CARBON ENHANCED MBR's

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Outline

- Oily WW Treatment Challenges
- Treatment Options
  - Biological IWWTP & GAC Columns
  - PACT WWTP
  - MBR & GAC Columns
  - PAC MBR (Carbon Enhanced MBR)
- Conclusion / Summary

Problem

- Refinery / Oil Processing Wastewater
  - High Temp (> 50 C) – Bio Difficult
  - High Chlorides (->1,000 mg/L)
  - V. High TDS Variability
  - High Ammonia/Phenol Concentrations
  - Frequent Flow interruptions
  - Refractory Organics
- High Maintenance Sensitivity
- Water Conservation Important

Main Concern

- Refractory Organics -

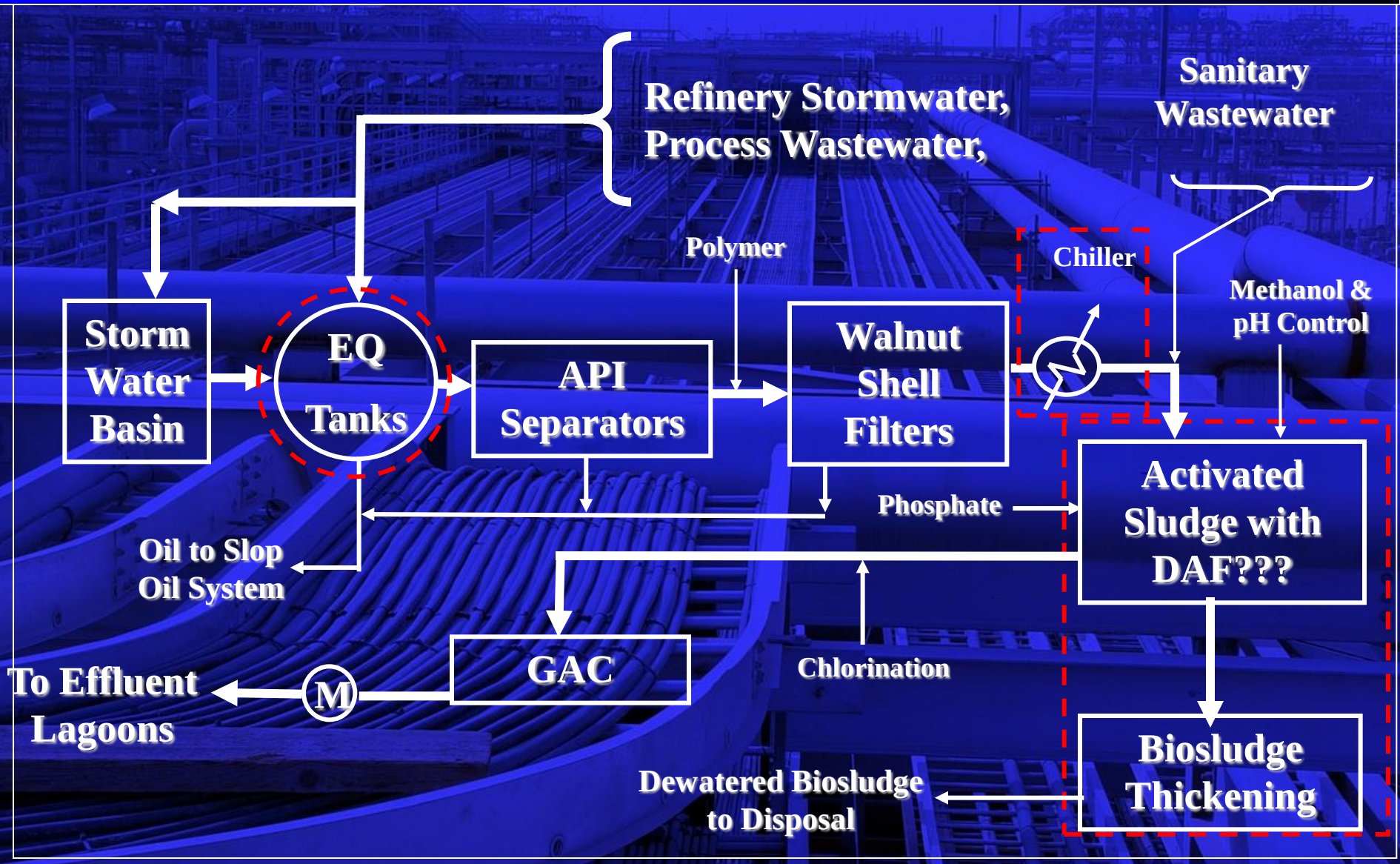
Conventional WWTP – Not Feasible

Carbon Adsorption Required

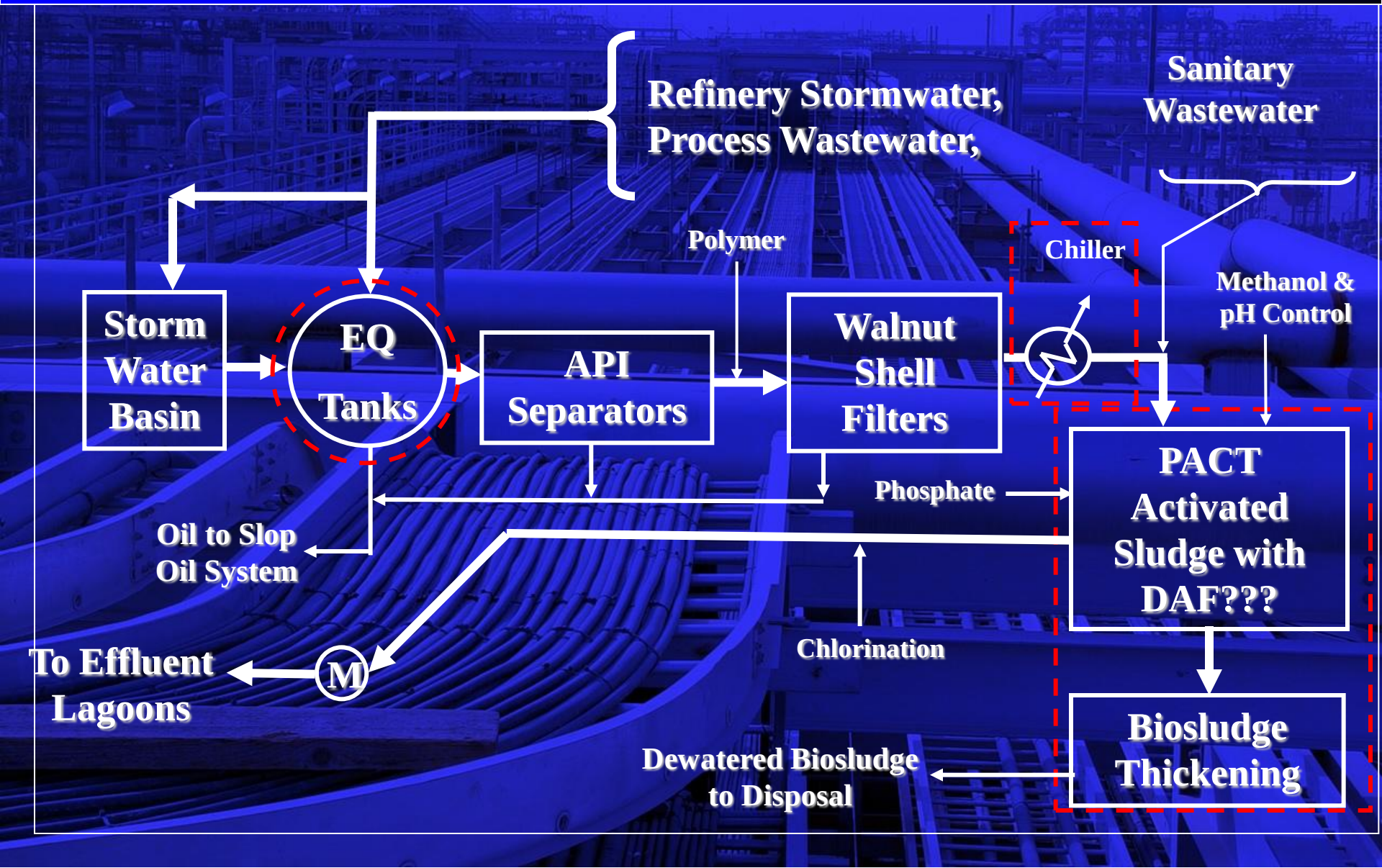
Treatment Options

- Oil/Water Sep. & Conventional IWWTP
  - Conventional IWWTP & GAC Columns
  - PACT IWWTP
- Oil/Water Separation & MBR
  - MBR & GAC Columns
  - PAC MBR (Carbon Enhanced)

Conventional Biological Treatment & GAC Columns



PACT Biological Treatment



Conventional Biological Treatment Advantages / Disadvantages

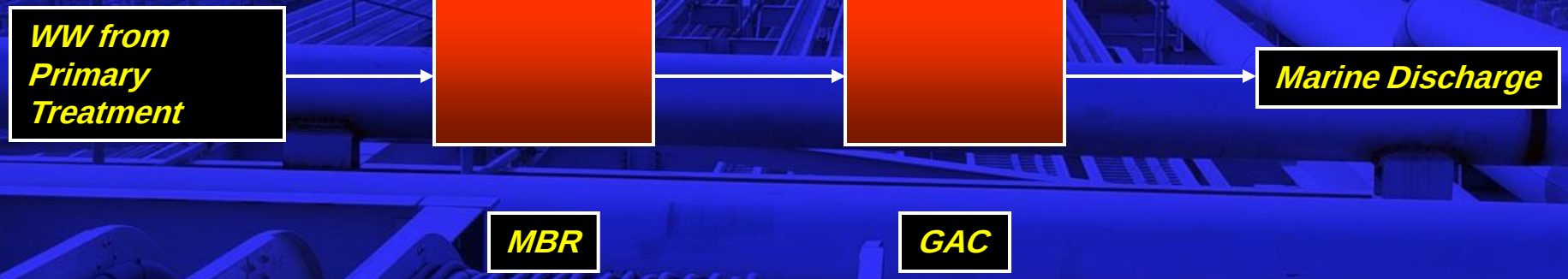
Advantages

- Most common system

Disadvantages

- Biomass unstable – feed fluctuations = upsets
- Solids won't settle in Clarifier
- Can't meet effluent requirements w/o GAC
- Ammonia may be toxic
- Extensive plot area required to accommodate equipment – Space Limitations

MBR & GAC Process Design



MBR & GAC
Advantages / Disadvantages

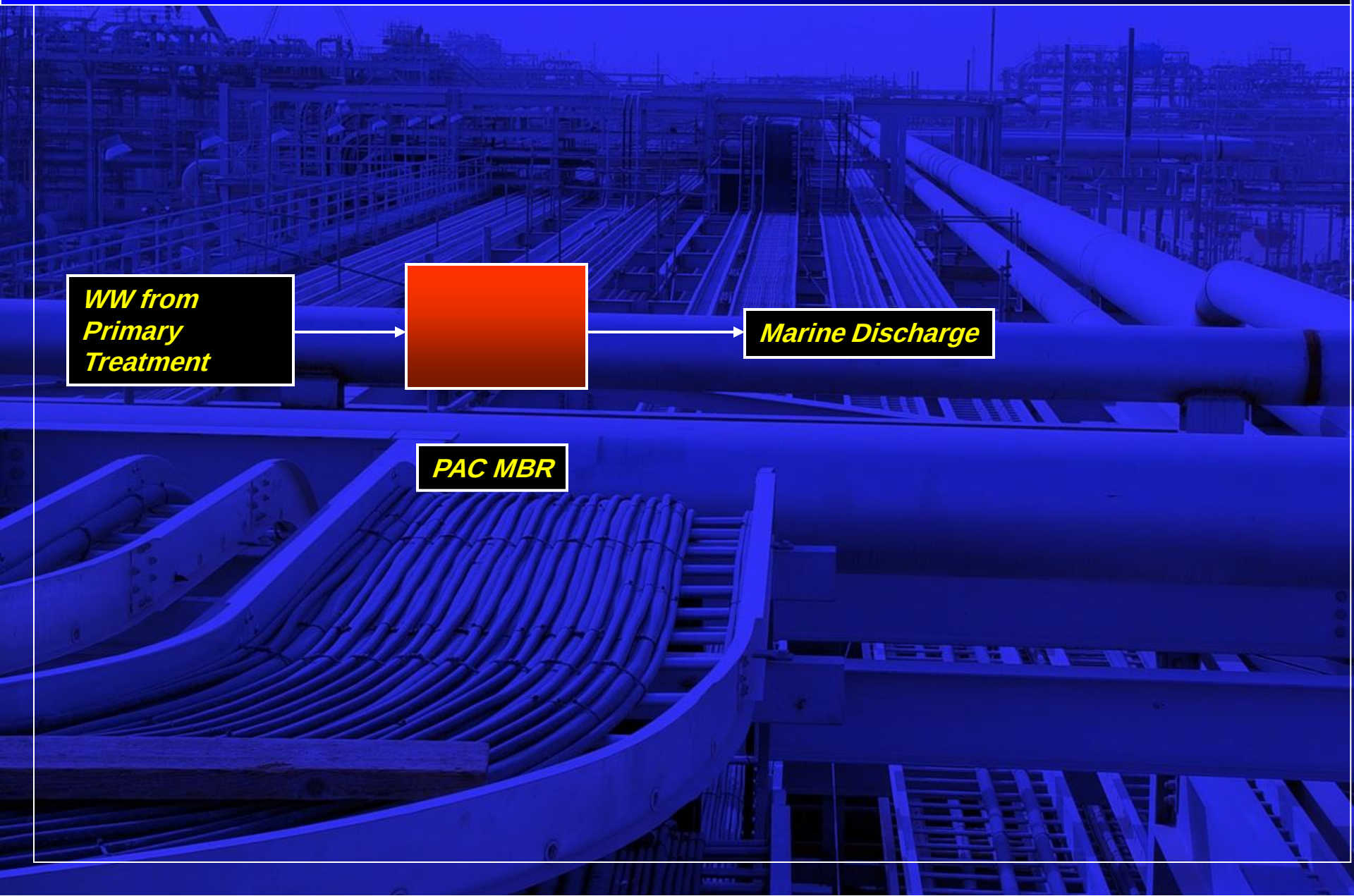
Advantages

- No Clarifier = No Settling Problems
- Smaller Footprint
- More Stable Biomass

Disadvantages

- Membrane Fouling
- High Cost for GAC

PAC MBR Process Design



PAC MBR (Carbon Enhanced) Advantages / Disadvantages

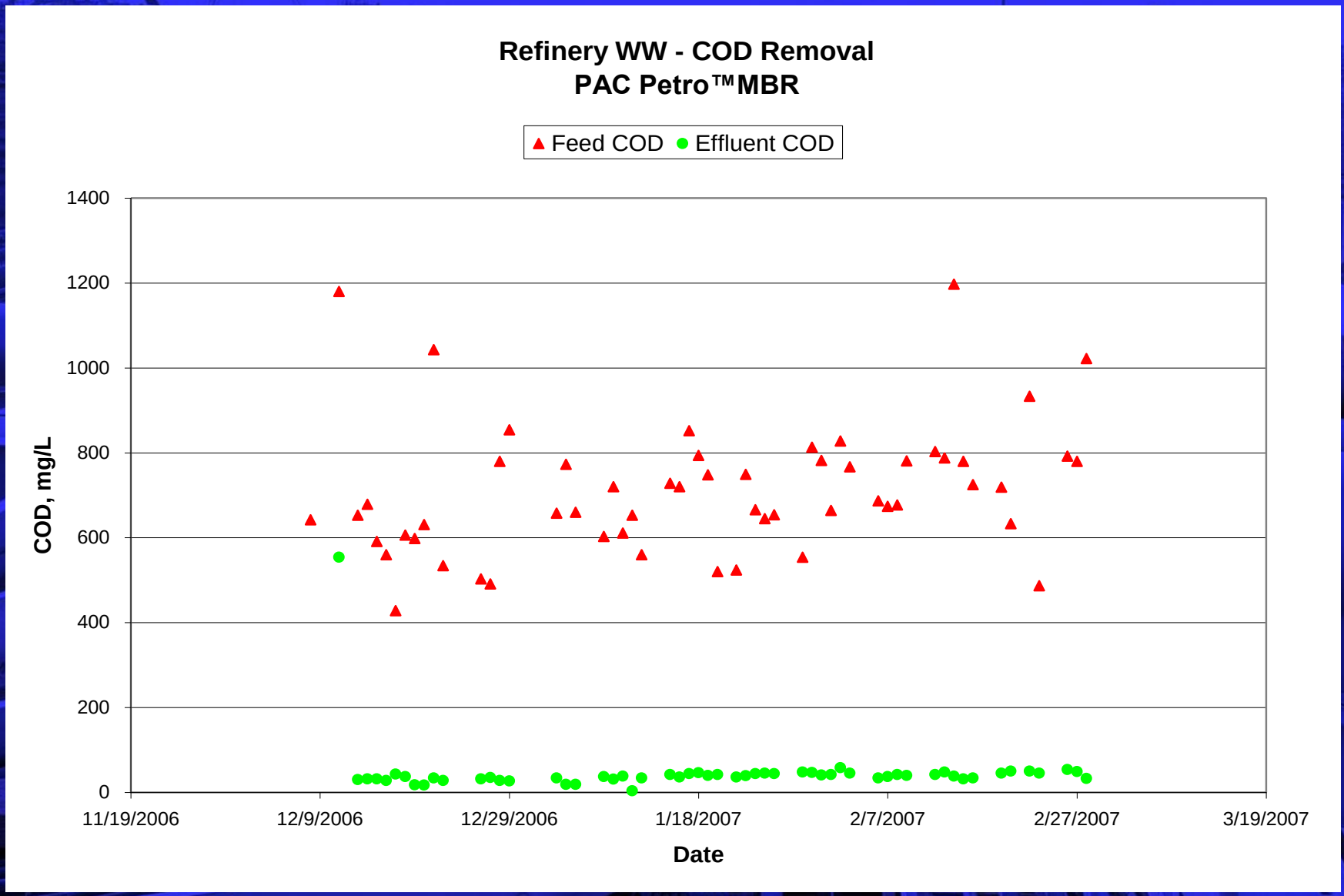
Advantages

- No Clarifier = No Settling Problems
- Smaller Footprint
- More Stable Biomass
- Lower Cost for Carbon
- No Fouling
- Reuse Possible

Disadvantages

- Membrane Abrasion

PAC MBR COD Removal

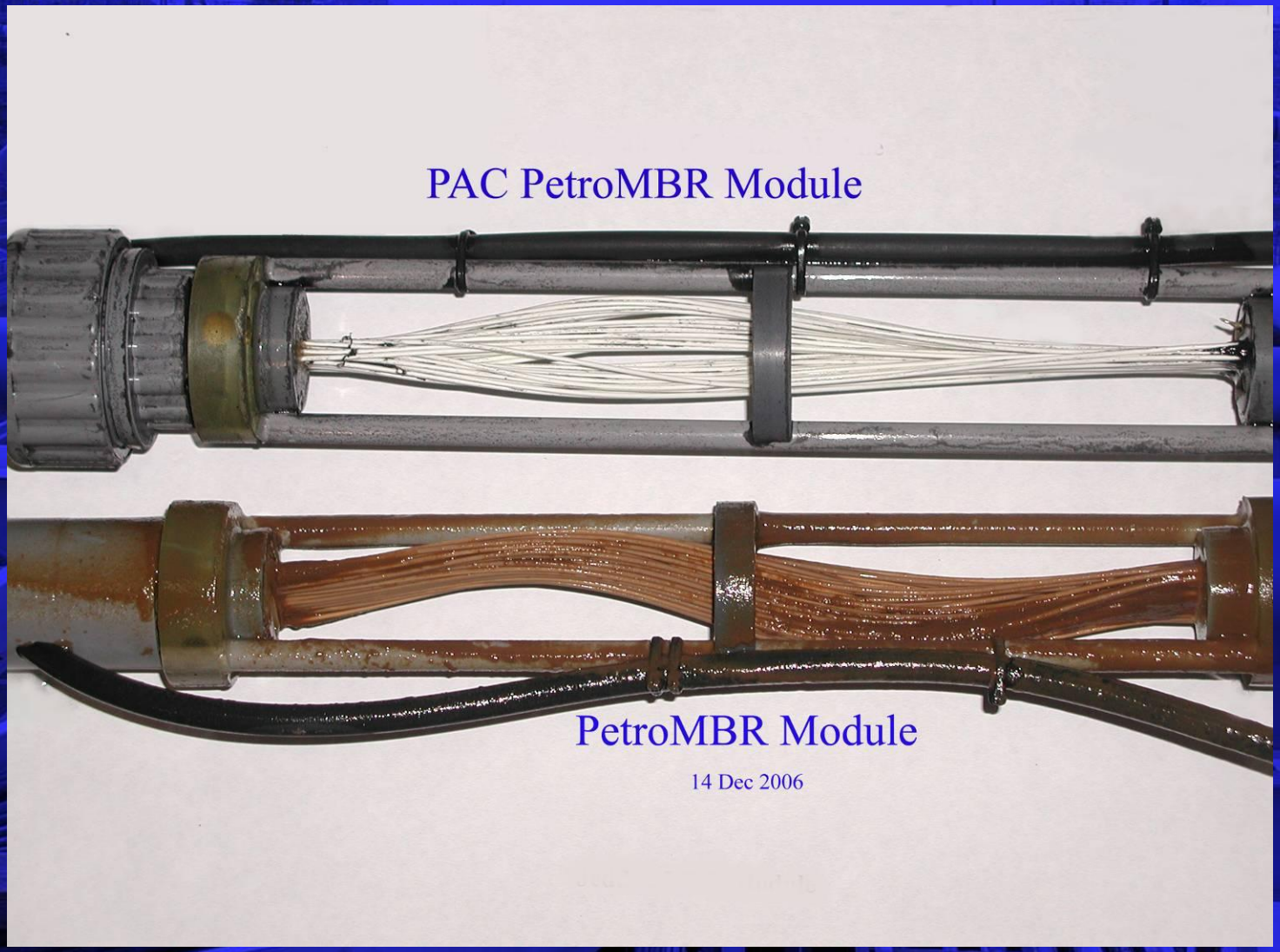


MBR & PAC MBR Comparison

	Feed	MBR Removal %	PAC MBR Removal %
BOD	~400 mg/L	(~4 mg/L) 99%	(~5 mg/L) 99%
COD	~750 mg/L	(151 mg/L) 81%	(46 mg/l) 92%
TOC	~200 mg/L	(27 mg/L) 86%	(11 mg/L) 94%

Effluent Comparison

Membrane Comparison



MBR – PAC MBR RO Comparison

	MBR	PAC MBR
Silica - Total	1.1 mg/L	<0.2 mg/L
Turbidity	0.43 NTU	<0.18 NTU
Total Dissolved Solids	238 mg/L	27 mg/L

MBR & GAC vs. PAC MBR

MBR & GAC	PAC MBR
High Op. Cost for GAC	*Lower Op. Cost*
Higher Capital Cost	*Lower Capital Cost*
Slow Acclimation	*Immediate Acclimation*
Susceptible to Upsets	*Tolerant to Upsets*
Frequent Cleaning	*Less Frequent Cleaning*
Poor Refractory Removal	*Ex. Refractory Removal*
Slow Drying Sludge	*Better Dewatering Sludge*
Effluent Fouled RO	*RO Acceptable Effluent*
Long Term Fouling??	*Long Term Abrasion??*

Summary

- Conventional IWWP
  - Not Stable
- MBR & GAC Columns
  - Stable Operation
  - Fouling Problems
- PAC MBR
  - Stable Operation
  - No Fouling Problems
  - Economical – Lower Cap & Op. Expenses
  - Abrasion


Thank You