

Water Recycle at a Commercial Greenhouse

By

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Grower Direct Farms

40 acres of greenhouse and outdoor growing area in Somers, Connecticut



Grower Direct Farms

- Wholesale grower to large clients such as Walmart and Home Depot
- Grow from seeds, cuttings, etc.
- Produce bedding plants and hanging baskets



Watering Methods



Booms

Drip Irrigation

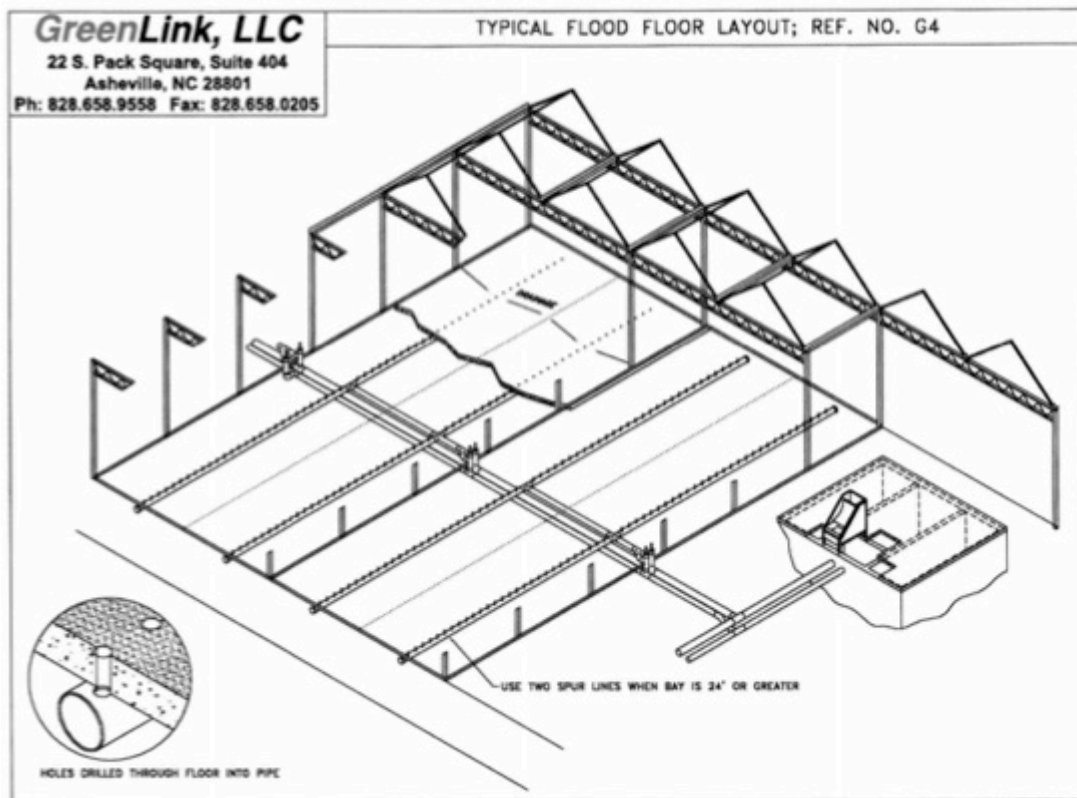


Flood floors

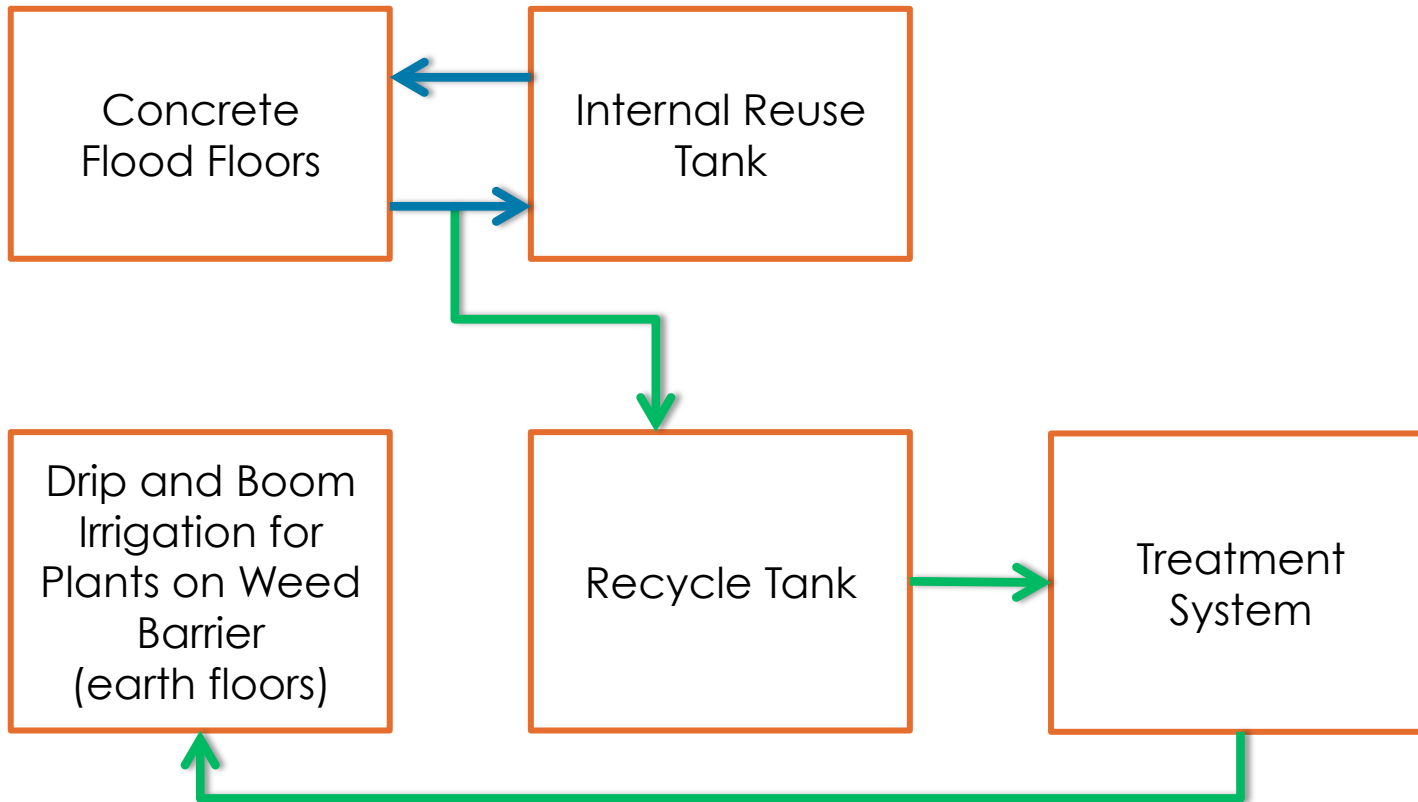


Flood Floors – Mono-crops

- Source of water for reuse
- Water pumped to floors to depth of 1 to 2 inches
- Sits for a few minutes then drains back to separate tank for reuse



Flood Floor Schematic



Mono-crop ———

Multiple crops ———

Water Recycling – Stage 1

- Recycle water only on monocrops
- Only very hardy plants e.g., Mums
- Could not reuse on sensitive plants e.g., begonias
- Some discharge was required

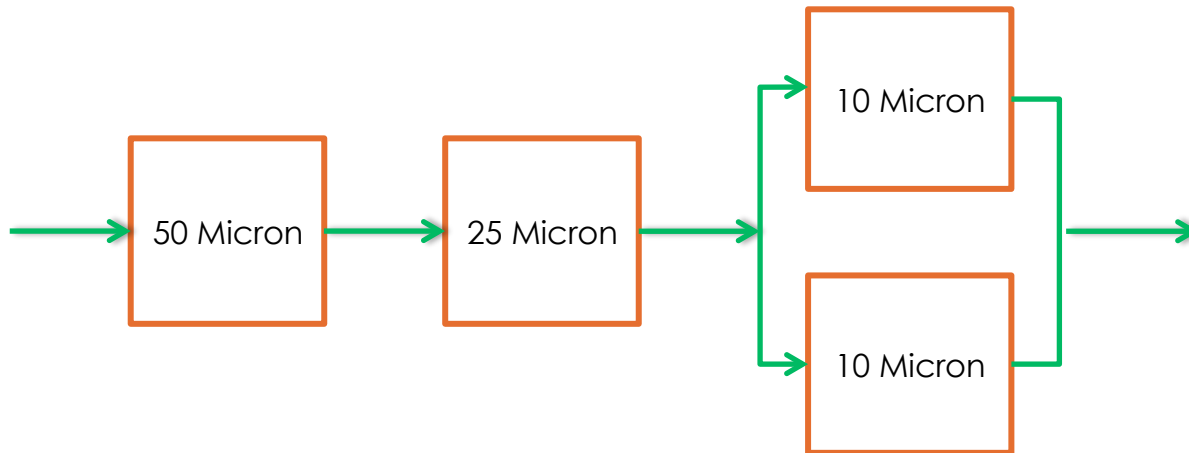
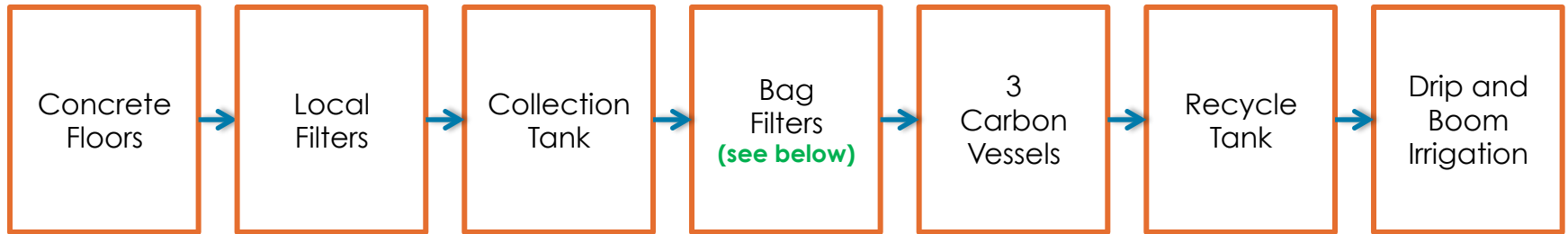


Reuse of Water with Multiple Crops

- Reused in irrigation booms and drip irrigation
- Does not make “multiple passes” through flood floors
- Reused once to prevent formation and/or spread of fungus or disease while minimizing chemical use

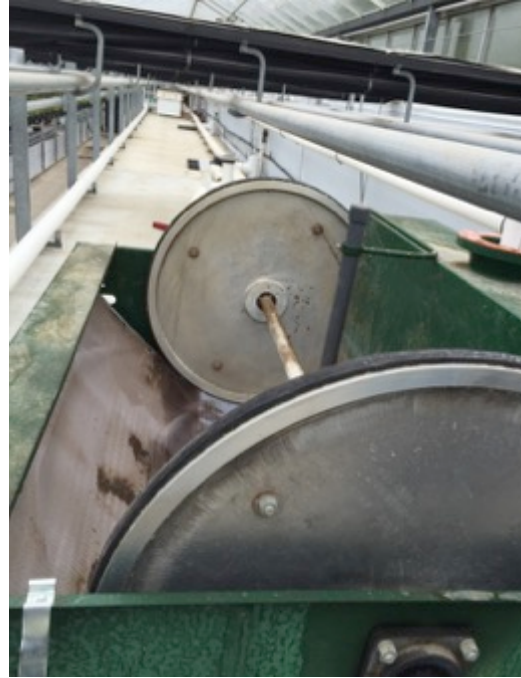


Treatment System for Multiple Crops



Water Treatment

Filters on Greenhouse Floor



Paclobutrazol

- Widely used growth regulator
- Used in golf courses to reduce mowing requirements
- Low doses used to prevent green house plants from getting “leggy”



“Bench” Test of Carbon Treatment

- No data available on Paclobutrazol removal using carbon
- Challenging to find lab to test it
- Improving detection limits through course of project
- 5 gallon bucket test



Bench Test Data

Paclobutrazol concentrations in ug/L

Date	Reclaimed water	Spiked Influent	Effluent	Duplicates
4/14/2014		308	141	
4/22/2014		422	51	44
4/25/2014		542	177	71
5/1/2014	64	694	322	321
5/12/2014	32	1232	235	586

Treatment System Pilot Test

- Considered going to drum size pilot test, but decided on larger units that withstand pressure
- 1000 pounds carbon each
- 50 gpm pilot



Filtration for Pilot Test

- Used two sets of Duplex Bag Filters
- Tried variety of combinations
- Liked 50 micron followed by 25 micron and then 10 micron in parallel



Data from Pilot Test

Paclobutrazol concentrations in ug/L

	Influent	After First Carbon Unit	After Second Carbon Unit
7/14/2014	37	<10	<10
7/21/2014	101	15	<10
8/12/2014	6	2	2
8/18/2014	8	3	T
8/26/2014	2	1	<1
9/2/2014	3	2	T
9/9/2014	1	1	T
9/16/2014	1	<1	<1
2/24/2015	55.5	32.5	26.5

Full Scale Implementation

- Considered new and used steel and fiberglass
- Chose fiberglass for long-term durability
- Three 1,000 pound units
- Kept same bag filters



Paclobutrazol Data - Full Scale Implementation

Date	Influent, ug/L	After Third Carbon Unit, ug/L
3/10/2015	11.5	0.5
3/16/2015	4.2	<0.1
3/23/2015	15.5	0.3
4/13/2015	23	0.25
4/27/2015	8.75	0.25
5/4/2015	7.75	<0.2
5/18/2015	14.25	3.25
5/28/2015	12	0.25
6/1/2015	20	0.5
6/8/2015	72.5	1.25
6/15/2015	19.25	0.75
6/25/2015	56.8	0.75
6/30/2015	28.5	<0.2
8/24/2015	8.25	<0.2
8/31/2015	3.2	<0.75
10/6/2015	0.5	<0.25
10/13/2015	1	<0.25
10/27/2015	0.25	<0.25

Metal Data – Pilot Testing

Laboratory Data		June 2014	July 2014			October 2014	
		Untreated	Untreated	After Bag Filters	After Activated Carbon	Before Filter	After Activated Carbon
Parameter	Unit	6/5/2014	7/22/2014	7/22/2014	7/22/2014	10/7/2014	10/7/2014
Copper	mg/L	0.313	0.136	0.096	0.073	0.215	0.147
Nickel	mg/L	0.008	0.006	0.011	0.012	0.011	0.006
Lead	mg/L	0.004	< 0.002	0.003	0.003	<0.002	<0.002
Zinc	mg/L	1.01	0.457	0.485	0.49	0.587	0.499

Water Quality Parameters – Pilot Test

Laboratory Data		June 2014	July 2014			October 2014	
		Untreated	Untreated	After Bag Filters	After Activated Carbon	Before Filter	After Activated Carbon
Parameter	Unit	6/5/2014	7/22/2014	7/22/2014	7/22/2014	10/7/2014	10/7/2014
B.O.D. /5 day	mg/L	< 4.0	5.8	< 4.0	< 4.0	<4.0	13
C.O.D.	mg/L	57	96	76	68	136	106
Ammonia as Nitrogen	mg/L	23	11.7	15.0	13.4	18.4	20.9
Nitrite-N	mg/L		1.05	1.21	1.25	N/A	N/A
Nitrate-Nitrite (N)	mg/L		48.4	49.8	53.5	N/A	N/A
Nitrate- N	mg/L	104	47	49	52	93.5	82
pH	S.U.	6.66	7.28	7.17	7.09	6.08	7.17
Nitrogen Tot Kjeldahl	mg/L	27.1	17.4	20.2	17.0	28.4	25.8
Oil & Grease, Non-polar Material	mg/L	N/A	N/A	N/A	N/A	<1.4	<1.4
Phosphorus, as P	mg/L	8.9	6.45	7.27	7.08	7.2	6.76
Total Suspended Solids	mg/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

A Few Comments on Client Approach

- Fun client to work with
- Family owned – quick decision-making
- Very hands on
- Very practical - less study/more construction



Conclusions

- **Very successful evolving recycle systems**
- **Saves millions of gallons of water per year**
- **Enables healthy growing conditions for mono-crops and mixed crops**

