Wastewater in the FSM: Pilot test on Yap

Joseph D. Rouse, P.I., UOG, WERI

FSM population (est., 2010; SBOC): 108,000.

Yap, 12,000; Chuuk, 53,000; Pohnpei, 35,000; Kosrae, 8,000

(Yap Is., 7,000) (Lagoon, 40,000) (Pohn. Is., 31,000) (only one island)
## Septic Tanks, etc.
(One household = ca. 6 persons)

<table>
<thead>
<tr>
<th>Items</th>
<th>YAP</th>
<th>CHUUK</th>
<th>POHNPEI</th>
<th>KOSRAE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Households</td>
<td>2,311</td>
<td>7,024</td>
<td>6,289</td>
<td>1,143</td>
</tr>
<tr>
<td>Sewer connection</td>
<td>12%</td>
<td>9%</td>
<td>17%</td>
<td>4%</td>
</tr>
<tr>
<td>Septic tanks</td>
<td>31%</td>
<td>31%</td>
<td>35%</td>
<td>94%</td>
</tr>
<tr>
<td>Other/none</td>
<td>57%</td>
<td>60%</td>
<td>48%</td>
<td>2%</td>
</tr>
</tbody>
</table>

**Chuuk:** Sewer connections may increase soon with restoration of old sewage treatment plant.

**Kosrae:** Septic-tank culture working well, though treatment ponds have a lot of unused capacity.

**Yap, Chuuk, and Pohnpei:** High “other/none” levels largely reflect unserviced outer islands.
CHUUK
WELCOME TO YAP
Cultivation and Retention of Biomass

Micro-biological Wastewater Treatment

Suspended growth (Activated sludge):
- Contact stabilization
- CSTR / SBR
- Plug-flow
- Bardenpho
- Etc.
- MBR (w/ membrane)

Attached growth / biofilm

Fixed-bed:
- Trickling filter
- Bio-tower
- Nonwovens
- Swim-bed

Moving-bed:
- MBBR
  - Plastic rings
  - Sponge cubes
  - Gel beads
Biofilm Carriers

Gel beads

Swim-bed
Slime: 3 weeks (Guam)

“Nonwoven” Sheets
Framework for biocarrier

A = 2' - 0" X 14
B = 2' - 3" X 2
Approximate lengths
Sampling Plan

Sludge box
<table>
<thead>
<tr>
<th>Year</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/5</td>
<td>62</td>
<td>5</td>
<td>107</td>
<td>53</td>
<td></td>
<td>Rain!</td>
<td></td>
</tr>
<tr>
<td>*9/25</td>
<td>511</td>
<td></td>
<td></td>
<td></td>
<td>415</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/17</td>
<td>101</td>
<td>59</td>
<td>39</td>
<td>120</td>
<td></td>
<td>Rain</td>
<td></td>
</tr>
<tr>
<td>*12/9</td>
<td>308</td>
<td>209</td>
<td>206</td>
<td>226</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>open</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>channel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(no Biofilm)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/23</td>
<td>331</td>
<td>273</td>
<td></td>
<td></td>
<td>234</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/30</td>
<td>328</td>
<td>290</td>
<td></td>
<td></td>
<td>285</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/6</td>
<td>256</td>
<td>272</td>
<td></td>
<td></td>
<td>254</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/11</td>
<td>330</td>
<td>300</td>
<td></td>
<td></td>
<td>340</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/13</td>
<td>297</td>
<td>305</td>
<td></td>
<td></td>
<td>295</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/27</td>
<td>355</td>
<td>425</td>
<td></td>
<td></td>
<td>383</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/6</td>
<td>309</td>
<td>355</td>
<td></td>
<td></td>
<td>341</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## COD Time course

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/30</td>
<td>switch</td>
<td>Back to</td>
<td>Biofilm</td>
<td>Channel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/16</td>
<td>464</td>
<td>476</td>
<td>301</td>
<td>311</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/19</td>
<td>349</td>
<td>286</td>
<td>260</td>
<td>284</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/10</td>
<td>389</td>
<td>280</td>
<td>282</td>
<td>311</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7/24</td>
<td>311</td>
<td>315</td>
<td>310</td>
<td>293</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9/25</td>
<td>389</td>
<td>280</td>
<td>282</td>
<td>311</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/2</td>
<td>424</td>
<td>384</td>
<td>339</td>
<td>394</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/9</td>
<td>362</td>
<td>274</td>
<td>216</td>
<td>214</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Early summary:** \[(\text{inf} - \text{Eff}) = \text{Cut} \] (SD %)

- `'n=7 <No-bio>`: \[316 - 305 = 3\% \] (13.8)
- `'n=7 <Yes-bio>`: \[384 - 303 = 21\% \] (12.7)
Inspection – Dec. 2014
What’s next?

1. Biocarrier SF/CF = 1.4 (500 would be better)
   - Surface 2X, 20% $\rightarrow$ 40% ??
   - Get real, 40% $\rightarrow$ 80% ???
   - Aeration, ????
   - Nitrogen cycle?

2. Composting for waste sludge
   - Monitor for TC, E coli, Enterococcus
   - Apply to crops, or repair badlands??
   - Save landfill, make $$$$???
Excess sludge?
1 g sludge
Sludge ➔ Compost
Sludge ➔ Compost
Sludge $\rightarrow$ Compost

Treatment:
- 50% moisture
- Aerobic (mix twice/wk)
- Temp. $> 130^\circ F$
Sludge $\rightarrow$ Compost

After about 1 month $\rightarrow$
Sludge → Compost

June – raw sludge (1 g)
Total Coliform: $> 2,400$  Now used for food crops!!
E. coli: $> 2,400$

August – treated compost (1 g)
Total Coliform: $> 2,400$
E. coli: $= 21$  Could use for non-food crops?

Notes: 1. For food crops, only Class A biosolids; i.e., TC & Ec nearly zero (0).
2. Compost temp $> 130^\circ F$ (this test, only $120^\circ F$)? Should get hotter at larger/deeper scale.
3. Must be about 50% moist (this test too dry).
Sludge ➔ Compost

The ceaseless cycle of compost making

Each compost bin should have a one year filling period and a one year retention (aging) period. At the end of the second year, the compost in the first bin will be ready for agricultural use. Turning from bin to bin is not necessary. In a diseased population, the compost should be aged for two years, and a third, separate, active bin will be required.
Thank You
Happy Hour!