Small Wastewater Systems

Keith Radick – CT Consultants

County Sanitary Engineers Association

Summer Conference

June 17, 2014

Columbus, Ohio

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Ohio Water Environment Association

Preserving & Enhancing Ohio's Water Environment

Small Systems Committee

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Background – Why This Guy?

- Operator – Village of Brookville, Ohio
  - 0.500 mgd POTW
- Former Allen County WWTP Supt (‘68 to ‘77)
- 18 WWTPs - 12 Package Plants & 3 Conventional
- NW Chairman in 1977-78
- OWEA (OWPCC) Chairman 1987-88
- WEF POMC Chairman

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Keith Radick – Currently Semi-Retired

- 37 years w/ Floyd Browne Group/CT
- Ex-Director of Operations Services Team
- Class IV – Wastewater
- Class III for 35 years
- 47+ Years Experience
- Been lucky – involved in some interesting stuff

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Like to Share that "Stuff"

- If you take one tip home with you I'll be happy
- If you take two tips, I'll celebrate with a glass of wine.
- I have two 'soapboxes' and a few "tips" & some sales pitches

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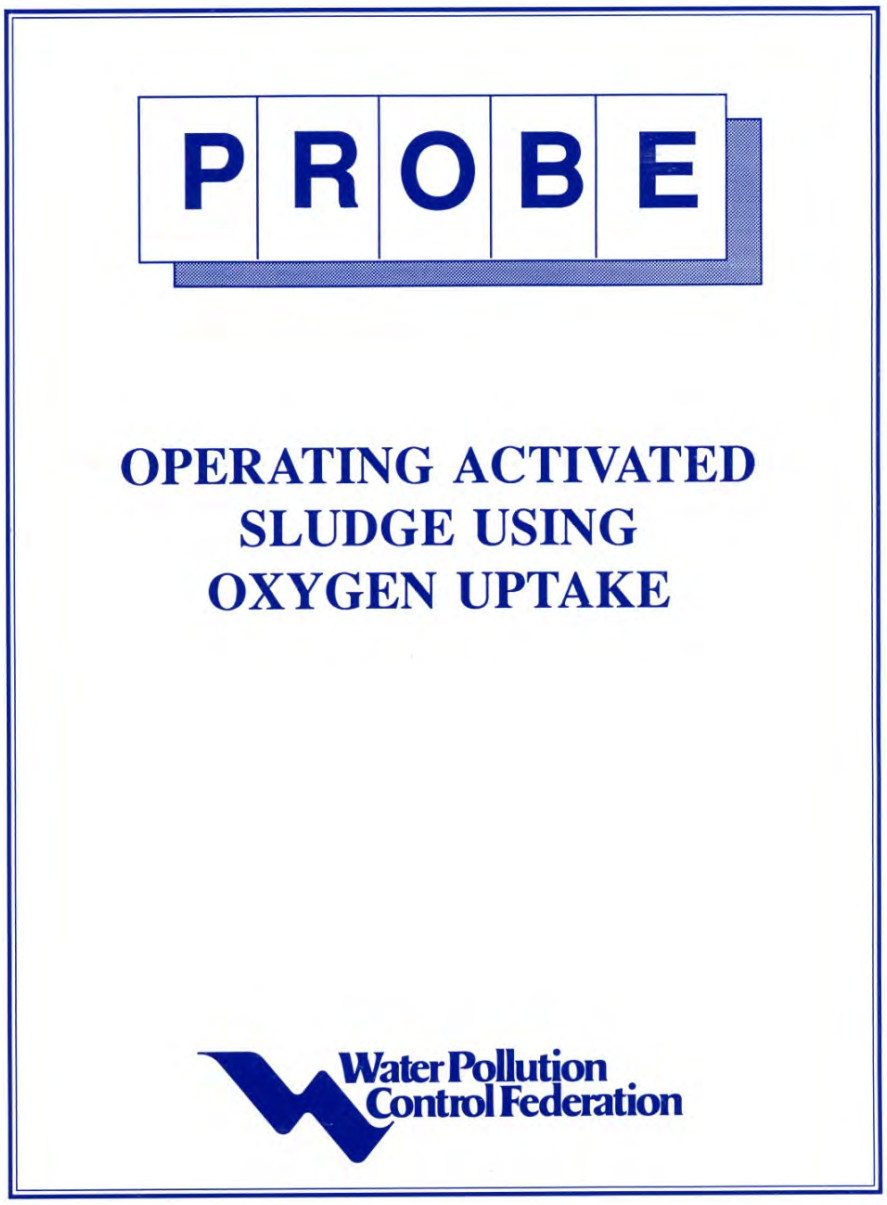

FIRST 'PROBE'

- WEF contracted the preparation to Floyd Browne
- Sole Author

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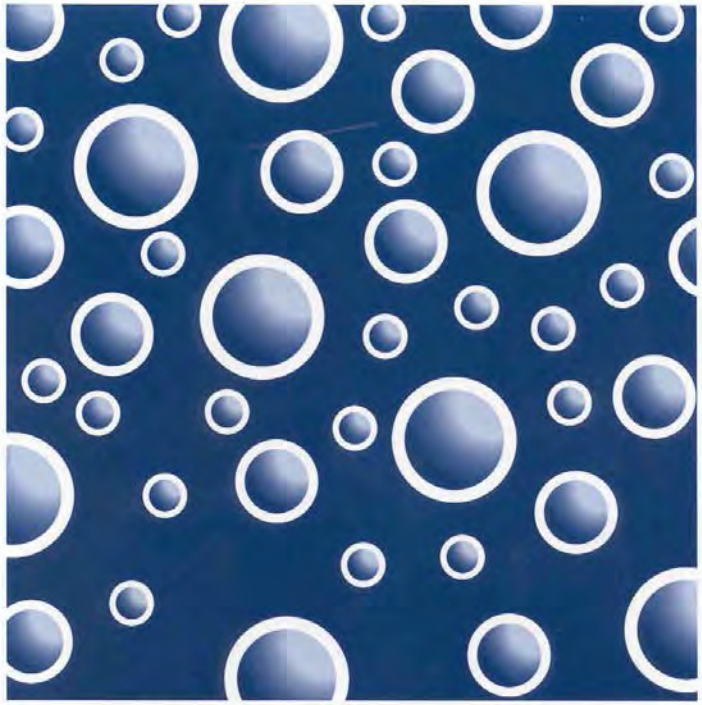
Package Plant MOP

- Fairly new from WEF:
  - Task Force Chair
  - Author
  - Reviewer



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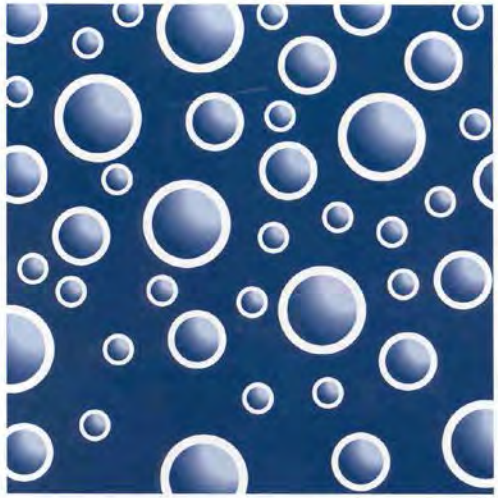
MOP OM-7

- MOP intended to provide “two-views”
  - Basic instructions – “Do This …”
  - Reference Material Back-up

- “Do This”
  - then understand Why



Operation of Extended Aeration Package Plants

Manual of Practice OM-7

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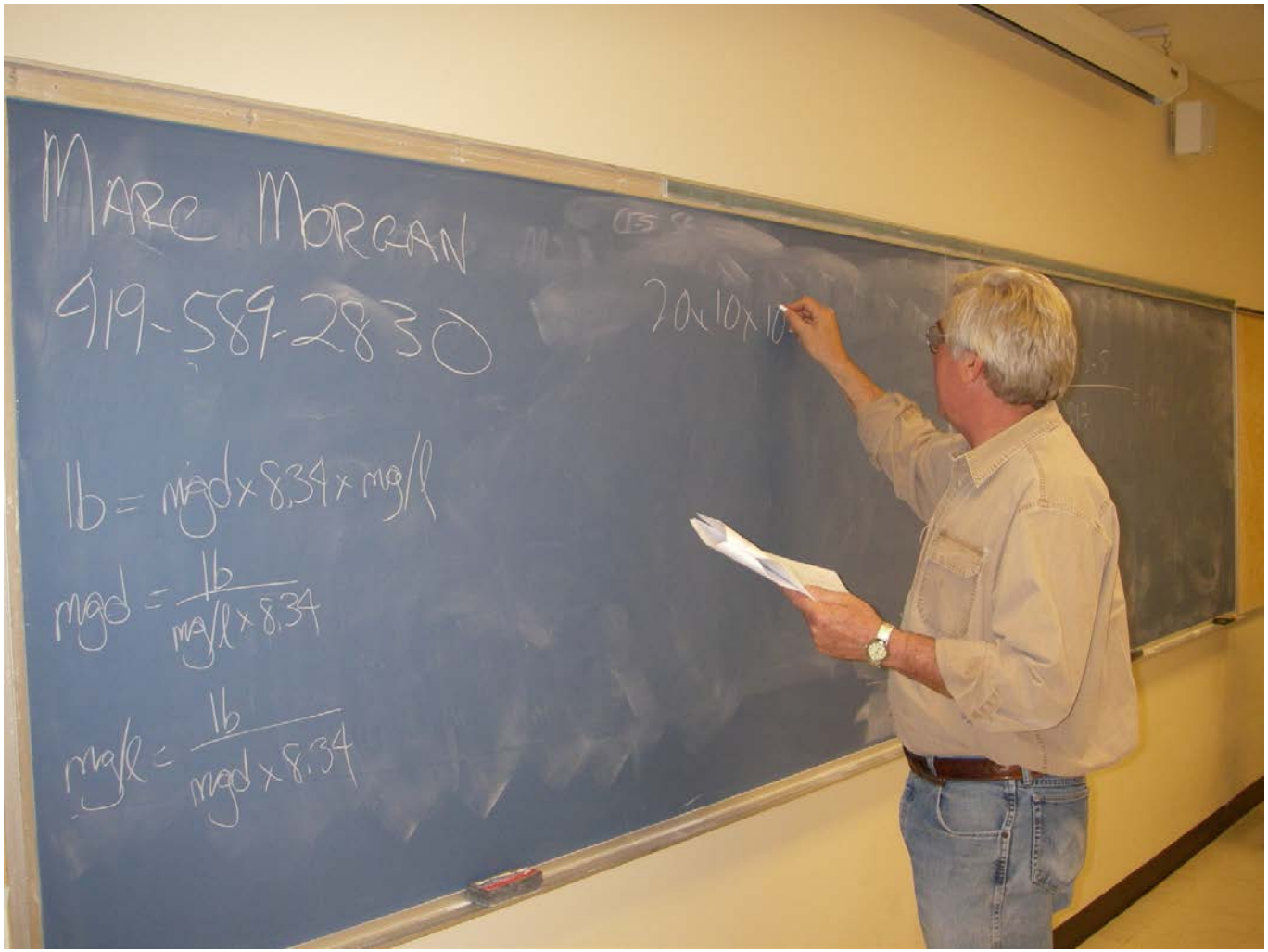
Certification Prep Assistance NE & NW



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What IS a Package Plant?

- Pre-fabricated (to some degree)
- Can be any technology
  - Usually as simple as possible
- Usually extended aeration
- Usually all driven by air

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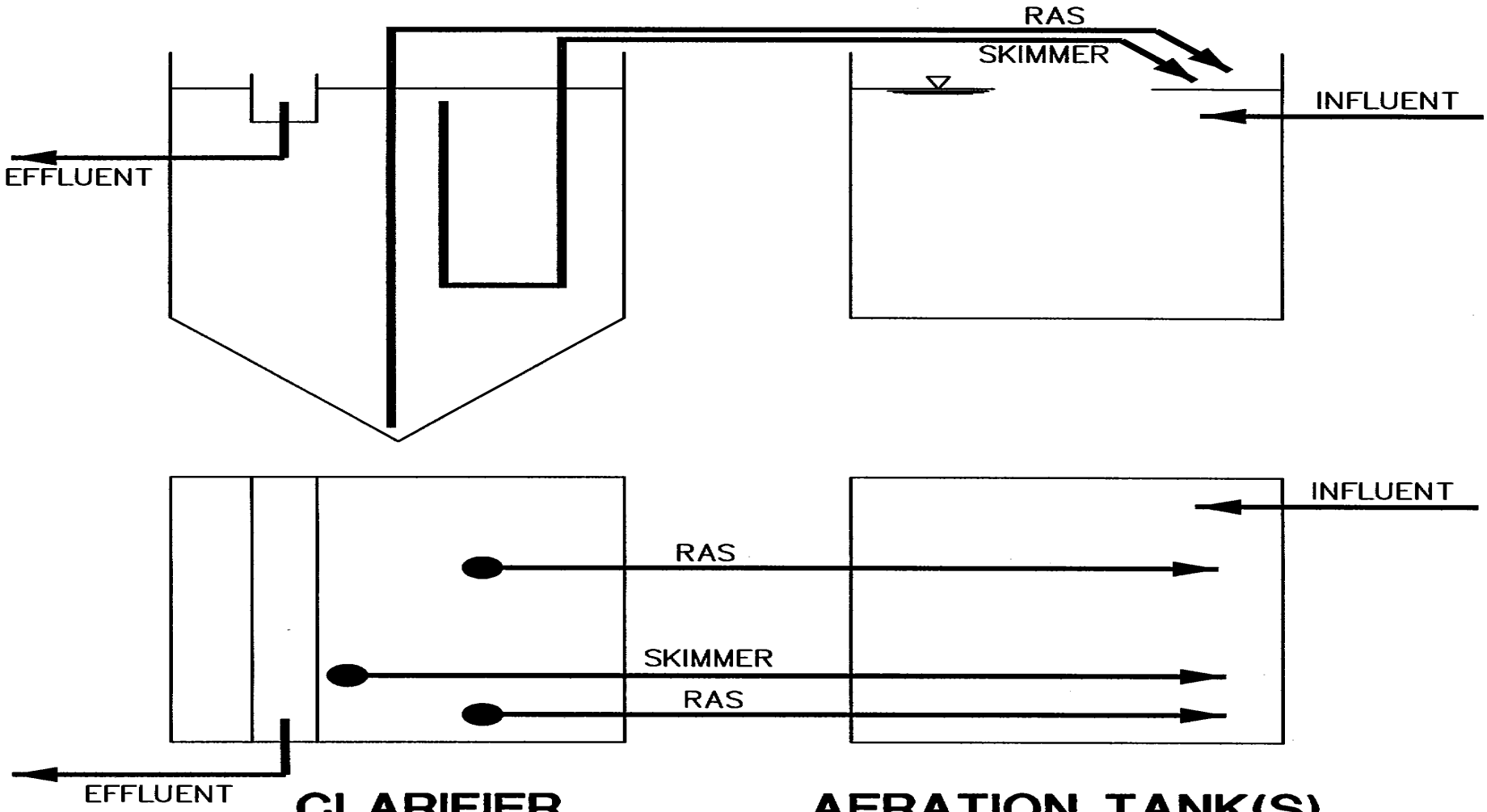

FIGURE NO.1 - A BASIC PACKAGE PLANT

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Small Industrial Plants

Jammed into parking lots

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Small Municipal Plants

Out in the middle of nowhere

if possible

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Usually designed for small flows

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May Incorporate Newer Technologies

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And a Problem Common to all is …

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SAFETY

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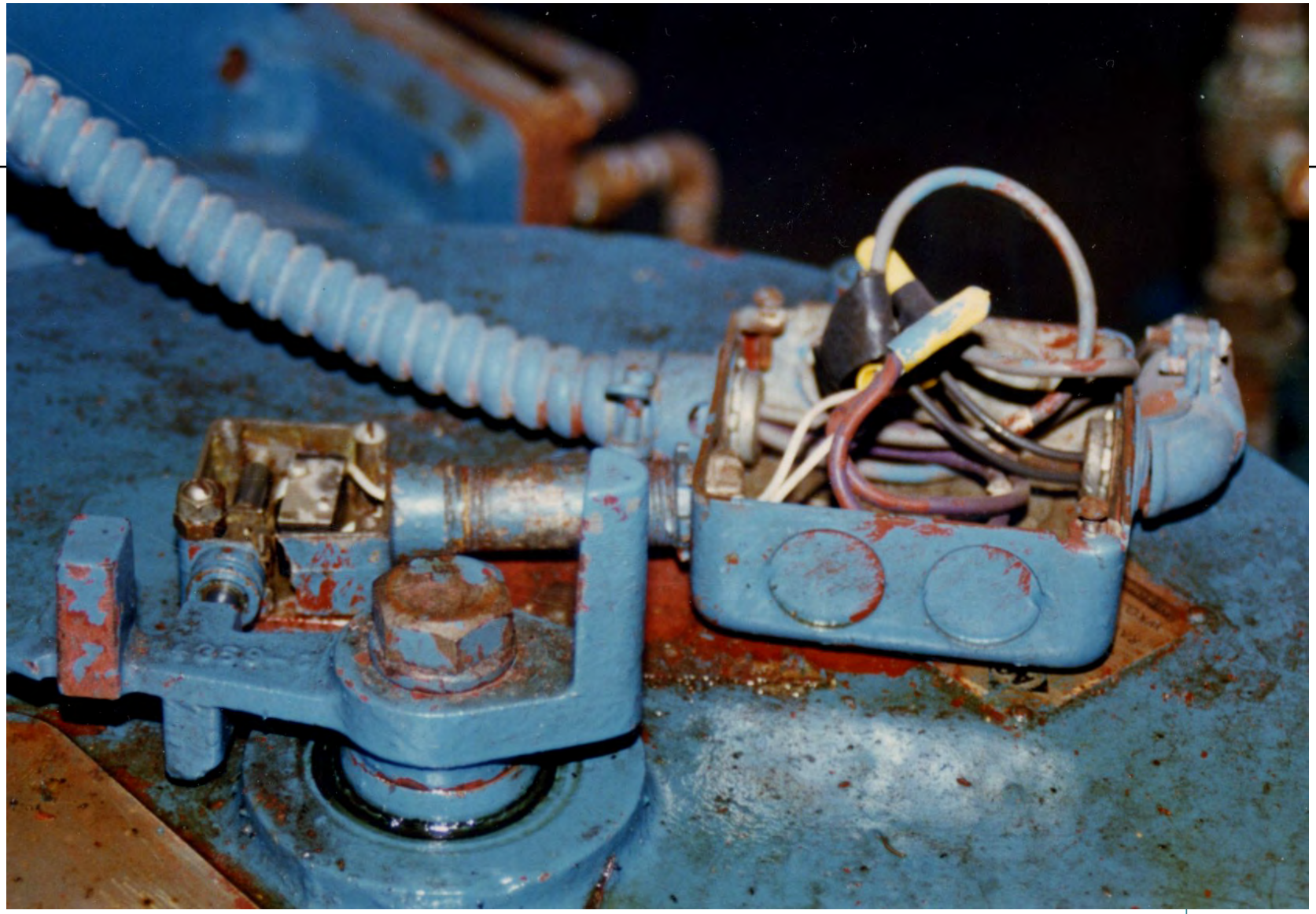

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STUDIES / EVALUATIONS

- USCP/Gnadenhutten

- Sodium Benzoate
- Benzoic Acid

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Package Plant TAR #1

- A TAR is a “Truth According to Radick”
- TAR #1 - You ALL run your returns too fast

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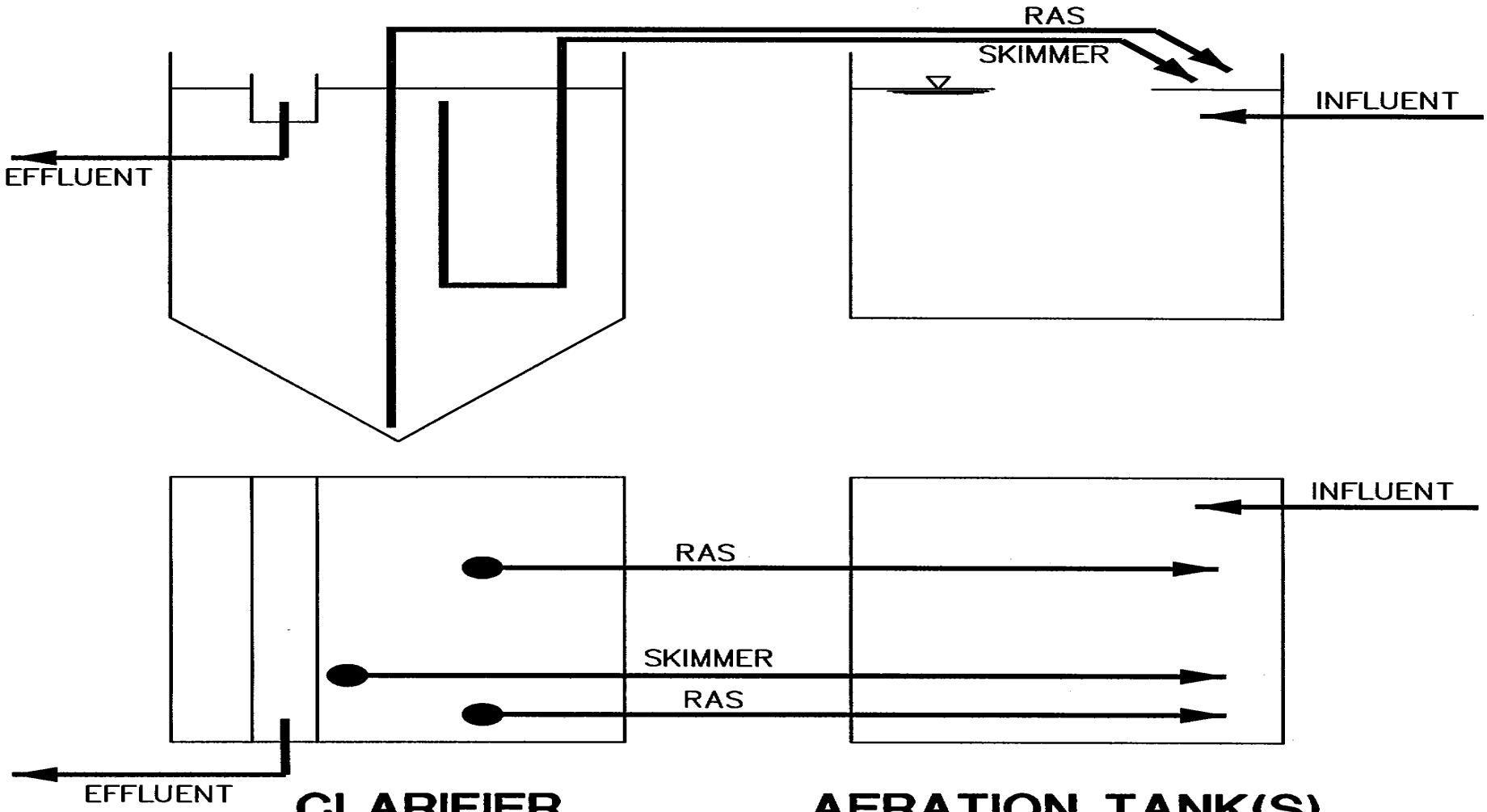

FIGURE NO.1 - A BASIC PACKAGE PLANT

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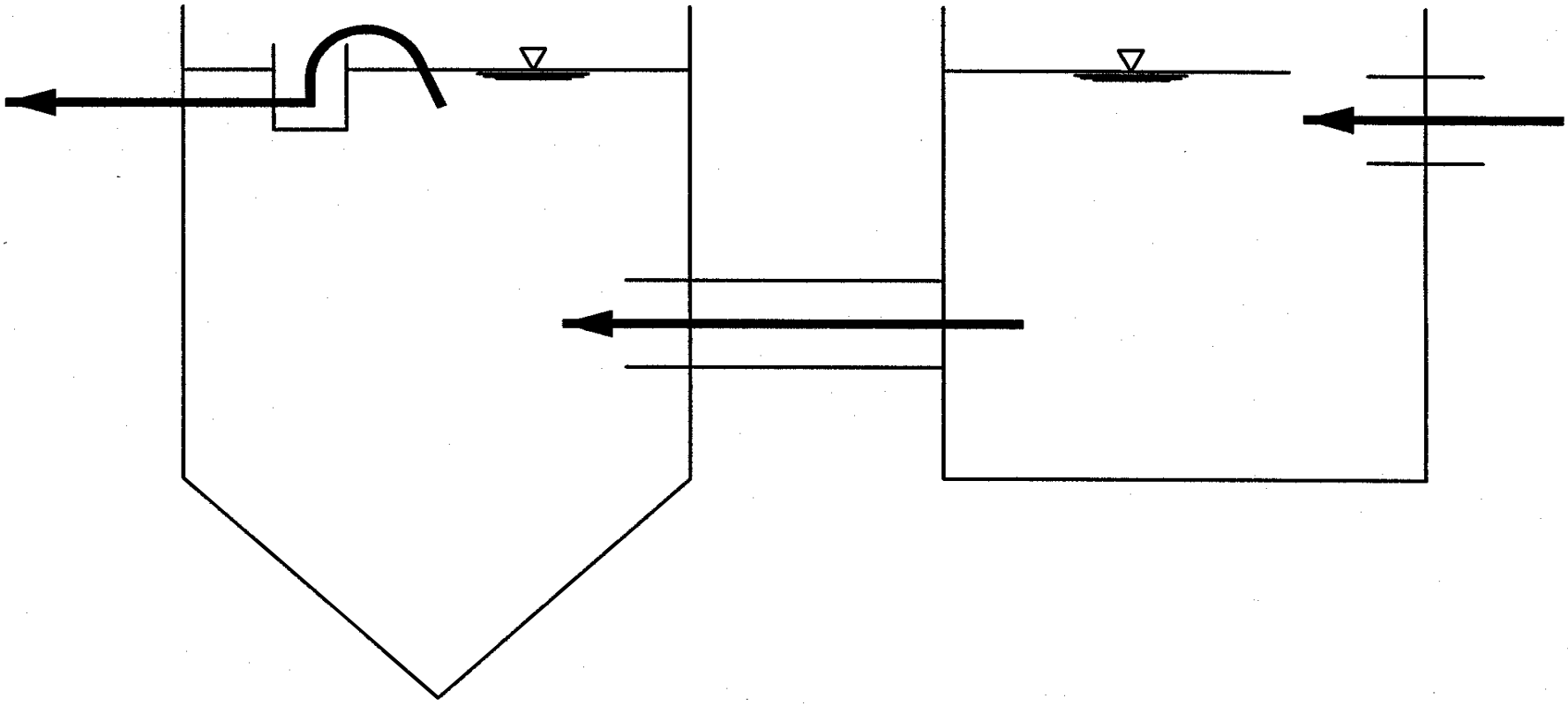

FIGURE NO.2 - FLOW THROUGH

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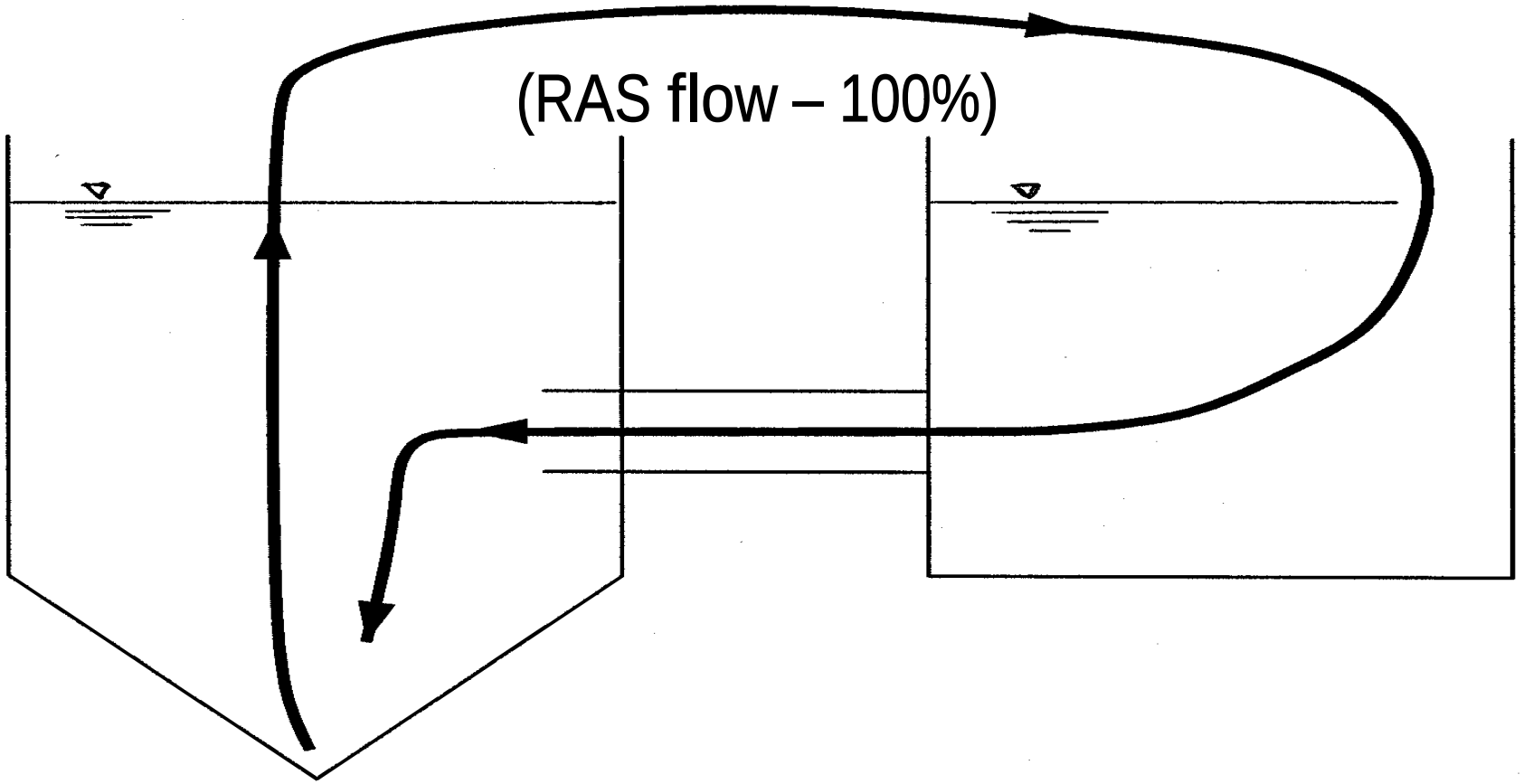

FIGURE NO.3 - RAS FLOW

100% ?? RETURN

- What does that mean?
- How Can You eyeball it?

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Well … Here's one way

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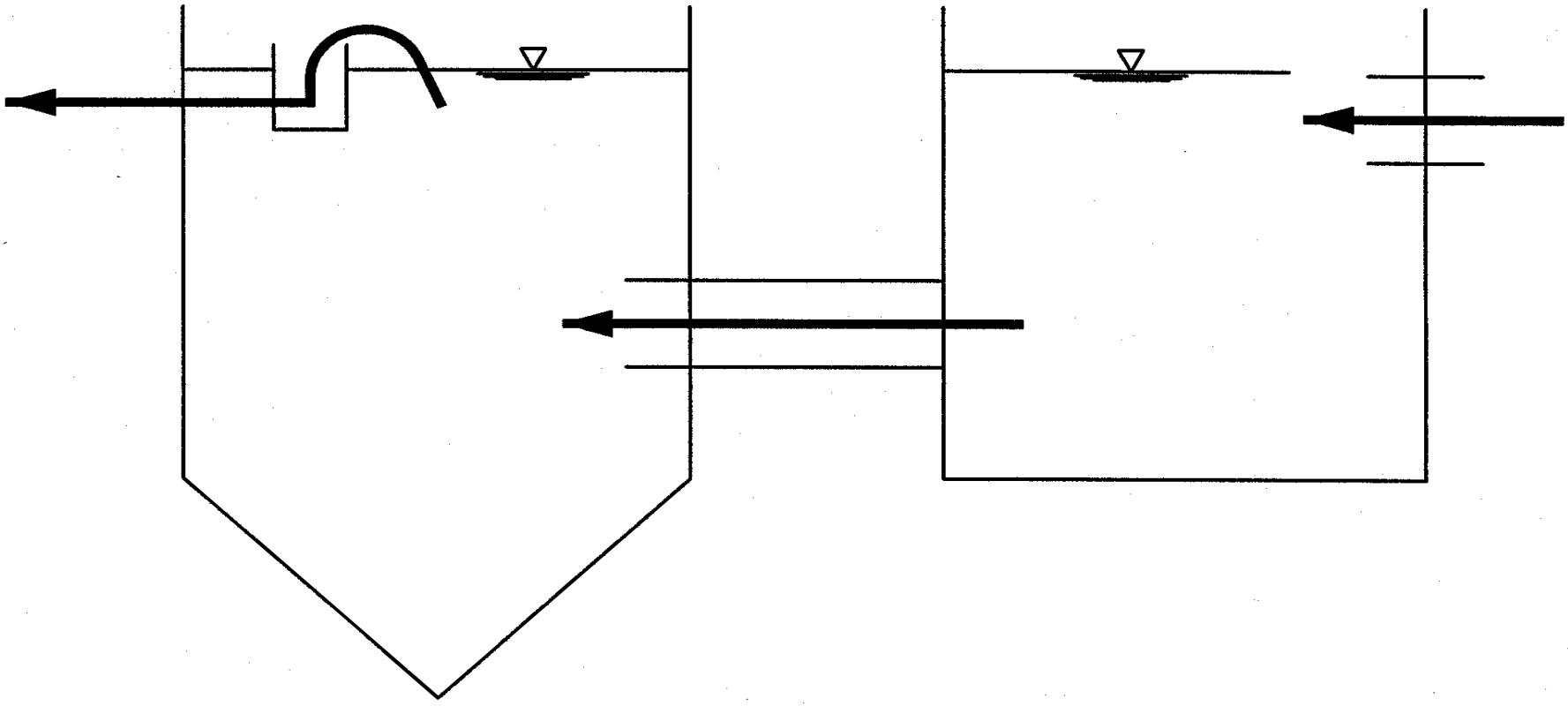

FIGURE NO.2 - FLOW THROUGH

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F80

Air-Sucking Do-Nothing Skimmers

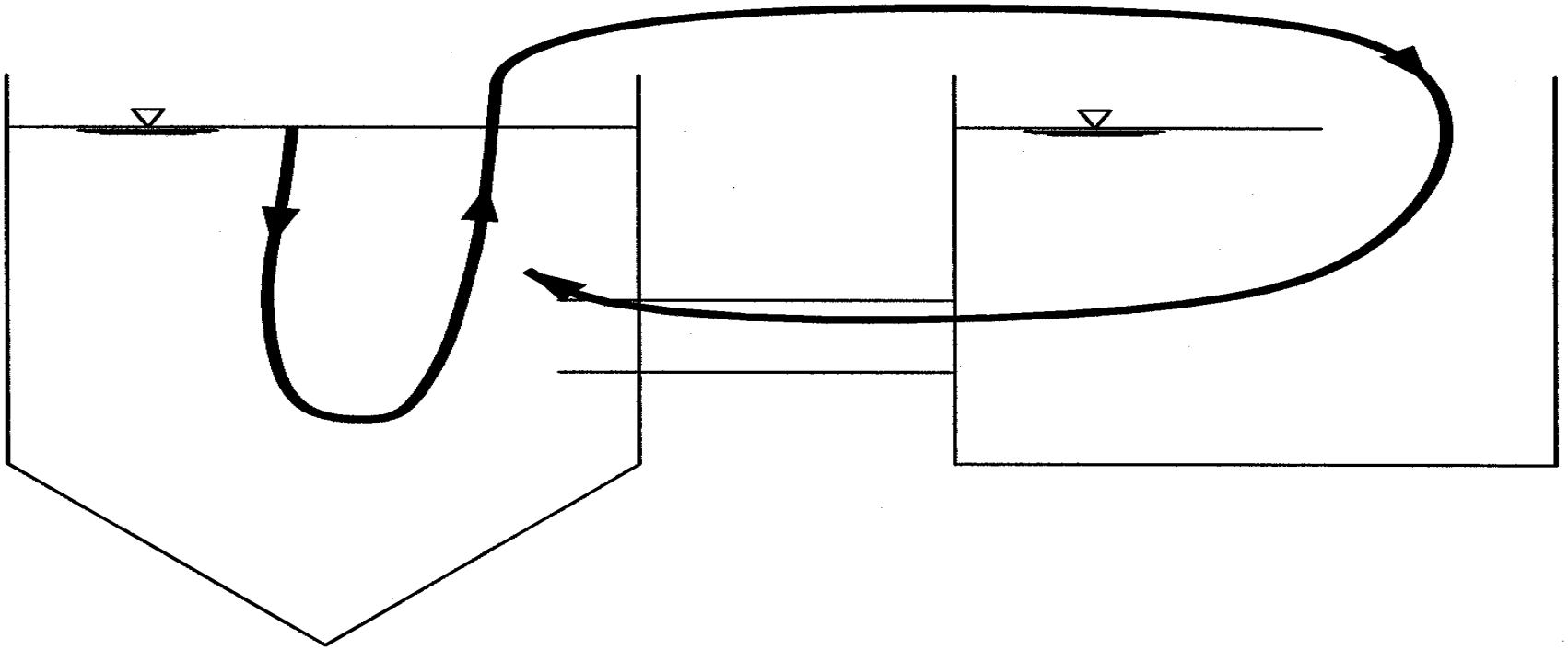

FIGURE NO.4 - SKIMMER FLOW

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TURN 'EM ~~DOWN~~ OFF

- Plant will run better – a LOT!
  - Sludge will actually SETTLE
- You'll "find" a bunch of wasted air
- You can balance the system better
- Turn the Skimmers OFF!

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Or … make that &/or …

- Install Geyser Pumps
- Not Cheap
- Dosing Chamber – dosing air

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Geyser Pumps

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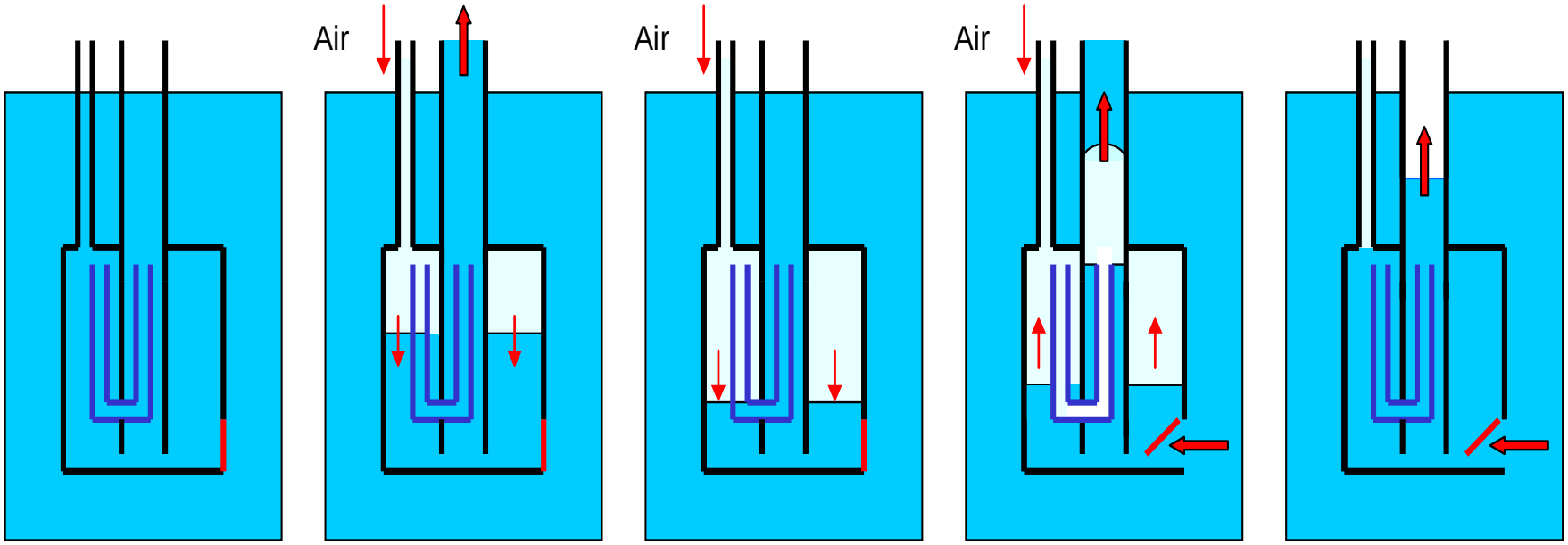
How it works - basically



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Skimmer Option

- Build your own
- You only run it when you're there!

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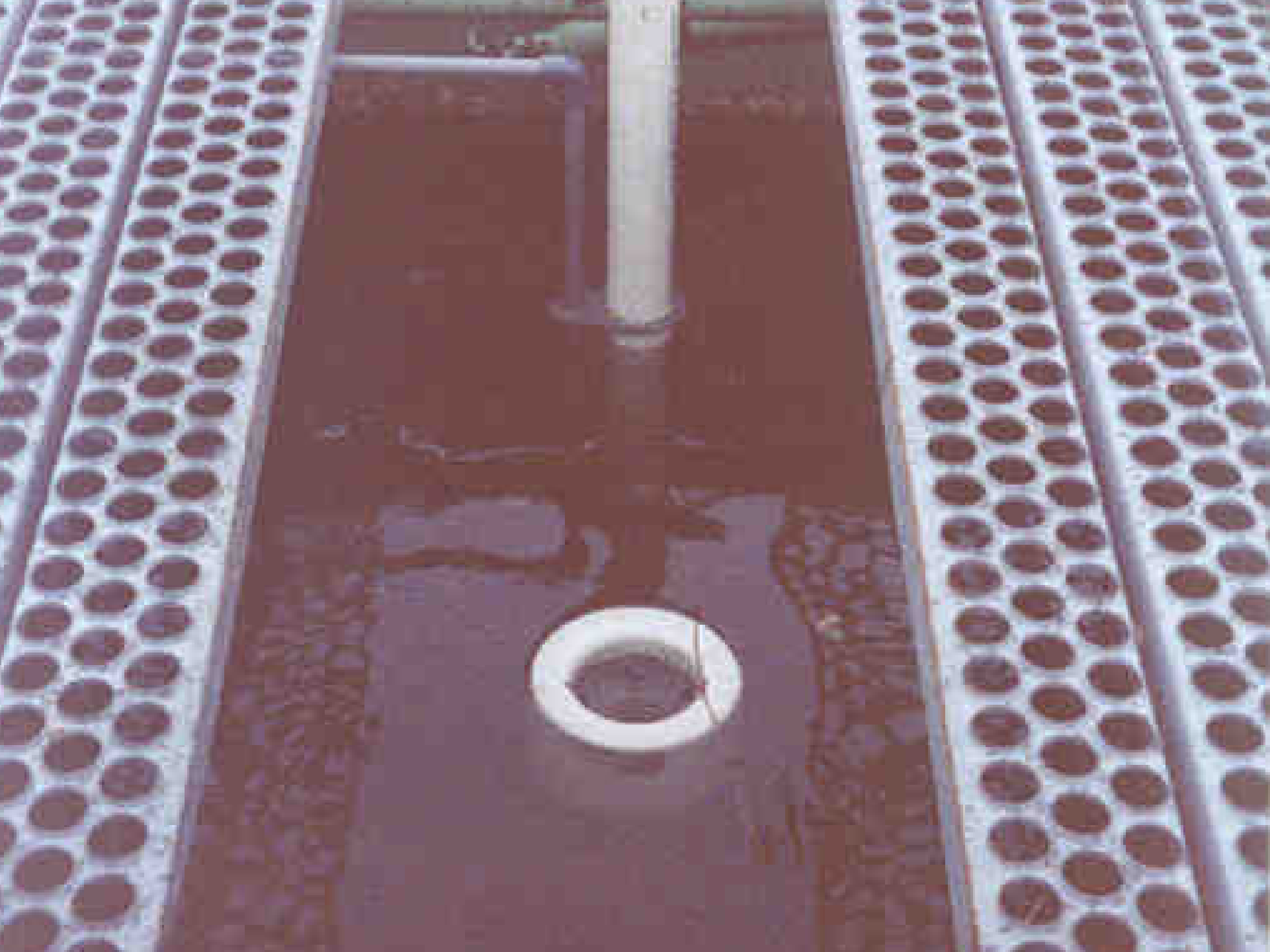

To Build Your Own

- It's been a long time
- I can't find my original supplier
- Try www.Floatingskimmersusa.com

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Closest I've Found

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TAR # 2 – Trash is Trash

- Trash is (one of) the biggest problem(s) in a Package Plant
- Screenings Stink
  - Take ‘em away
- Requires Visits – Aw, Gee!

- Take out ANYTHING you don’t need.

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TAR # 2 – Trash is Trash

- Processes are Requiring Removal
- It just makes sense

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TAR # 3 – “Think LESS Air”

- Put Blowers on Timers
  - And USE Them!
- Turn Your Skimmers OFF!
- Turn Your RAS Waaayy Down

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Blower Air

- 0.05 mgd x 8.34 x 200 mg/L = 83.4 lb/d BOD_5
- Means you need 83.4 lb O_2
- BOD_5 IS oxygen, right?

- Extended Aeration needs 2100 cuft/lb BOD_5

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Blower Air

- Air is 21% oxygen (23%?)
- Coarse air diffusers are < 5% transfer
- Air weighs 0.0745 lb/CuFt

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Blower Air

- 83.4 lb O_2 required
- 83.4 lb/d x 2100 cu ft/lb = 175,140 cu ft/d
- 175,140 cu ft/d ÷ 1440 = 122 cfm

- ** 2100 cu ft allows for 1.5 lb oxygen/lb BOD_5

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Blower Air – from another view

- 83.4 lb/d = 0.21x0.05x0.0745x X
- X= 83.4 ÷ (0.21 x 0.05 x 0.0745)
- X= 106,616 cu ft/d
- 106,616 ÷ 1440 = 74 cfm
- Add 10-15 each for RAS & Skimmers

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Blower Air

- You can turn them OFF!
- Wastes energy
- On/off cycles help recover alkalinity
- Much of the air provided is just for mixing

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Miscellaneous “Other”

- “Can’t beat it with a stick”
  - OR a hose

Window sash weight

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Miscellaneous “Other”

- Valves

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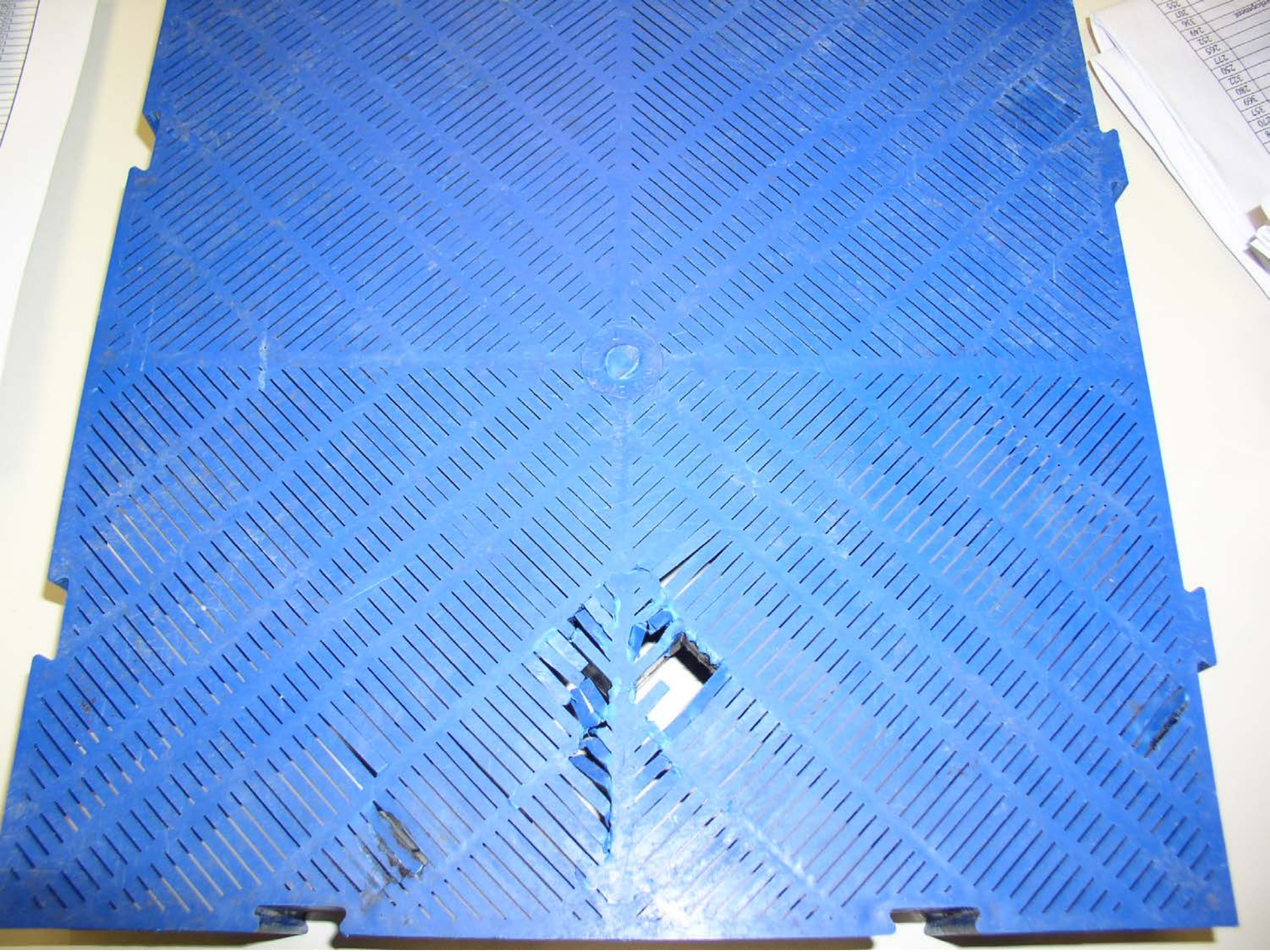
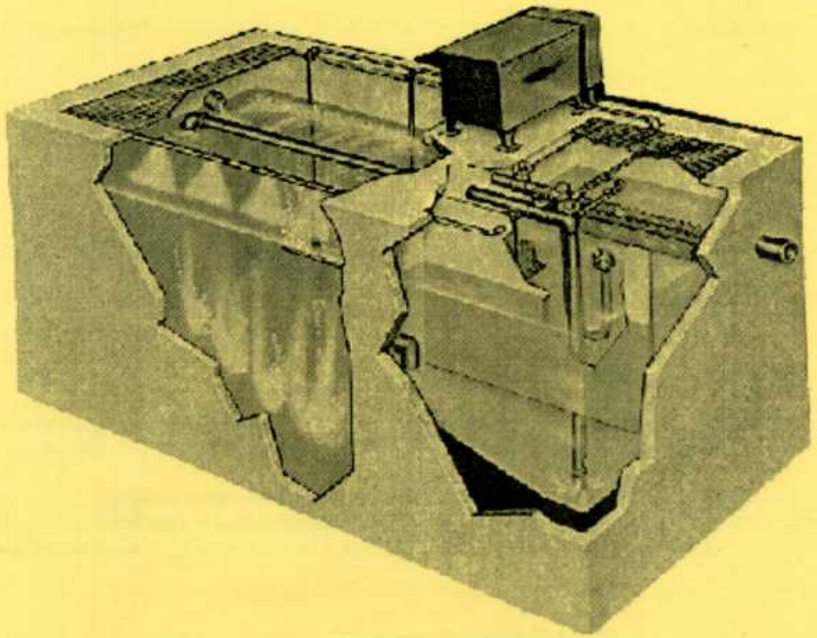


OhioEPA

State of Ohio Environmental Protection Agency

OPERATION AND MAINTENANCE

GUIDE FOR OWNERS OF PACKAGE EXTENDED AERATION SEWAGE TREATMENT PLANTS



Division of Surface Water
2000

/9-78-001

FIELD MANUAL FOR

PERFORMANCE EVALUATION AND TROUBLESHOOTING AT MUNICIPAL WASTEWATER TREATMENT FACILITIES

JANUARY 1978

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

MUNICIPAL OPERATIONS BRANCH
OFFICE OF WATER PROGRAM OPERATIONS
WASHINGTON, D.C. 20460

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QUESTIONS?

COMMENTS?

Thank You

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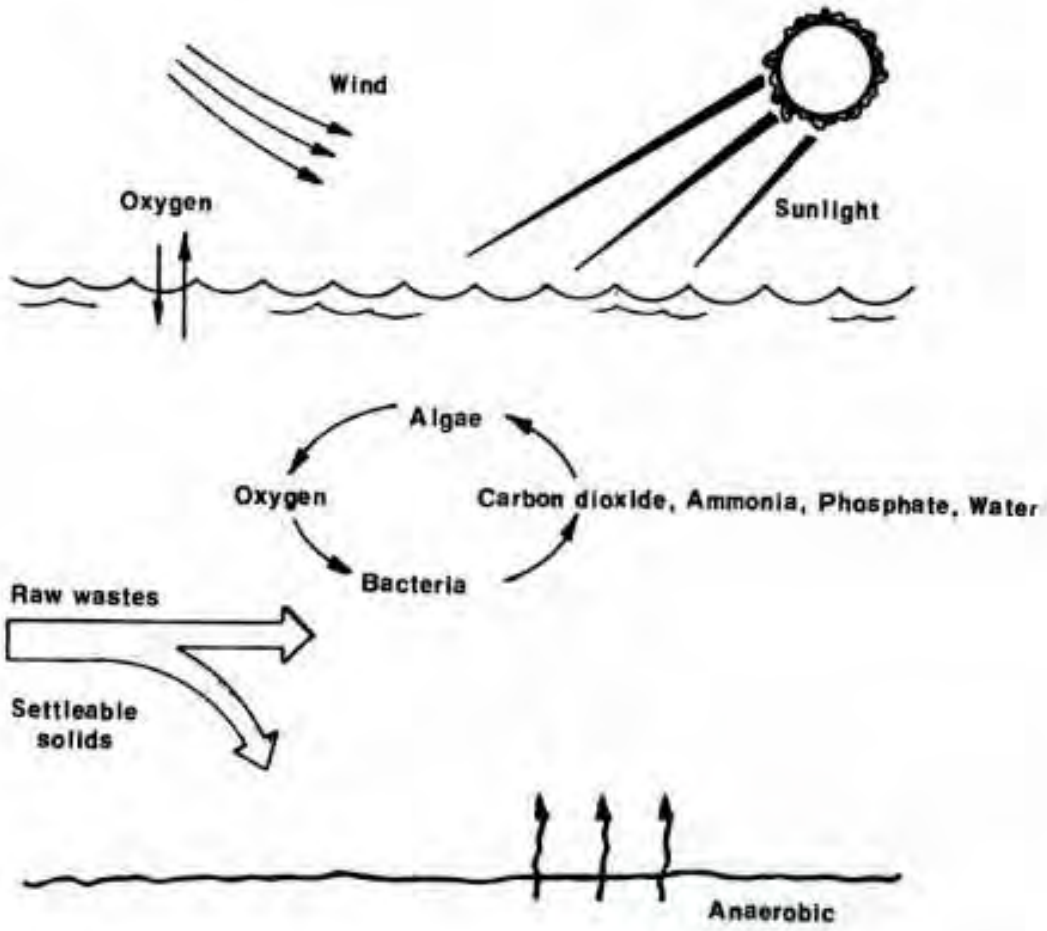
Lagoons


Wind
Oxygen
Sunlight
Algae
Oxygen
Carbon dioxide, Ammonia, Phosphate, Water
Bacteria
Raw wastes
Settleable solids
Anaerobic

Algae Control = TSS Control

- Duckweed
- Algae mats
- Aeration
- Surface Irritation
- Barley Straw

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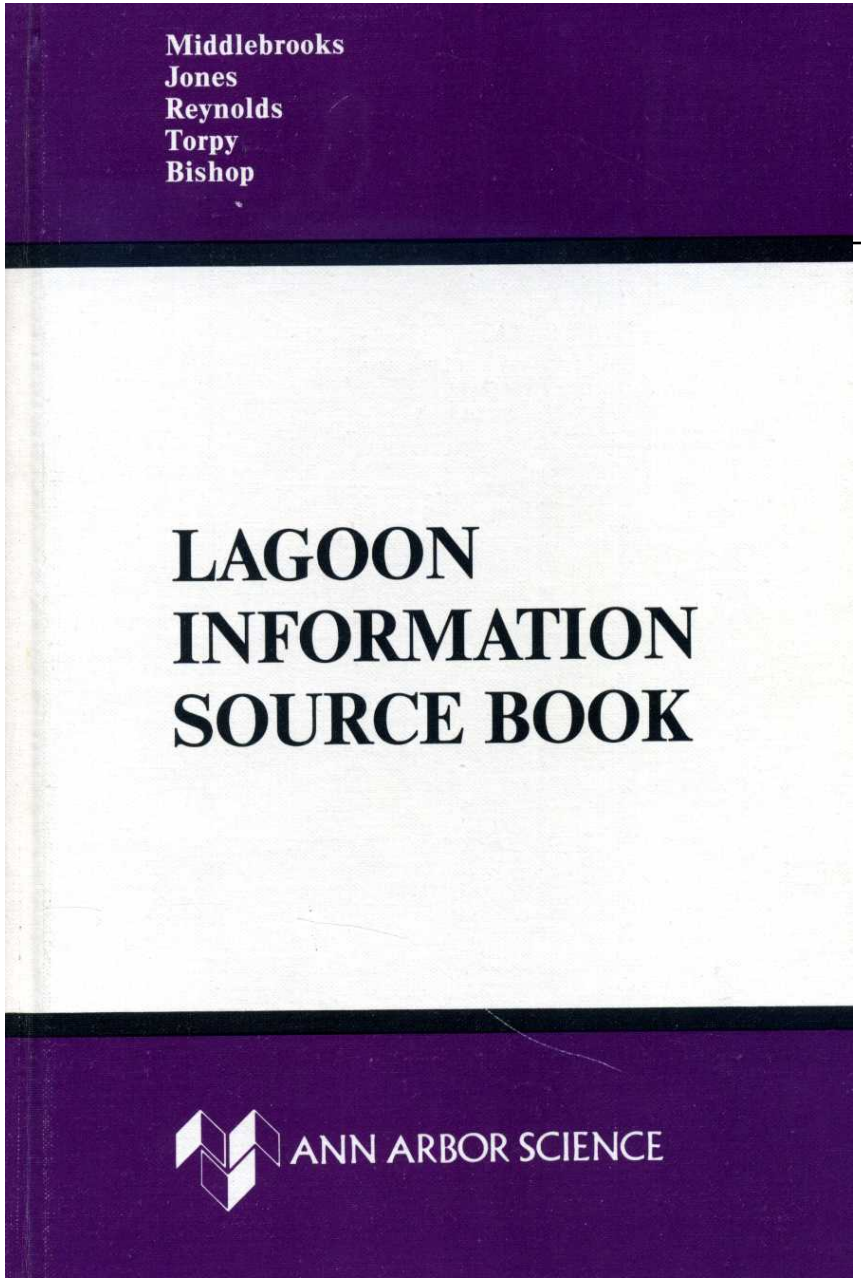
TABLE 5. DESIGN PARAMETERS FOR STABILIZATION PONDS (Metcalf and Eddy, 1972).

Parameter	Type of Pond			
	Oxidation Pond	Facultative	Mechanically Aerated Facultative	Mechanically Aerated Lagoons
Detention time, days*	10-40	7-30	7-20	3-10
Depth, ft	3-4	3-6	3-8	6-20
pH	6.5-10.5	6.5-9.0	6.5-8.5	6.5-8.0
Temperature range, ^{o}C	0-40	0-50	0-50	0-40
Optimum temperature, ^{o}C	20	20	20	20
BOD_5 loading, lb/acre/day	60-120	15-50	30-100	
BOD_5 conversion, percent	80-95	70-95	80-95	80-95
Principal conversion products	Algae, CO_2, bacterial cell tissue	Algae, CO_2, CH_4 bacterial cell tissue	CO_2, CH_4 bacterial cell tissue	CO_2, bacterial cell tissue
Algal concentration, mg/liter	80-200	40-160	10-40	

*Depends on climatic conditions and in cold weather areas detention times as great as 120 days are used for facultative ponds.

TROUBLESHOOTING GUIDE

INDICATORS/OBSERVATIONS	PROBABLE CAUSE	CHECK OR MONITOR	SOLUTIONS
1. Poor effluent quality.	1a. Organic overloading.	1a.	1a. Add sodium nitrate to lagoon in order to provide more oxygen or recirculate pond effluent.
	1b. Low temperature.	1b. Air temperature, lagoon brown-colored.	1b. When 2 or more cells provided, operate in series.
	1c. Toxic material in influent.	1c. Brown colored lagoon.	1c. Identity and control at the source.
	1d. Loss of lagoon volume caused by sludge accumulation.	1d.	1d. Remove sludge more frequently.
	1e. Aeration equipment malfunction.	1e. Inspect aeration equipment (if used).	1e. Repair or replace damaged and worn parts.
	1f. Mixing/agitation equipment malfunction.	1f. Inspect mixing/agitation equipment.	1f. Repair or replace damaged and worn parts.
	1g. Excess turbidity from scum and algal mats.	1g. Turbidity.	1g. (1) Break up scum mats. (2) Operate transfer pipes less than ½ full so that unobstructed water surface is maintained between channels and ponds.
	1h. Blockage of light by excessive plant growth on dikes.	1h. Visual inspection.	1h. Remove plant growth at regular intervals.
2. Inability to maintain sufficient liquid level.	2a. Leakage.	2a. Seepage around dikes.	2a. Apply bentonite clay to the pond water to seal leak.
	2b. Excessive evaporation or percolation.	2b. Detention time in pond is probably long.	2b. Divert land drainage or stream flow into lagoon.



Another Reference

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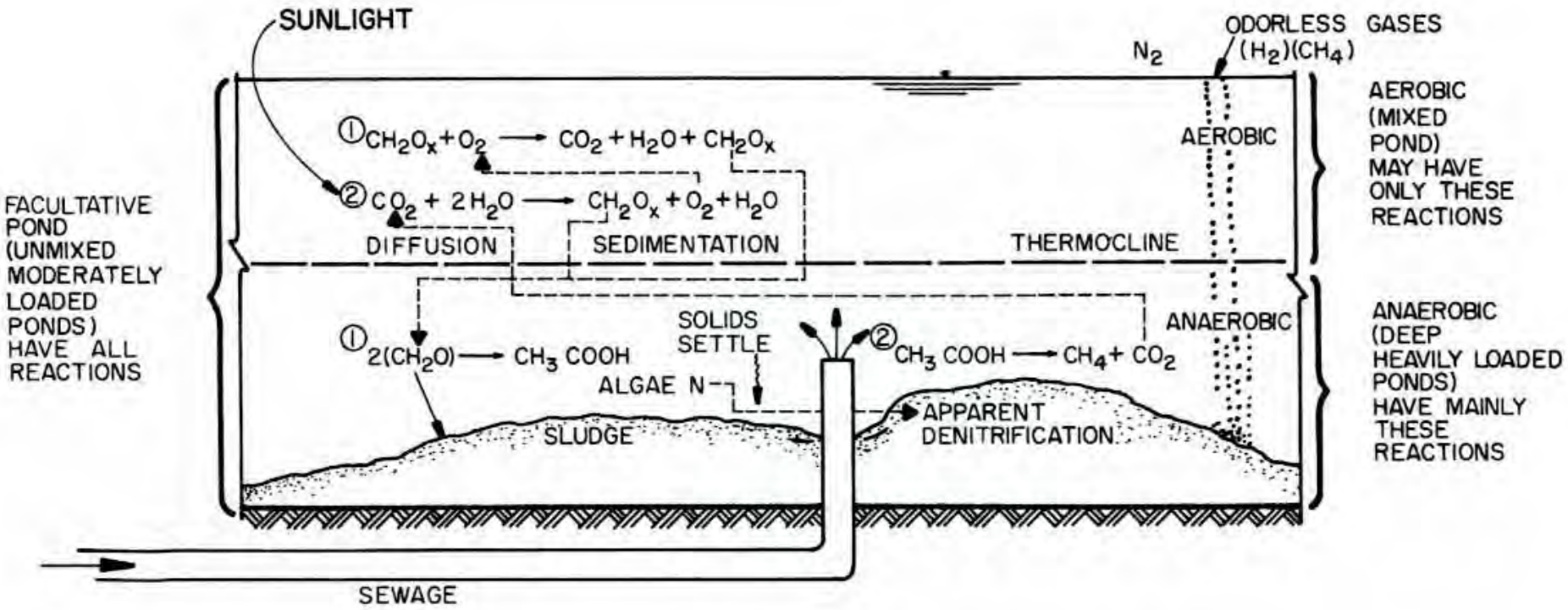
A Little Academic



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Section II
Abstracts

1. ABELISHVILI, G. Soviet Scientists Waterproof Ponds. Water and Sewage Works. 119(8):57. 1972.

   Key Words: Ponds, seepage losses

   A method is described where seepage losses in existing ponds are eliminated by a natural biochemical process. A layer of vegetation is spread by bulldozers on the soil surface. The vegetation layer is then covered with a six to eight inch thick protective layer of ground. Then the water is let in. The vegetation serves as a source for the development and vital activity of anaerobic bacteria, which create the water impermeable layer.

2. ADAMS, C. E. Hot Problem Solution by Aerated Lagoon. Water & Wastes Eng., 9(9):E-8, 1972; Multi-Stage Aerated Lagoon Design for a High Temperature Waste. 10th Annual Environ. and Water Resources Eng. Conf., Nashville, Tenn., 1971; Poll. Abs., 3(4):132, 1972.

   Key Words: Paper industry wastes, thermal discharges, lagoons, aeration

   Investigations were conducted to determine the most economical and practical treatment of paper mill wastes. The primary consideration was the reduction of effluent temperature to 100°F, the maximum for conventional biological waste treatment in aerated lagoons. Major design considerations, procedures, calculations, and process alternative comparisons are presented.

3. ADAMS, C. E., JR., ET AL. The Development of Design Criteria for Wastewater Treatment Processes. Vanderbilt University, Department of Environmental and Water Resources Engineering. 1973.

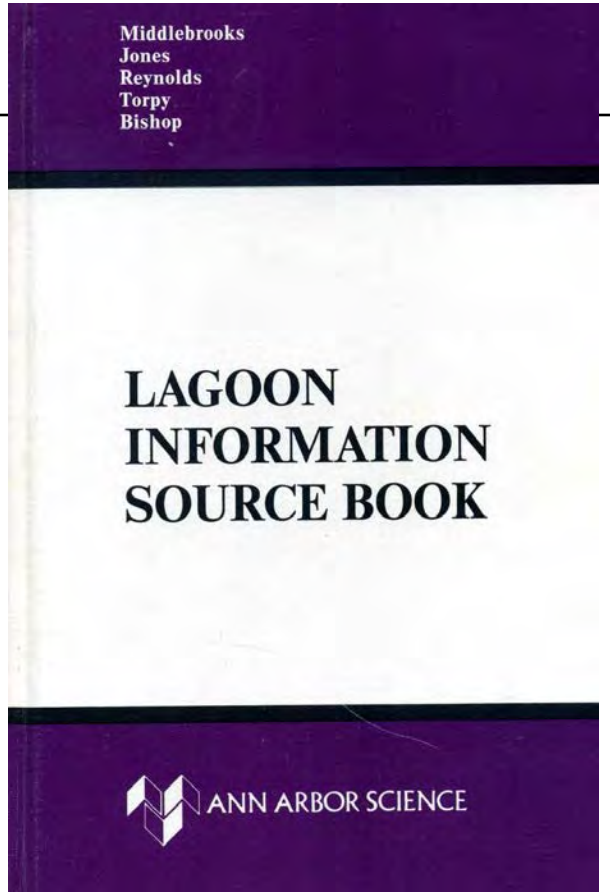
   Key Words: Wastewater treatment, lagoons, design criteria

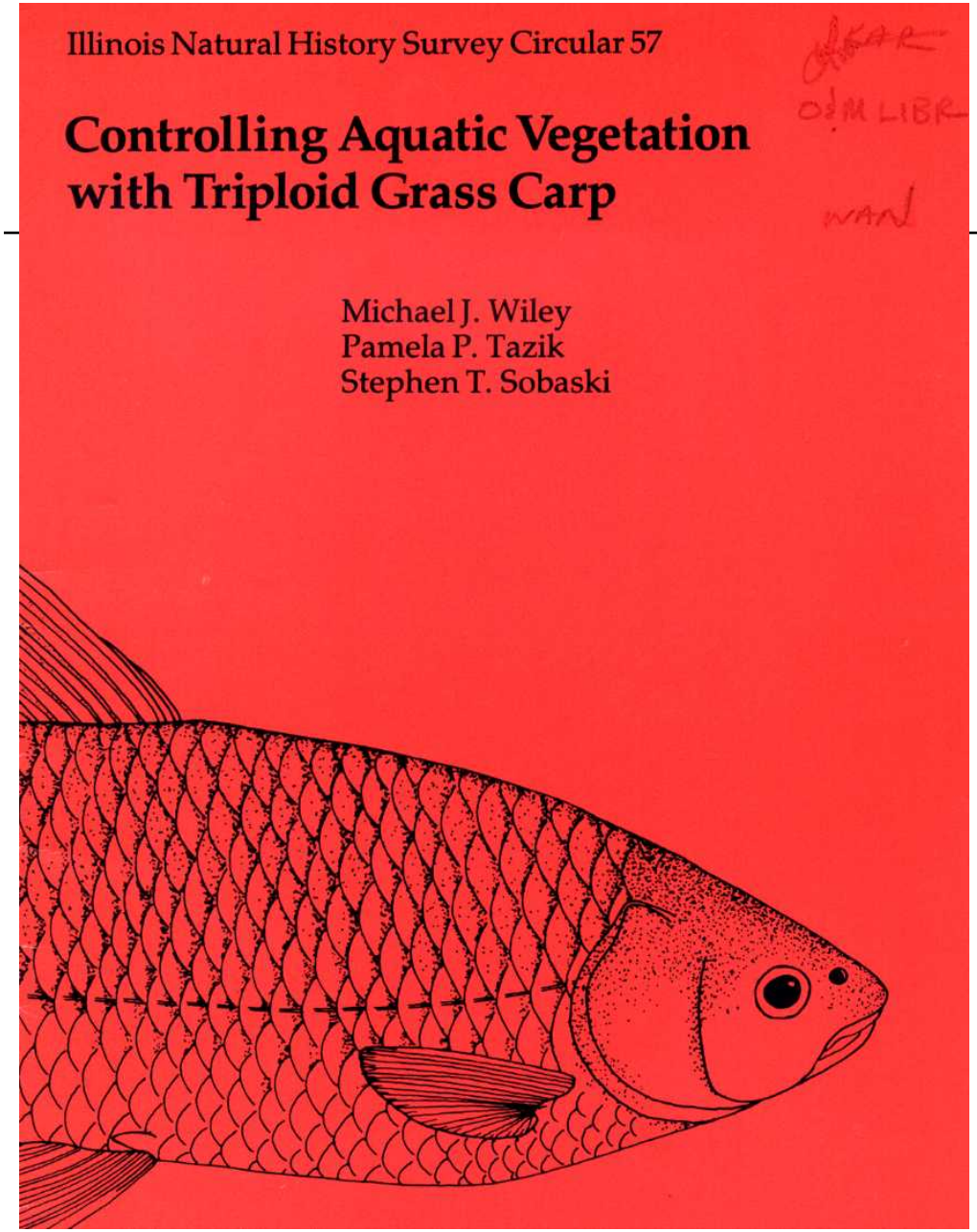
   Papers on various aspects of wastewater treatment are presented, including discussions of sampling and characterization principles, acclimation of biological sludges, methodology for evaluating toxicity and pretreatment methods. Specific topics include activated sludge, aerated lagoons, waste stabilization ponds, etc.

4. ADAMS, L., ET AL. Effects of Detergent Protease Enzymes on Sewage Oxidation Pond Phytoplankton. BioScience, 21:1035. 1971.

   Key Words: Detergents, oxidation ponds

   Adams et al. studied the influence of Types EP-1 and EP-2 alkaline protease enzyme on facultative lagoon performance. In the range between 0.1





Weed Control

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