

Ethyl M Chocolates, Las Vegas: Treating Wastewater Naturally



The Living Machine - Philosophy

- Diverse species arranged in new combinations for a specific purpose, like water purification
- “capable of self-design, self-regulation, and invention”
- efficiency of natural processes can reduce pollution and save money

The Living Machine - Components

1: Anaerobic Reactor

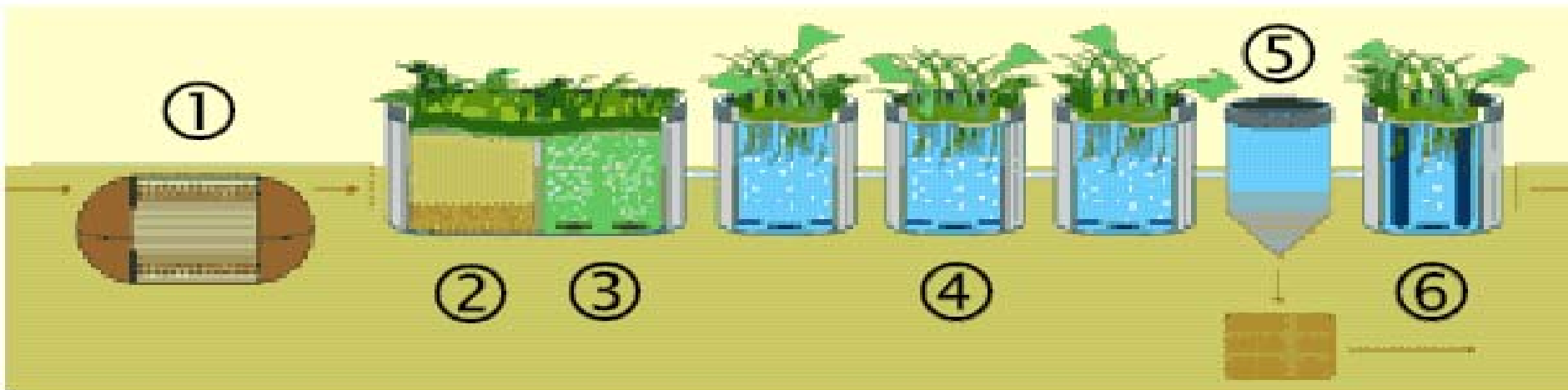
2: Anoxic Reactor

3: Closed Aerobic Reactor

4: Open Aerobic Reactor

5: Clarifier

6: Ecological Fluidized Beds



Living Machine Demonstration Project, South Burlington, VT

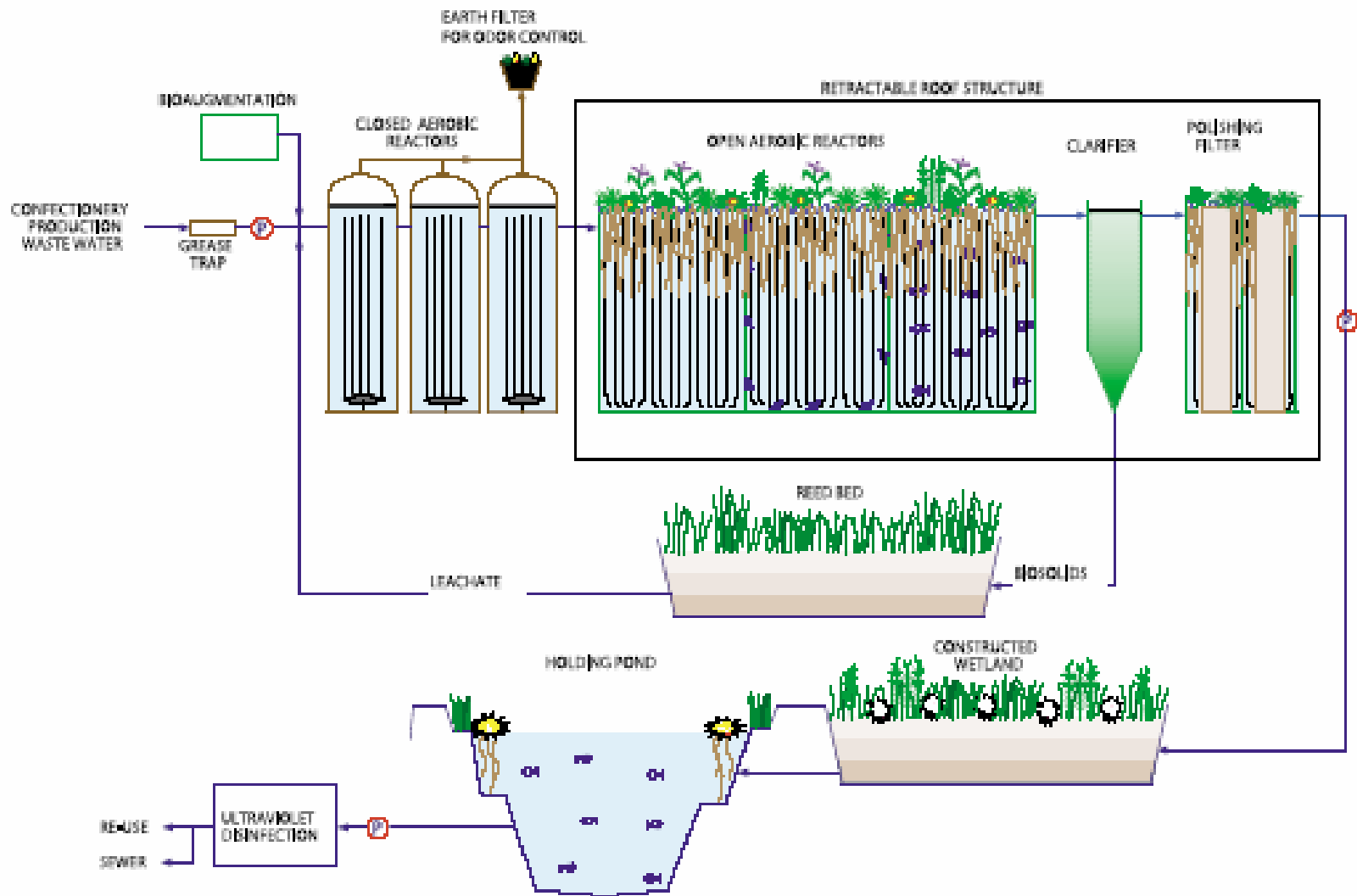


Photos ©1996 Gary Michael Photography

Source: Farrell, 1996

The Living Machine at Ethyl M

- Built in 1995, at a cost of \$1.5 million, by Living Technologies, Inc.
- 1-acre of outdoor tanks and marshes
- System custom-built according to wastewater volume and content, treatment requirements, and climate



Closed Aerobic Reactors



- Pumped in from grease trap
- Microbes begin breaking down wastes
- Exhaust gases pumped through a soil biofilter to eliminate odors

Open Aerobic Reactors



- Water floats by gravity from closed aerobic reactors
- Covered with vegetation, supported by racks
- Vegetation provides surface area for microbial growth, habitat for beneficial animals, and nutrient uptake

Clarifier

- Settling tank - separates out residual solids
- Sludge is directed to a reed bed, where it decomposes further over the next 5-10 years
- Surface covered with duckweed, to prevent algae growth.

Ecological Fluidized Beds

- Submerged biofilters filled with volcanic rock or gravel, remove any remaining suspended solids.
- Microorganisms provide final nitrification
- Flow can be reversed for cleaning purposes

Holding Pond

- Water enters holding pond through a constructed wetland

- Treated water is used for irrigation purposes



- Disinfected by ultraviolet light, not chlorine

Source: Farrell, 1996

Picture: Living Machines, Inc. 2003

How Well Does it Work?

- Treats 32,000 gallons/day of wastewater from production area, boilers, and cooling towers.
- Adjusts to changes in temperature and wastewater content

Waste Levels in mg/L

	<u>Before Treatment</u>	<u>After Treatment</u>	<u>Local Limit</u>
<u>Fats/Greases/Oils</u>	300-350	<1	250
<u>BOD</u>	1300-2000	3-10	300
<u>TSS</u>	600	1	300

TABLE 1 PERFORMANCE OF THE FREDERICK AND BURLINGTON LIVING MACHINES®

Parameter	FREDERICK				BURLINGTON			Effluent Goal
	Influent mg/L	GH Influent mg/L ^a	Effluent mg/L	% Removal	Influent mg/L	Effluent mg/L	% Removal	
BOD ₅	230	156	4	97	227	5.9	97	<10
COD	944	378	21	94	556	35.9	94	--
TSS	381	70	2	97	213	5.3	98	<10
NH ₃	-	22	1.2	94	16.3	0.4	98	<1
NO ₃	-	20.8	10	52	15.9 ^b	4.9	69	<5
TN (total nitrogen)	-	44	11	75	29.3	5.6	81	<10
TP (total phosphorus)	11	7.7	6	45	6.0	2.0	67	<3

a Effluent from the anaerobic reactor at Frederick into the reactors contained within the greenhouse.

b Assumes that all removed ammonia is converted to nitrate.

Environmental Benefits

- Lower amounts of sludge result from the greater diversity of organisms present
- Achieves high level of treatment, using no chemicals



- Looks nice, and emits no odors
- Conserves water

Benefits for Ethyl M

- Comparable costs for construction, maintenance

Cost Comparison

TABLE 2 PRESENT WORTH COMPARISON OF "LIVING MACHINES[®]" AND CONVENTIONAL SYSTEMS

Process	40,000 gpd	80,000 gpd	1 million gpd
"Living Machine" with greenhouse	\$1,077,777 ¹	\$1,710,280 ¹	\$10,457,542 ²
"Living Machine" without greenhouse	\$985,391	\$1,570,246	\$9,232,257
Conventional System	\$1,207,036 ¹	\$1,903,751 ¹	\$8,579,978 ²

(1) Cost difference is less than 20 percent

(2) Cost difference is greater than 20 percent

Benefits for Ethyl M

- Comparable costs for construction, maintenance
- Ethyl M is now a zero-emissions plant
- Reuse of water for irrigation saves money
- Good PR, advertising

Drawbacks



- Requires lots of space
- Requires special considerations for cooler weather
- Removes only about 50% of phosphorous
- Requires some additional maintenance
 - vegetation management
 - cleaning tanks/screens
 - removing sludge



“The Living Machine has been a real success story for Ethyl M Chocolates. It has met the goals set for the wastewater treatment plant, and not only does it clean the water, it was also cheaper to build and is cheaper to operate than conventional water treatment plant techniques.”

- Mike Seago, plant manager

References

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