PRODUCING WATER REUSE QUALITY EFFLUENT FROM A HIGH STRENGTH WASTEWATER SOURCE: A CASE STUDY

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PRESENTATION OUTLINE

- WHAT IS HIGH STRENGTH WASTEWATER?
- NSF/ANSI 350 STANDARD
- DESIGNING FOR HSW
- CASE STUDY
- CONCLUSIONS

RESIDENTIAL STRENGTH

NSF DEFINITION

BOD_5 = 100 to 300 mg/L
TSS = 100 to 250 mg/L
TKN = 35 to 70 mg/L
FOG ≤ 25 mg/L

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WHAT IS HIGH STRENGTH WASTE?

- HIGH BOD
- HIGH COD
- HIGH NITROGEN
- HIGH TSS
- HIGH FAT, OIL AND GREASE (FOG)

Anything NOT
“residential waste”
IS
“high strength”

Sometimes, even
“residential waste”
is
“high strength”

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HIGH STRENGTH COMMERCIAL

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OTHER HIGH STRENGTH APPLICATIONS

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NSF/ANSI 350

ONSITE RESIDENTIAL
AND
COMMERCIAL
WATER REUSE TREATMENT SYSTEMS

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SCOPE: STANDARD 350

- Residential and Commercial
- Sources; Graywater and Combined
  - Graywater
    - Laundry And Bathing
    - Excludes: Toilet And Kitchen
  - Combined: Blackwater And Graywater
- Non-potable Effluent Uses
  - Indoor
    - Toilet And Urinal Flushing
  - Outdoor
    - Surface And Subsurface Irrigation

EFFLUENT CRITERIA: STANDARD 350

PARAMETER	CLASS R	CLASS C
$CBOD_5$	10 mg/L (25)	10 mg/L (25)
TSS	10 mg/L (30)	10 mg/L (30)
Turbidity	5 NTU (10)	2 NTU (5)
E. coli	14 MPN/100 mL (240)	2.2 MPN/100 mL (200)
pH	6.0 – 9.0	6.0 – 9.0
Chlorine	0.5 - 2.5 mg/L	0.5 - 2.5 mg/L

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ONE SIZE MAY OR MAY NOT FIT ALL

- LAUNDROMATS (LINT)
- BAKERIES (FLOUR)
- SENIOR COMMUNITIES (MEDICATIONS)
- CONVENIENCE STORE (SODA SYRUP)
- BREWERY (SUGARS AND ALCOHOL)

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HOW WILL I KNOW?

- INFLUENT LABORATORY ANALYSIS
- EXPERIENCE
- COMMON SENSE

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TEXAS RESTAURANT WW ANALYSIS

WASTEWATER STRENGTH BY RESTAURANT TYPE					
No in Group	Type Restaurant	BOD mg/L Avg/High/Low	TSS mg/L Avg/High/Low	COD mg/L Avg/High/Low	FOG mg/L Avg/High/Low
6	Fast Food/Burgers	2137/974/176	233/1107/25	2164/6290/367	102/207/13
1	Pizza	1856/3220/1270	321/1100/63	2762/4320/2330	183/539/85
4	Chinese	1364/4100/626	448/2840/232	2430/7540/1258	241/2026/30
9	Mexican	1254/18,800/44	668/15100/15	2425/11,700/152	190/1430/37
1	American	1063/1600/536	297/585/120	1647/2340/837	147/280/9
1	American Buffet	792/1385/300	195/308/62	1311/1948/668	63/98/42
2	Steakhouse	601/1160/433	160/310/134	99/1942/950	77/249/14
3	Seafood	555/1180/55	229/2118/20	901/1630/185	47/109/12

HONG KONG RESTAURANT STUDY

HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

Type of Restaurant	BOD mg/L	COD mg/L	Oil & Grease mg/L	SS mg/L
Chinese	167-1380	606-2400	120-712	35.2-193
Western Restaurant	729-1160	1940-2190	729-1160	152-339
American Fast Food	668-2240	1150-4240	355-402	130-218
Student Canteen	825-1250	2450-2760	1090-1500	547-578

SOURCE: Xueming Chen, Guohua Chen *, Po Lock Yue; The Hong Kong University of Science and Technology; *Separation of Pollutants from Restaurant Wastewater by Electrocoagulation* ; 9 October 1999

QUESTIONS TO ASK

MANY FACTORS CAN AFFECT THE STRENGTH OF WASTEWATER.

RESTAURANT DATA EVALUATION	
Water Use	Type of Dishwashing
Type of Food Prepared	Dishwashing Temperature
Free Salad Dressing	Detergent Type
Buffet Service	Use of Public Restrooms
Specialty Meals	Use of Low Plow Fixtures
Ice Cream/Yogurt Machine Use	Automatic Shut Off Fixtures
Self Serve Drinks	Ice Machine Discharge Type
Types of Plates	Air Conditioning Condensate
Type of Service Available	Discharge Type
Type of Cooking Oil	Floor Drain Discharge
Use of Preservative	Use of Wash-Down Water
Defrosting of Use of Running Water	Type of Wash
Number of Seats	Use of Kitchen Laundry
Size of Restaurant	Cleaning Water Destination
Meals Served per Day	Map Water Destination
Hours of Operation	Grease Trap Size
Days of Operation	Grease Trap Pumping Schedule
Use of Garbage Disposal	Location of Sampling Port
Were Plates Scraped	

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TYPICAL PROCESS DESIGN

Example: Restaurant

- Grease Trap with 1 times daily flow
- Settling with ½ to 1 times the daily flow
- SaniTEE ® screens in the settling tank
- Flow Equalization if required
- HighStrengthFAST® with plenty of settling
  (AVOID USING MINIMUMS IF POSSIBLE)

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LAKE PEARL LUCIANO'S

- Function Hall and Restaurant In Wrentham, MA
- Design Flow 6,600 GPD
- Start Up March 2006
- HighStrengthFAST® 9.0 Followed by MicroFAST® 9.0

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LAKE PEARL LUCIANO'S INFLUENT

	BOD_5	TSS	TKN
Samples Collected	33	33	32
Maximum Value	10,180 mg/l	7,080 mg/l	199 mg/l
Minimum Value	79 mg/l	4 mg/l	3 mg/l
Average	1004 mg/l	604 mg/l	49 mg/l
Mean	640 mg/l	188 mg/l	36 mg/l

LAKE PEARL LUCIANO'S EFFLUENT

	BOD_5	TSS	TKN
Samples Collected	35	35	34
Maximum Value	520 mg/l	59 mg/l	16 mg/l
Minimum Value	2 mg/l	4 mg/l	0.5 mg/l
Average	23 mg/l	11 mg/l	3.4 mg/l
Mean	4 mg/l	5 mg/l	2.5 mg/l

LAKE PEARL LUCIANO'S EFFLUENT

	BOD_5	TSS	TKN
Samples Collected	32	32	31
Maximum Value	25 mg/l	26 mg/l	7.4 mg/l
Minimum Value	2 mg/l	4 mg/l	0.5 mg/l
Average	7.5 mg/l	8.0 mg/l	2.7 mg/l
Mean	4 mg/l	4.5 mg/l	2.3 mg/l

Without 3 Outliers

AYER ROAD OFFICES

- Office Building in Harvard, MA
- Design Flow = 3,564 GPD
- MicroFAST® 4.5 Followed by NitriFAST® 4.5 Followed By ABC-N® 3.0

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AYER ROAD OFFICES INFLUENT

	BOD_5	TSS	TKN
Samples Collected	36	36	36
Maximum Value	3,760 mg/l	4,960 mg/l	259 mg/l
Minimum Value	8 mg/l	10 mg/l	9 mg/l
Average	243 mg/l	338 mg/l	69 mg/l
Mean	38 mg/l	46 mg/l	61 mg/l

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AYER ROAD OFFICES EFFLUENT

	BOD_5	TSS	TKN
Samples Collected	37	37	37
Maximum Value	23 mg/l	28 mg/l	39 mg/l
Minimum Value	4 mg/l	1 mg/l	3 mg/l
Average	6 mg/l	5 mg/l	12 mg/l
Mean	4 mg/l	4 mg/l	10 mg/l


MatuNuck
OYSTER BAR
RESTAURANT
SHELLFISH FARM TOURS

DESIGN DETAILS

- 80 SEATS
- 0.8 ACRE
- RIDEM
  CRITICAL RESOURCE AREA – NITROGEN REDUCTION

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DESIGN CONSIDERATIONS

- All Components Installed In Parking Lot
- All Tanks Meet H-20 Loading
- Design Flow Based On Meter Readings
- Wastewater Sampling For Maximum Concentrations

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ENGINEER'S DESIGN

- FOG Removal Tankage
  - ➢Two Day HRT
- WW from Floor Drains and Mop Sink
  - ➢Isolated in Holding Tank
- Single Pass Sand Filter Soil Adsorption
- Membrane Biological Reactor (MBR)
  - ➢Due to High Reduction of TN Needed (<19 mg/L)

INFLUENT FOR SIZING

Flow (GPD)	<6,000
BOD_5 (mg/L)	<1,800
TSS (mg/L)	<1,000
TKN as N (mg/L)	<115
FOG (mg/L)	<400

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RIDEM EFFLUENT LIMITS

BOD_5 (mg/L)	<30
TSS (mg/L)	<30
TN (mg/L)	<19

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TREATMENT SYSTEM LAYOUT

- **12,000 Gallons of Grease Separation**
- **12,000 Gallons Total Settling Tanks**
- **Two SaniTEE® Screens with 1/8 inch Slots**
- **Feed Pumps to Pump 65 GPM every 15 Minutes**
- **3,000 GPD BioBarrier® MBRs**
- **One 9,000 Gallon Effluent Pump Chamber**
- **Single Pass Sand Filter Absorption System**

BSF DESIGN FOR PARKING LOT

BSF DRAINFIELD

INFLUENT JUNE 2016 TO JUNE 2017

Parameter	Design	Average	Median
Flow (GPD)	<6,000	3,070	2,700
BOD_5 (mg/L)	<1,800	956	970
TSS (mg/L)	<1,000	165	123
TKN (mg/L)	<115	87	81
FOG (mg/L)	<400	342	79

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EFFLUENT BOD

ALL EFFLUENT BOD_5 SAMPLES

NON-DETECTIBLE

LAB DETECTION LIMIT – 4 mg/L

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EFFLUENT RESULTS

Parameter	TSS (mg/L)	TN (mg/L)	FOG (mg/L)
Average	8	5	1
Median	8	5	1
Maximum	24	12	1.9
Minimum	<4	2	<1.2
# of Samples	13	12	11

EFFLUENT DATA COMPARISON

Parameter	NSF 350	Oyster Bar
BOD_5 Average (mg/L)	10	<4
BOD_5 Max (mg/L)	25	<4
TSS Average (mg/L)	10	8
TSS Max (mg/L)	30	24
pH	6 to 9	7.6 to 8.4

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BIO-BARRIER® NSF 350 TEST RESULTS

Turbidity (NTU)	
NSF 350 Limit	2 (5 Max)
Average	0.25
Maximum	0.63

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BIOBARRIER® NSF 350 TEST RESULTS

E. Coli (MPN/100mL)	
NSF 350 Limit	2.2 (200 Max)
GeoMean	1.3
Maximum	4

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COULD THIS EFFLUENT BE REUSED?

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QUESTIONS

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