ 650 MPN/100 mL Outdoors Not Exposed
 - Maintenance performed
- ▶ Outdoors Exposed survived the longest
- ▶ 4 weeks all samples below detection limit

ATS Holding Tank Storage Fecal Coliform

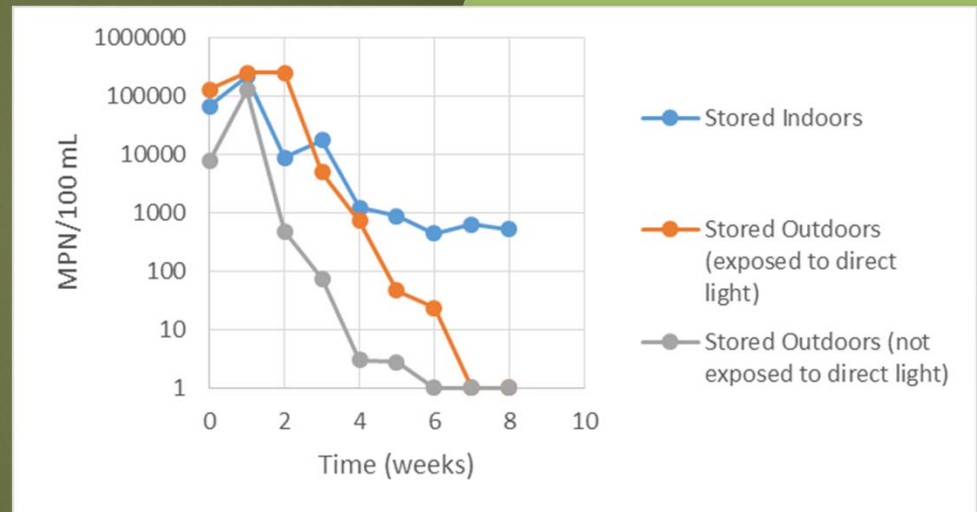
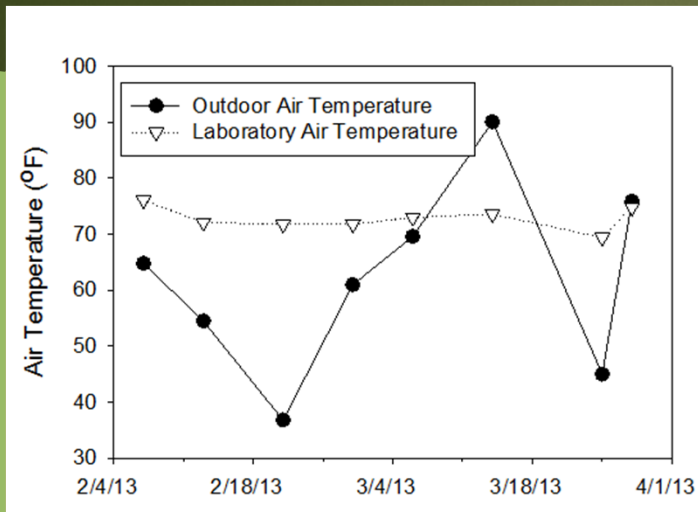
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- ▶ Increased from Initial
- ▶ $\sim 10^5$ Week 1
- ▶ Outdoors Exposed
 - $\sim 133,000$ MPN/100 mL Week 1
 - $\sim 255,000$ MPN/100 mL Week 2
 - $\sim 5,000$ MPN/100 mL Week 3
- ▶ Outdoors less than 1 MPN/100 mL Week 6 & 7
- ▶ Indoors ~ 500 MPN/100 mL Week 8

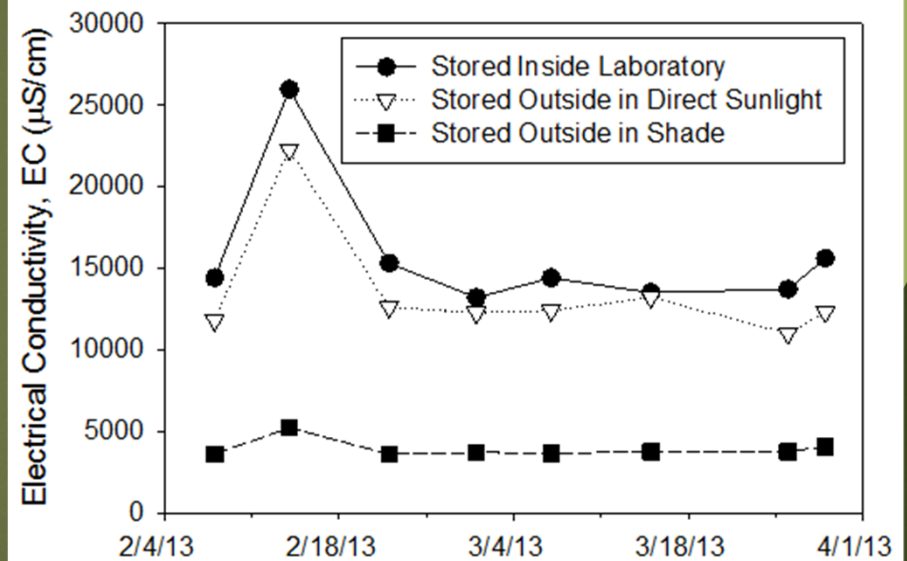
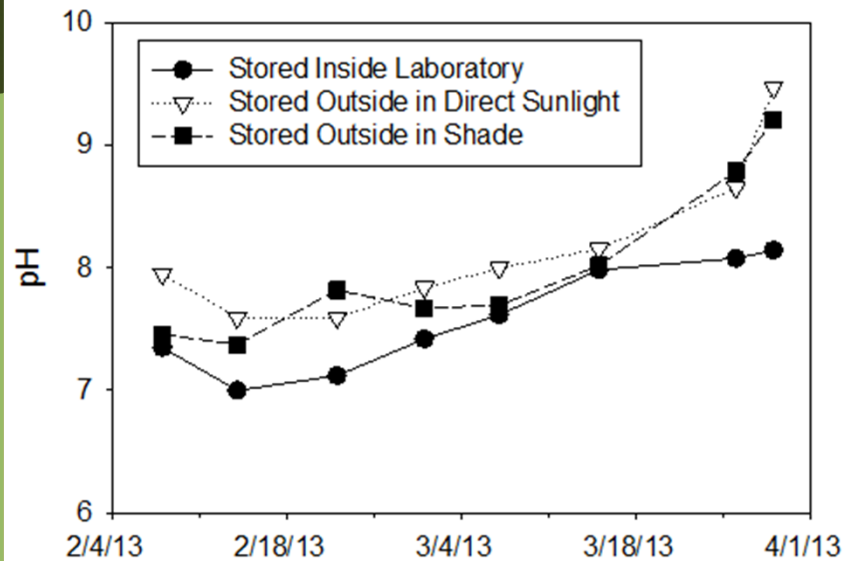
ATS Holding Tank Storage Temperature

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ATS Holding Tank Storage pH and EC

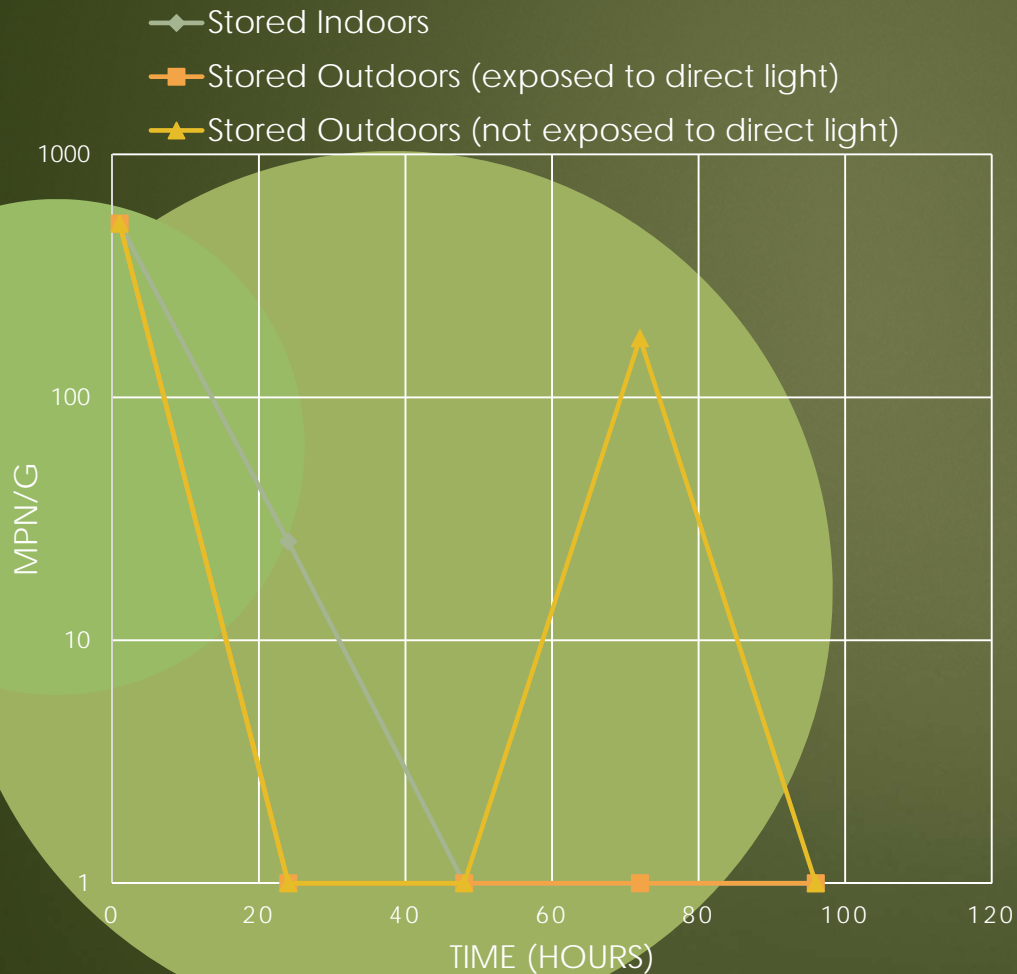
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Soil Effluent Application

E. coli

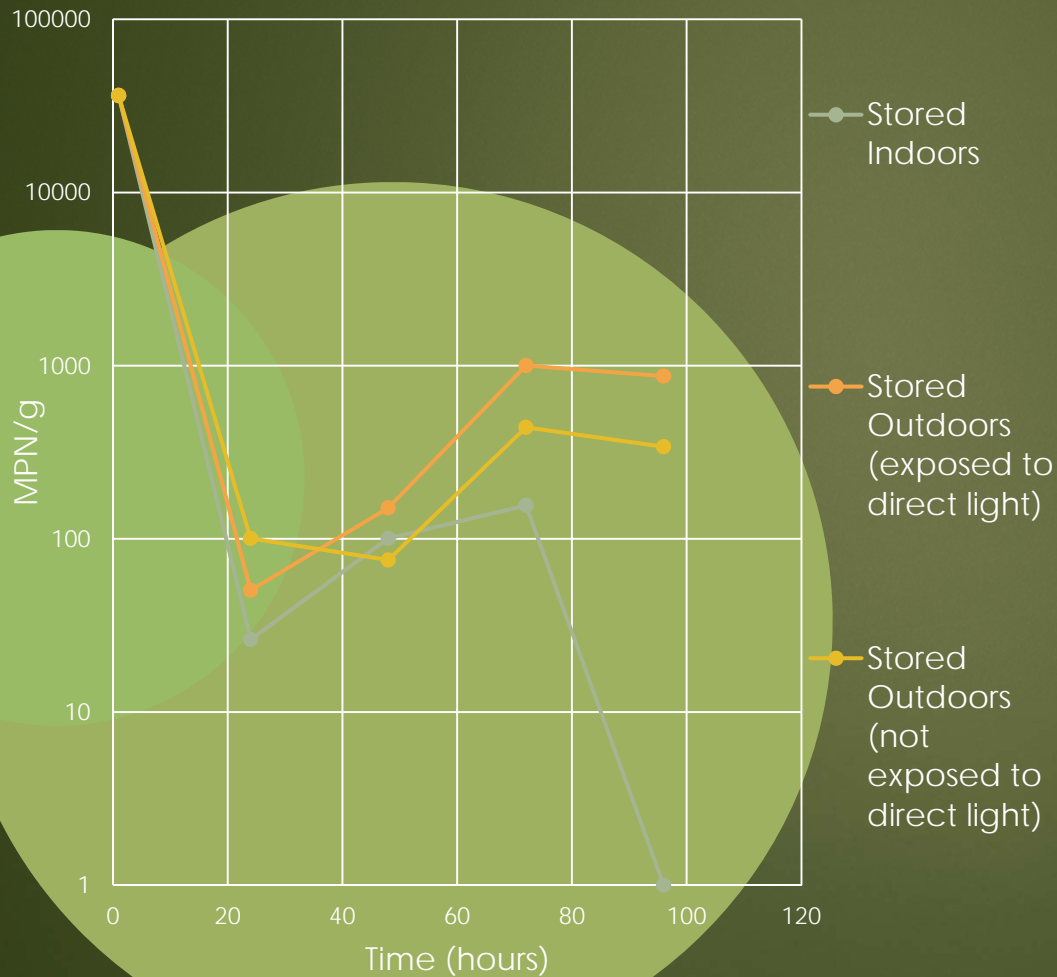
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- ▶ Less than 1 MPN/g
- ▶ 25.0 mL
- ▶ ~ 520 MPN/g at 1 hr.
- ▶ Below detection limit at 48 hr.
- ▶ Outdoors Not Exposed 175 MPN/g at 72 hr.
 - Moist to dry soil content

Soil Effluent Application Fecal Coliform

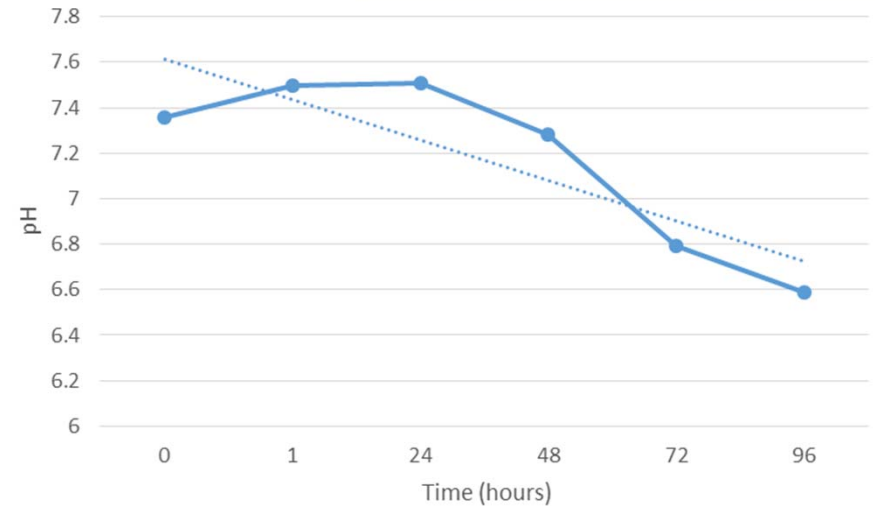
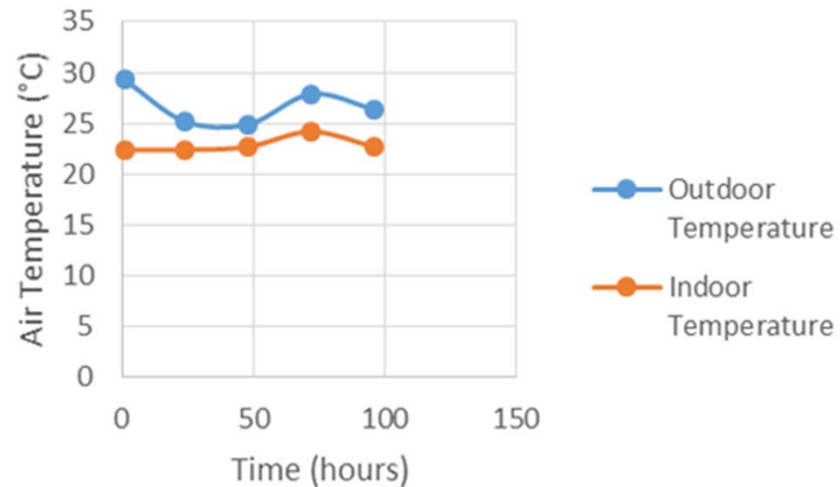
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- ▶ Initial ~ 4,000 MPN/100 mL
- ▶ ~ 36,000 MPN/g at 1 hr.
- ▶ Indoors Not Exposed less than 1 MPN/g at 96 hr.
- ▶ Outdoors Exposed ~ 900 MPN/g at 96 hr.
- ▶ Outdoors Not Exposed ~ 350 MPN/g at 96 hr.

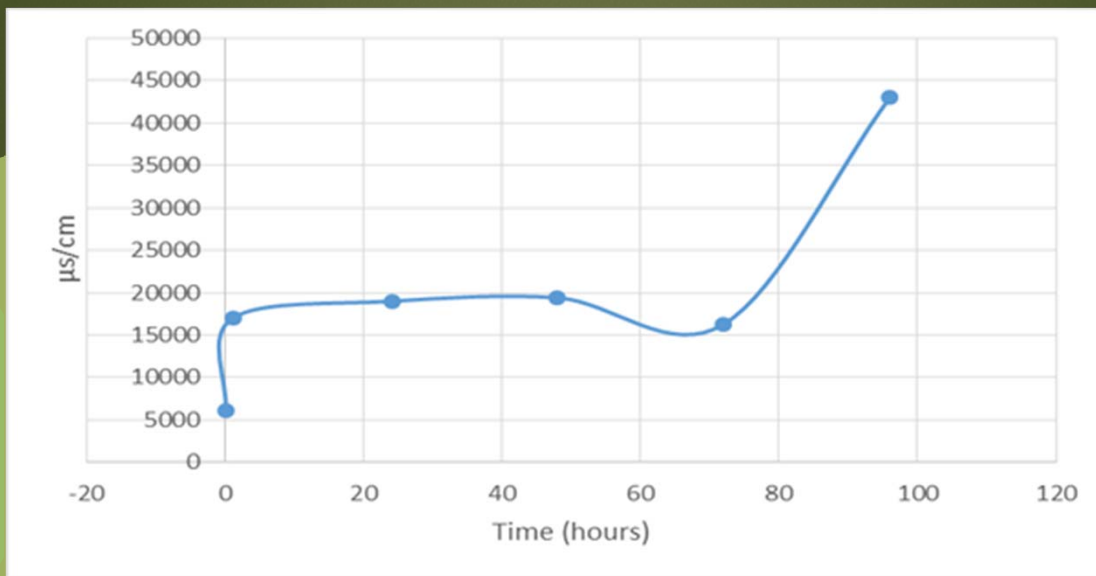
Soil Effluent Application Temperature and pH

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Soil Effluent Application EC

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- ▶ 6,100 $\mu\text{s/cm}$
- ▶ ~ 15,000 $\mu\text{s/cm}$ at 1 hr.
- ▶ ~ 40,000 $\mu\text{s/cm}$ at 96 hr.

Regulations Review

Fecal Coliform

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- ▶ Less than 200 colonies per 100 mL
- ▶ Revoked testing requirements
- ▶ Category 2
 - Daily
 - 4 of 7 samples
- ▶ Category 3
 - 3 times/week
 - Less than 200 cfu/100 mL (M/A)
 - Maintain monthly reports
- ▶ Category 4
 - Once/week
 - Less than 200 cfu/100 mL (M/A)
- Category 2 & 4
 - Submit monthly reports

Regulations Review Fact Sheet

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- ▶ Irrigate crops
- ▶ Children
- ▶ Stream or Creek
- ▶ Animals
- ▶ Human Contact
- ▶ Maintenance
 - ▶ Drip Irrigation
 - ▶ Ponding or Soil Saturation
- ▶ BACTERIA RISKS

Conclusions

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- ▶ Significant *E. coli* (1,000 to 100,000 MPN/100 mL) – ATS Holding Tanks
- ▶ Fecal coliform (10,000 to 200,000 MPN/100 mL) – ATS Holding Tanks
 - ▶ Temperature dependent
- ▶ *E. coli* below detection limit (less than 1 MPN/g) at 48 hr. – ATS Soil Application
- ▶ Fecal coliforms greater than 300 MPN/g post application – ATS Soil Application
- ▶ EC increased in soil with ATS pre-treatment application
- ▶ Low OM
- ▶ Rules and Regulations

References

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Questions?

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http://www.onceuponamiracle.com/2013_04_01_arc_hive.html

Thank You!