



OPEARTING EXPERIENCE WITH ANAEROBIC MEMBRANE BIOREACTOR TREATING FOOD WASTE

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LOW-RATE



MEDIUM-RATE



HIGH-RATE

ANAEROBIC DIGESTER TYPES





LOW-RATE



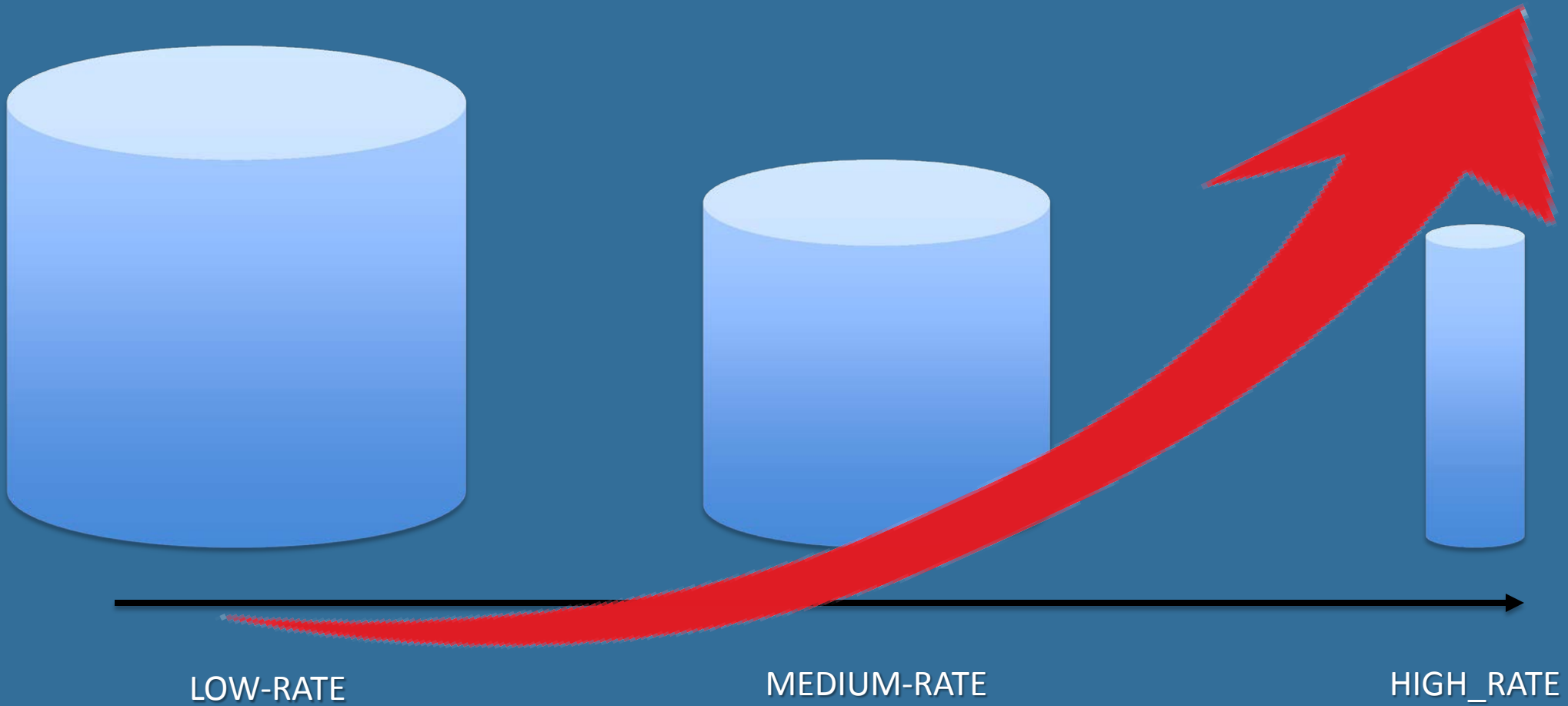
MEDIUM-RATE





HIGH-RATE

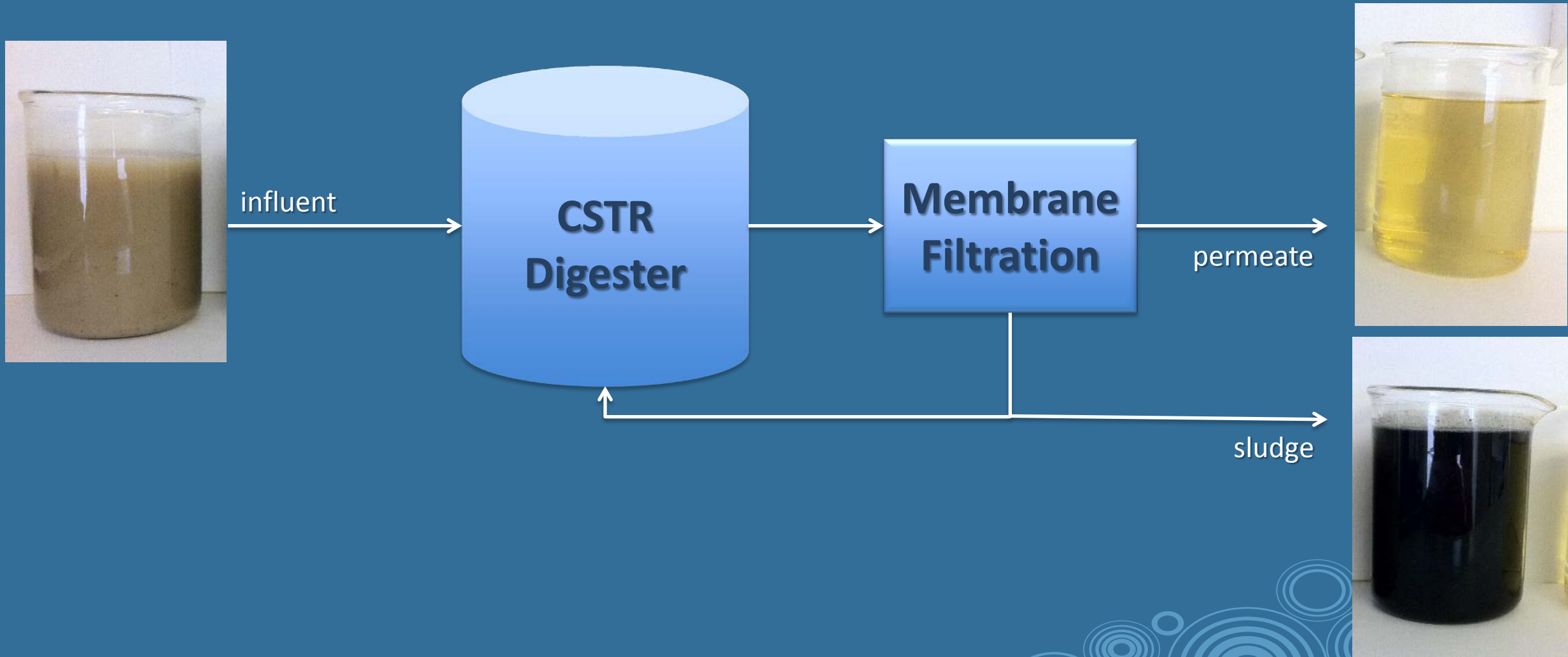




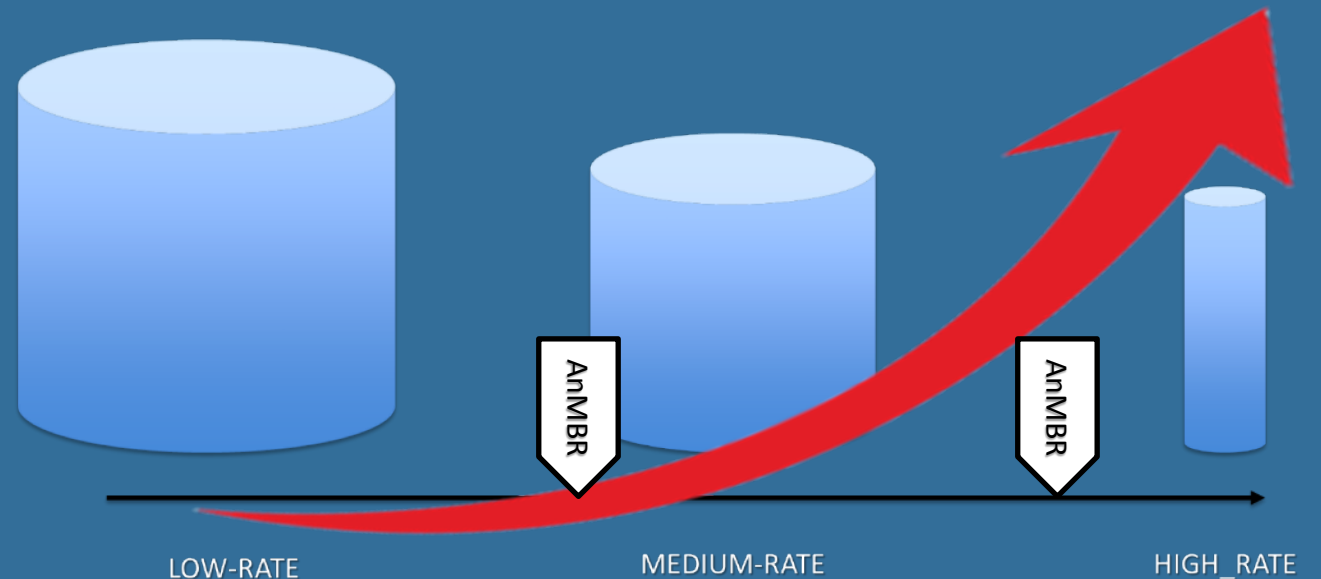
PRE-TREATMENT REQUIREMENTS



ANAEROBIC MEMBRANE BIOREACTOR (ANMBR)



- ✓ VERSATILE
- ✓ HIGHLY EFFICIENT
- ✓ COMPACT
- ✓ ROBUST
- ✓ RELIABLE
- ✓ FLEXIBLE



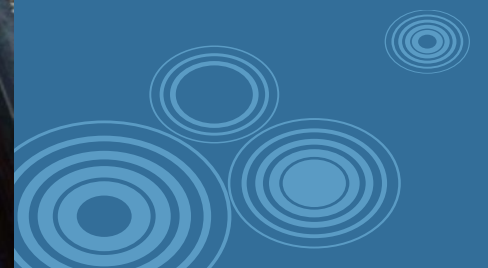
PRE-TREATMENT REQUIREMENTS



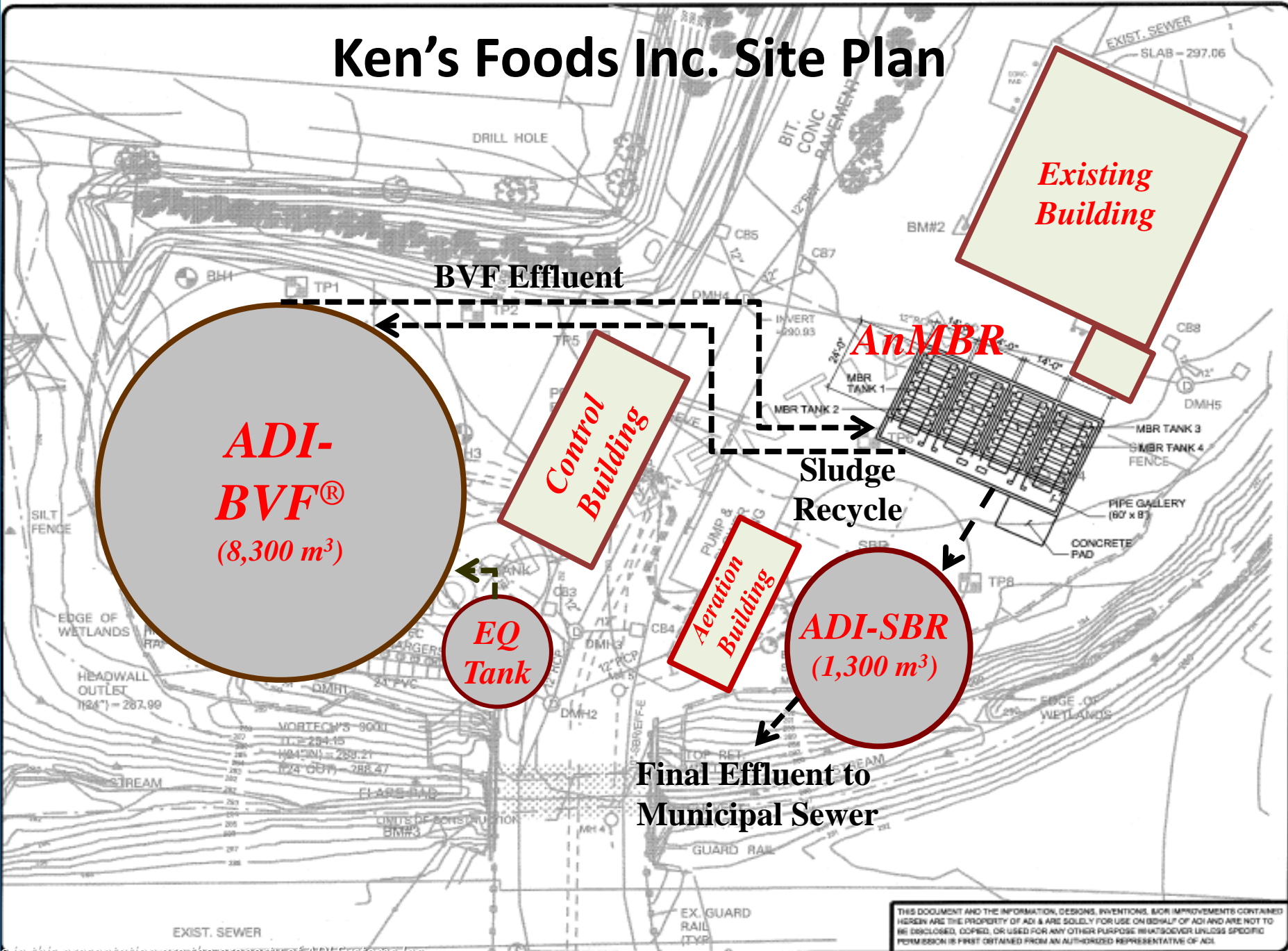
KEN'S FOODS, MA (US)



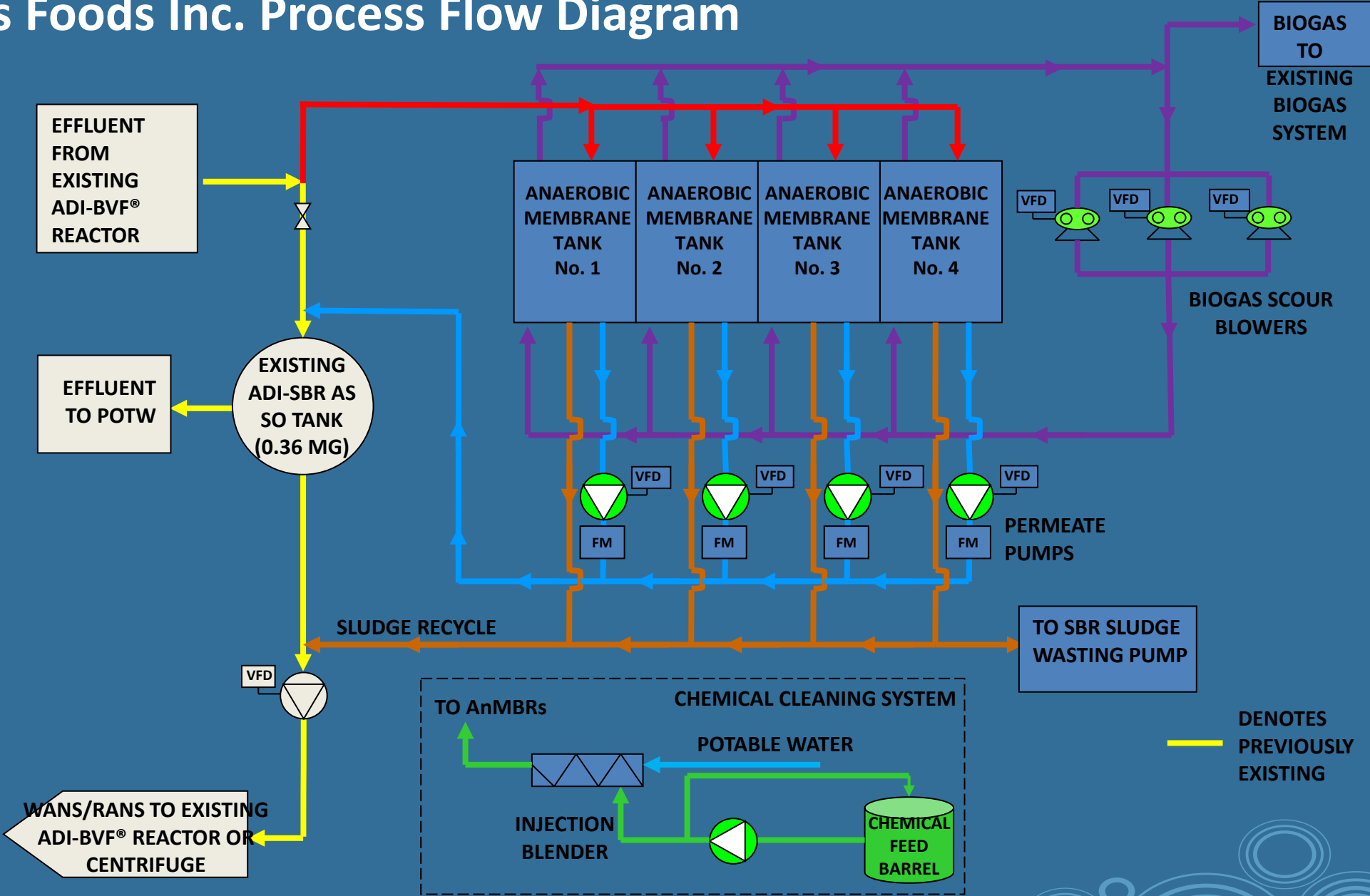
| Parameter | Influent |
|--------------------------|----------|
| Flow (m ³ /d) | 380 |
| COD (mg/l) | 37,400 |
| BOD (mg/l) | 18,000 |
| TSS (mg/l) | 11,500 |
| FOG (mg/l) | 840 |

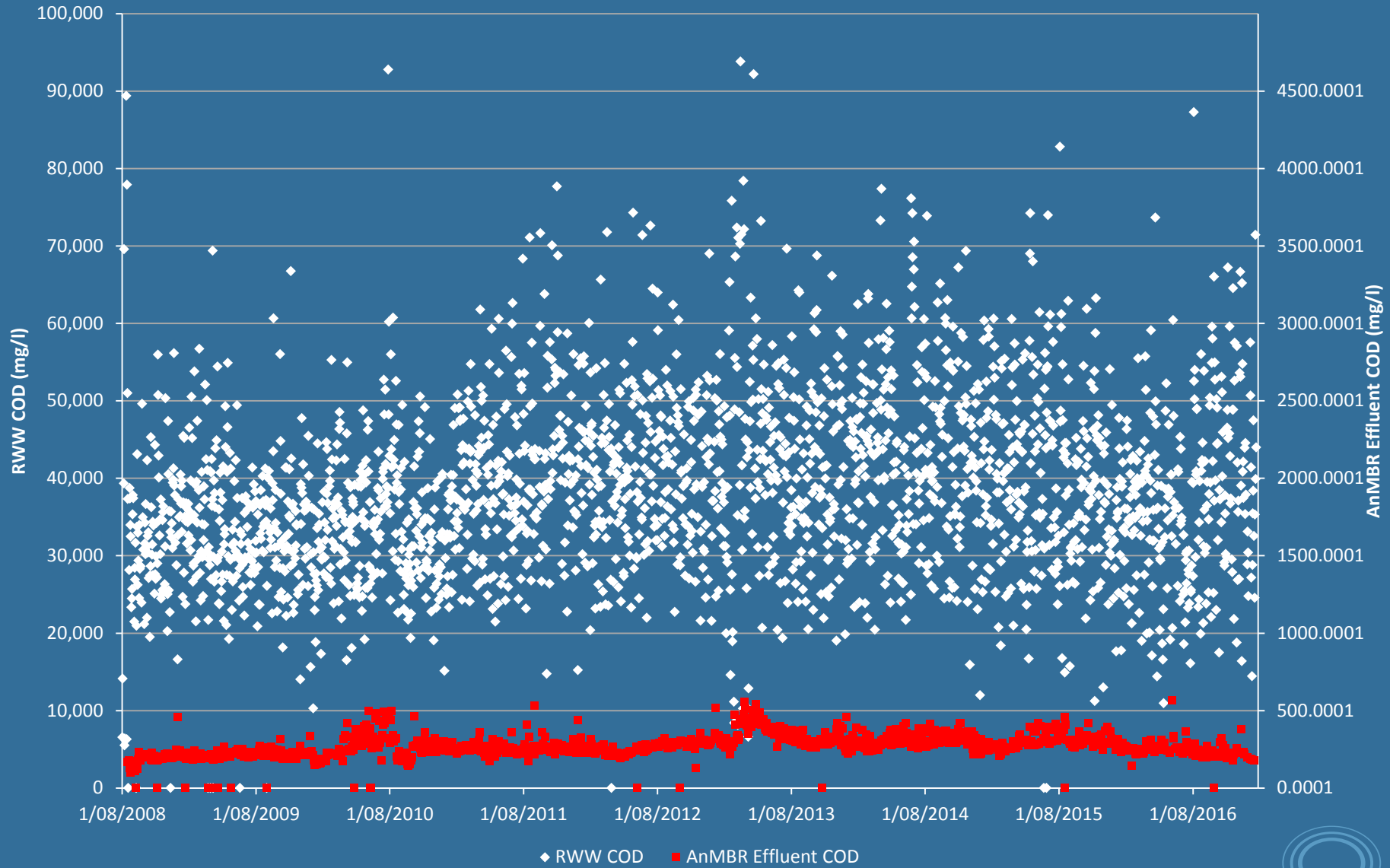


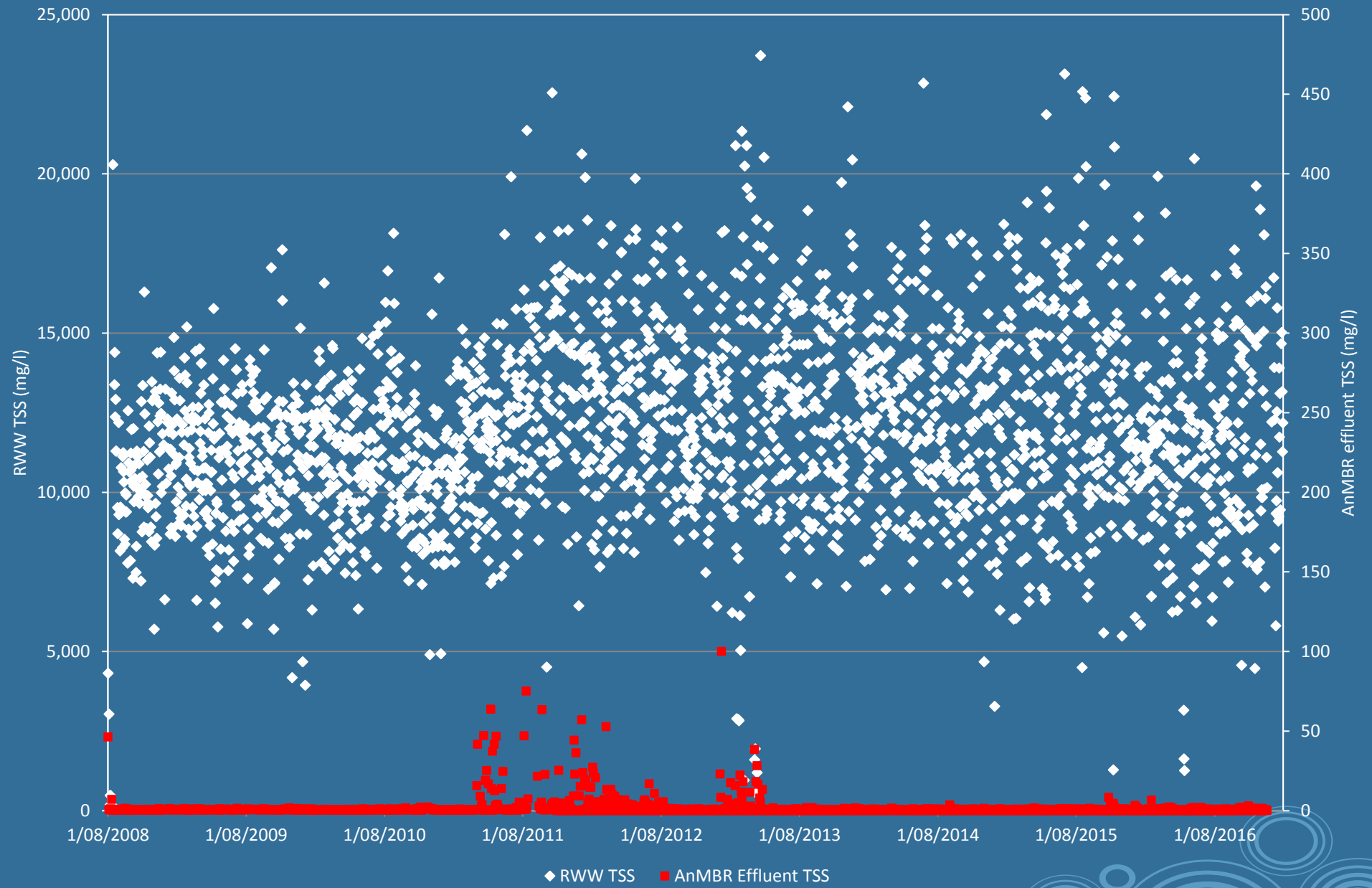
Ken's Foods Inc. Site Plan

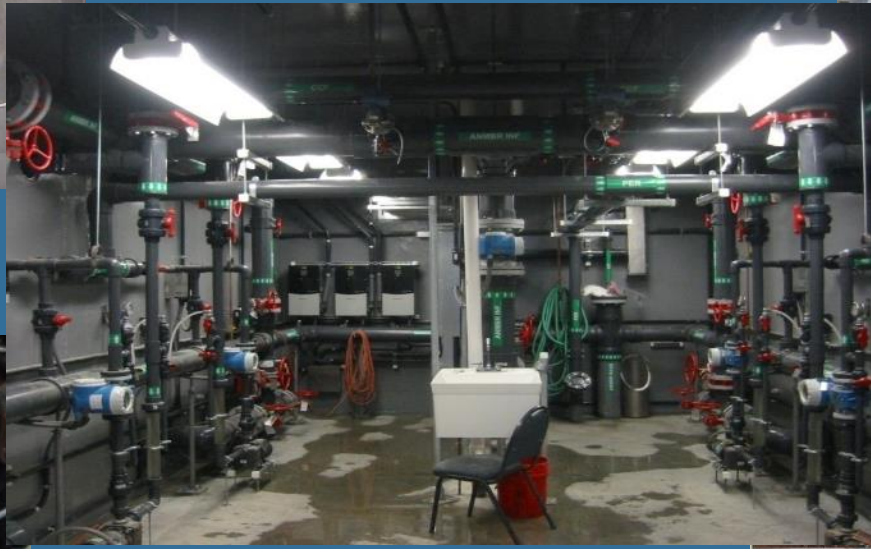


Ken's Foods Inc. Process Flow Diagram









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KEN'S FOODS, MA (US)

| Parameter | Influent | Effluent | Removal |
|--------------------------|----------|----------|--------------|
| Flow (m ³ /d) | 380 | 380 | - |
| COD (mg/l) | 37,400 | 250 | 99.3% |
| BOD (mg/l) | 18,000 | 25 | 99.9% |
| TSS (mg/l) | 11,500 | <3 | ~100% |
| FOG (mg/l) | 840 | nil | ~100% |

- ✓ AnMBR allowed 60% load increase
- ✓ Improved effluent quality
- ✓ >8 years in operation with no membrane failure
- ✓ Consistent performance (pH 7.0 ± 0.1, VA/PA ratio 0.4 ± 0.2)

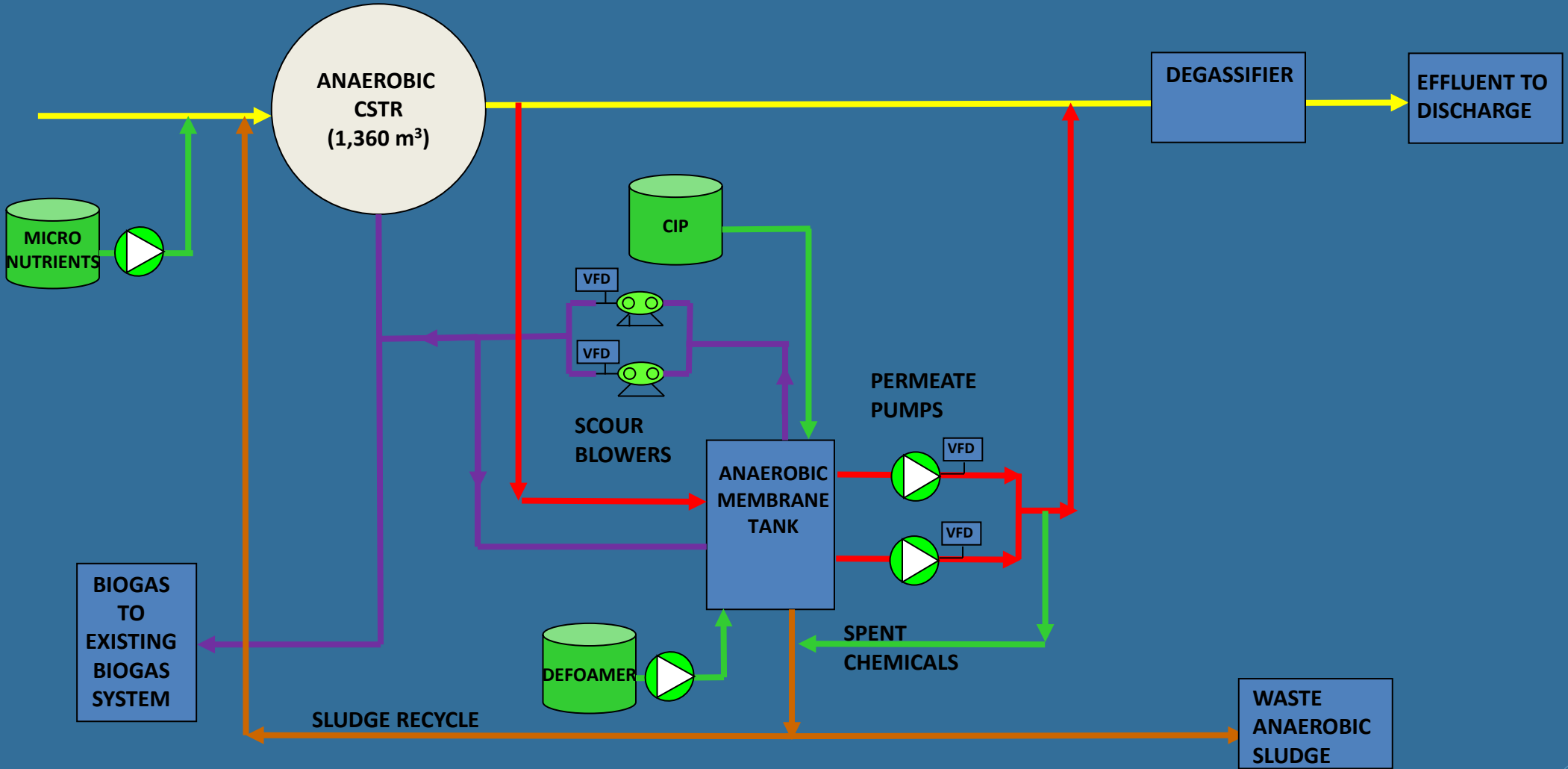


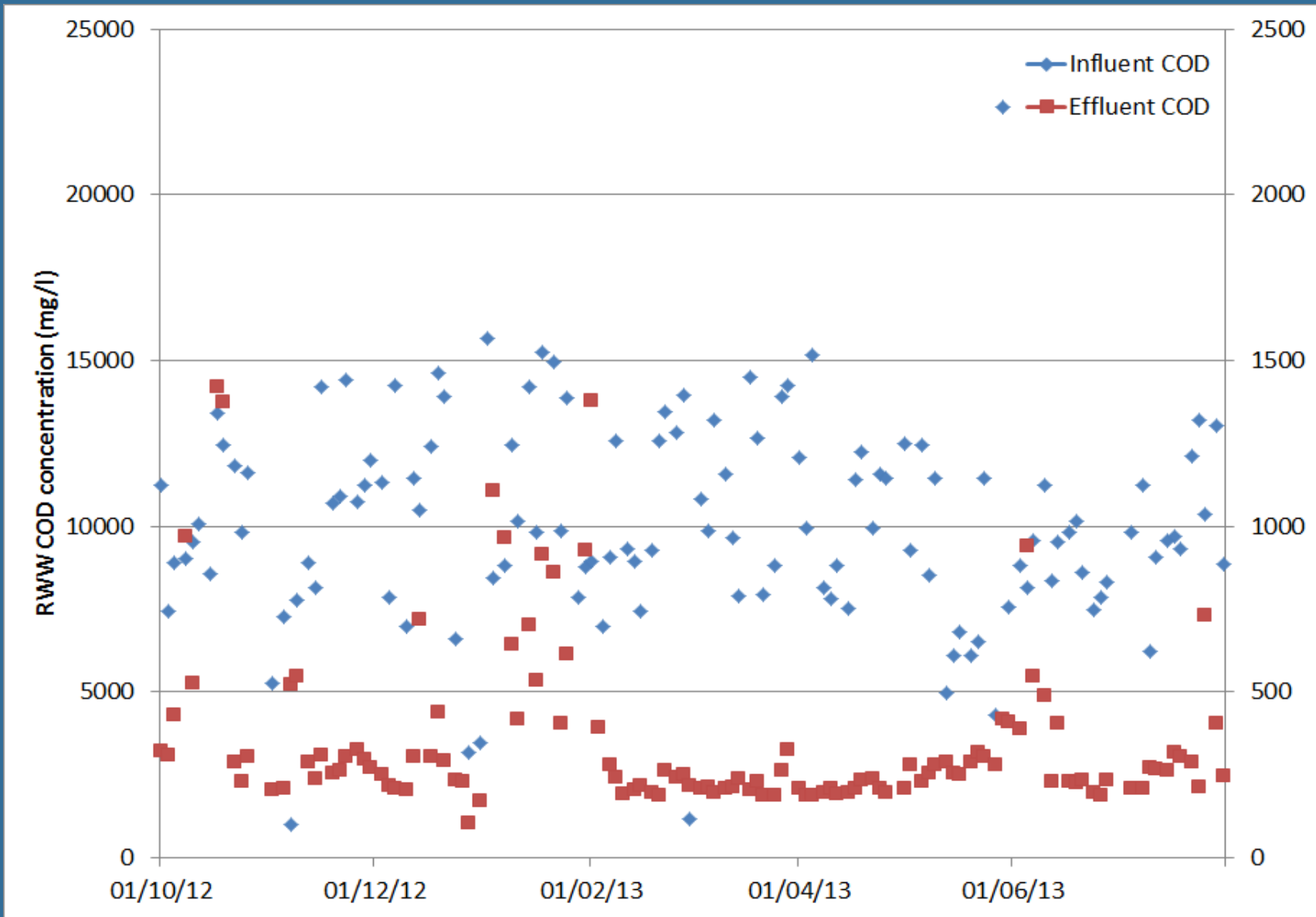
CONFECTIONERY MANUFACTURING PLANT (US)

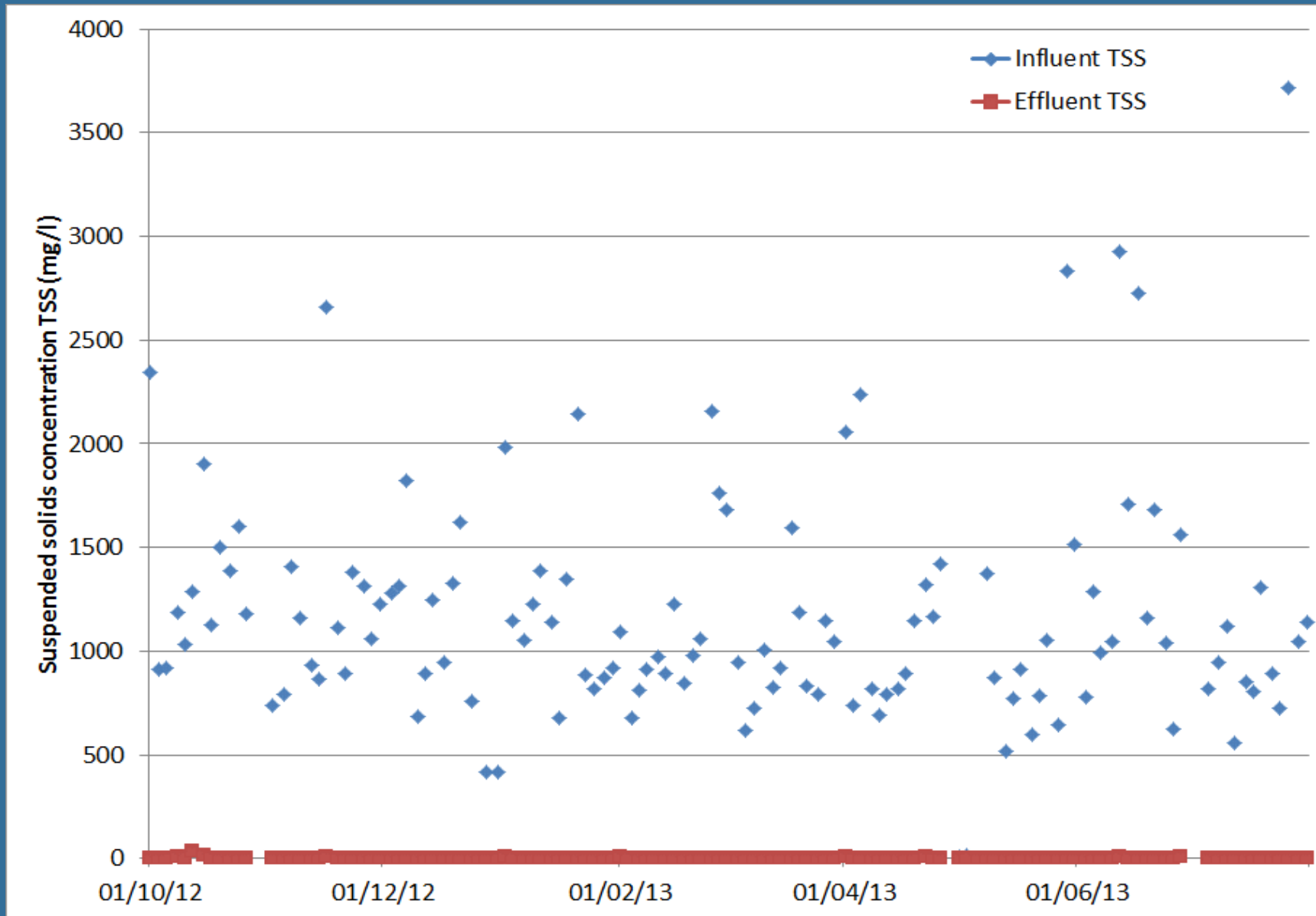


| Parameter | Influent |
|--------------------------|----------|
| Flow (m ³ /d) | 170 |
| COD (mg/l) | 16,000 |
| BOD (mg/l) | 8,000 |
| TSS (mg/l) | 10,000 |

Confectionery Plant Process Flow Diagram







**Raw
Wastewater**

**AnMBR Mixed
Liquor**

**AnMBR
Permeate**



CONFECTIONERY MANUFACTURING PLANT (US)

| Parameter | Influent | Effluent | Removal |
|-------------|----------|----------|---------|
| Flow (m3/d) | 155 | 155 | - |
| COD (mg/l) | 12,000 | 350 | >97% |
| BOD (mg/l) | 4,400 | 30 | >97% |
| TSS (mg/l) | 1,200 | nil | ~100% |

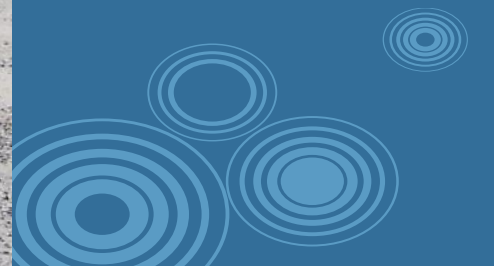
- ✓ AnMBR allowed to double the load
- ✓ Improved effluent quality
- ✓ Membrane cleaning every 6 months (>4 years of operation)
- ✓ Consistent performance



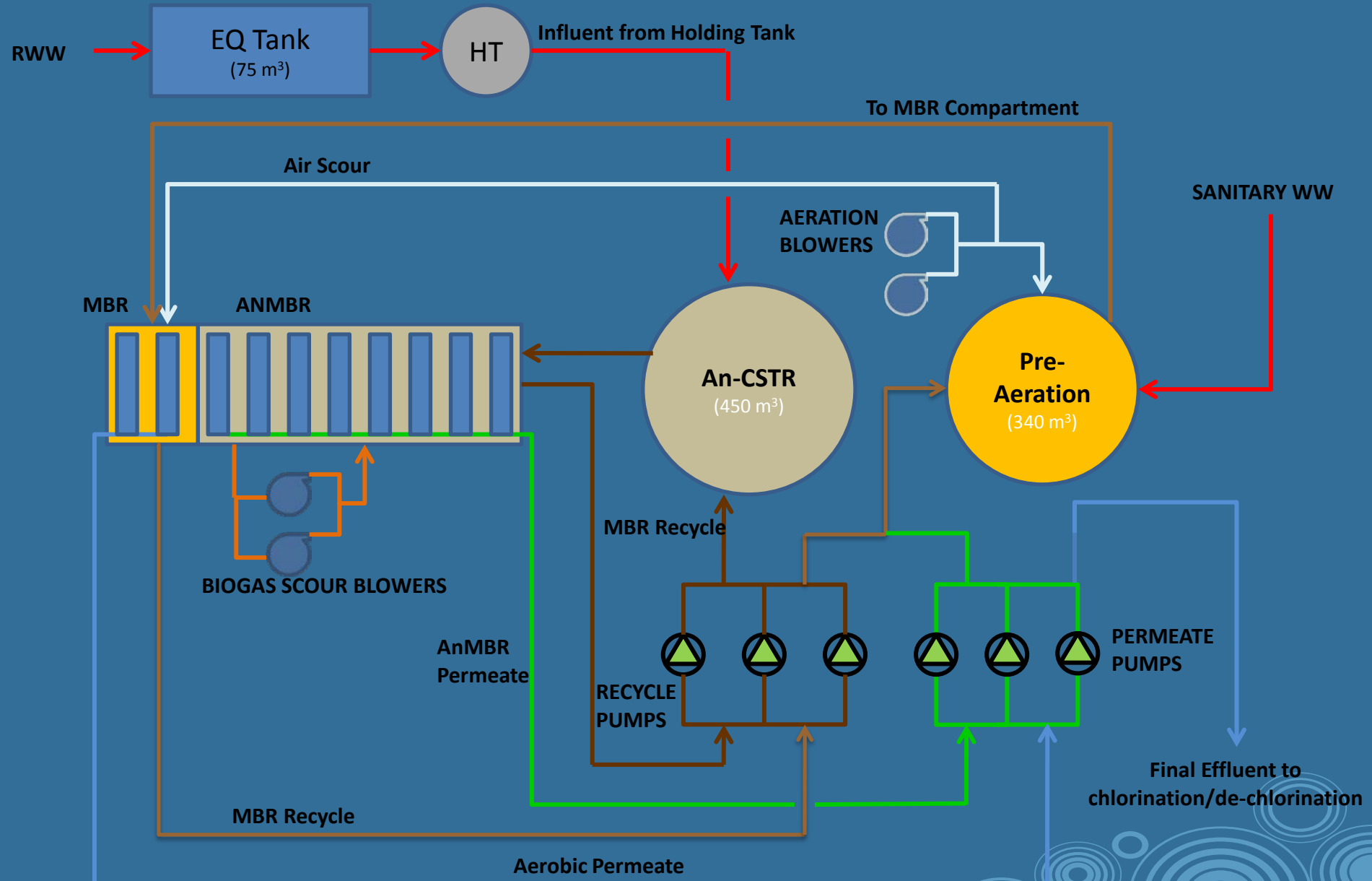
KELLOGG COMPANY PIKEVILLE PLANT(US)

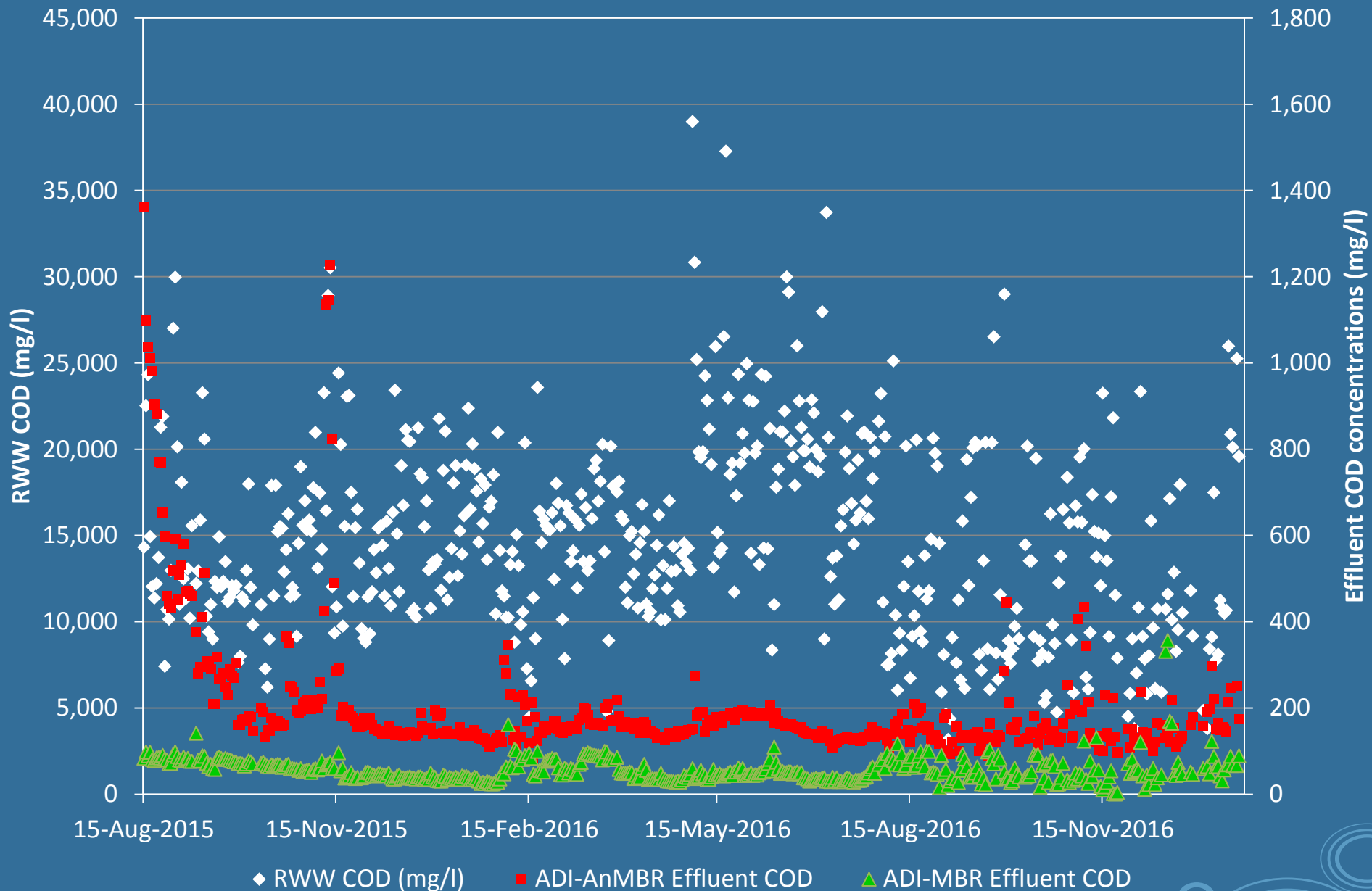


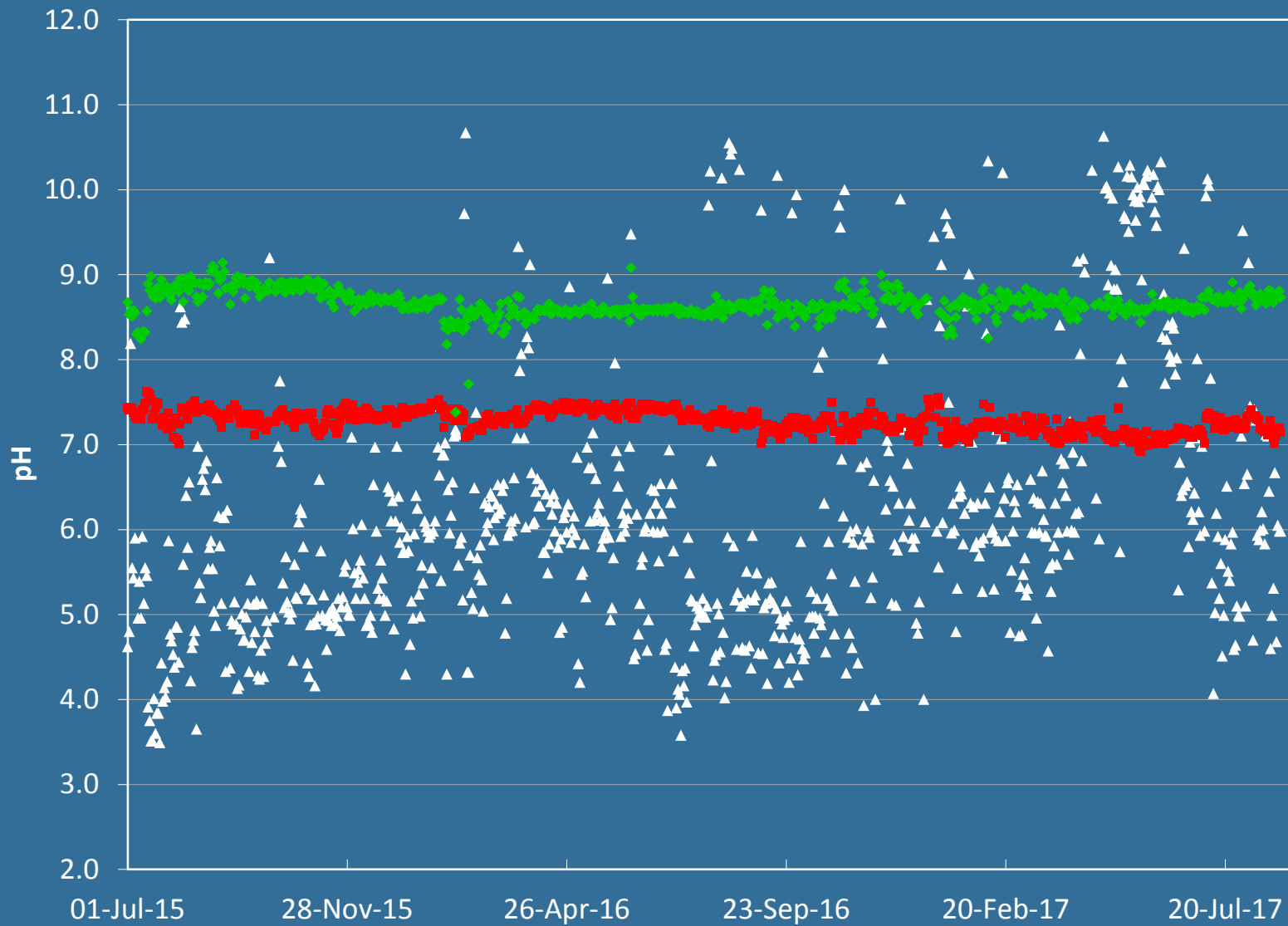
| Parameter | Influent |
|--------------------------|----------|
| Flow (m ³ /d) | 75 |
| COD (mg/l) | 34,500 |
| BOD (mg/l) | 17,000 |
| TSS (mg/l) | 1,600 |



Process Flow Diagram for Kellogg Kimper WWT







▲ Inf. pH ■ AnMBR pH ● MBR pH



KELLOGG COMPANY PIKEVILLE PLANT

- ✓ AnMBR allowed to increase the load
- ✓ Maximised use of existing equipment
- ✓ Improved effluent quality
- ✓ Reduced operating input demand (from 4 operators 24/7 to 2 operators 12/7)
- ✓ Consistent discharge quality compliance

| Parameter | Influent | AnMBR Effluent | Removal |
|-------------|----------|----------------|---------|
| Flow (m3/d) | 75 | 75 | - |
| COD (mg/l) | 34,500 | 380 | >97% |
| BOD (mg/l) | 17,000 | N.A. | - |
| TSS (mg/l) | 1,600 | nil | ~100% |

| Project | COD Load (kg/d) | Construction Start (Year) | Wastewater Type |
|------------------------|------------------------|----------------------------------|------------------------|
| Ken's Foods Inc. (USA) | 18,500 | 2008 | Salad Dressings |
| Plant A*** (USA) | 48,000 | 2011 | Supermarket Food Waste |
| Plant C*** (USA) | 2,700 | 2012 | Confectionery |
| Kellogg Company (USA) | 3,200 | 2012 | Bakery |
| Plant B*** (USA) | 20,440 | 2015 | Supermarket Food Waste |
| Ken's Foods Inc. (USA) | 45,420 | 2016 | Salad Dressings |



ANAEROBIC MEMBRANE REACTOR TECHNOLOGY

- ✓ Proven technology
- ✓ Versatile use
- ✓ Reliable operation
- ✓ Improves plant operability
- ✓ Compact and modular

