

# Ballasted Flocculation

High Rate Sedimentation

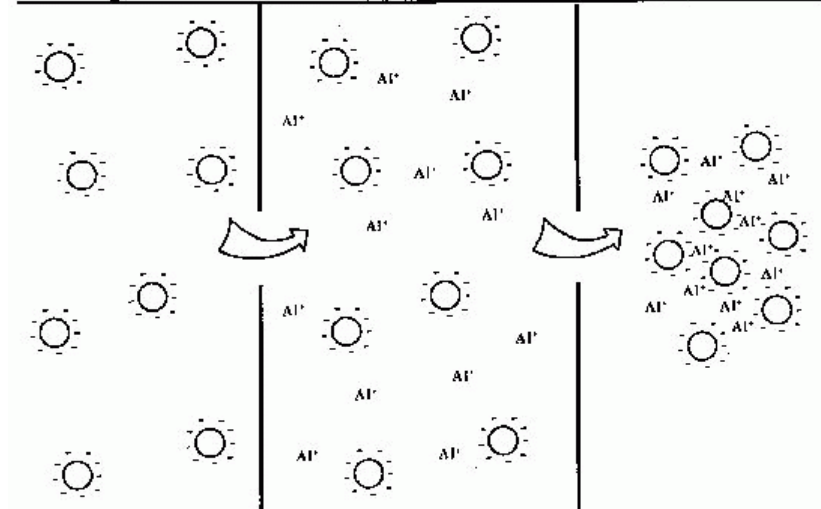
Presented by:  
Ryan Arbuckle, PE MBA

**WESTECH**

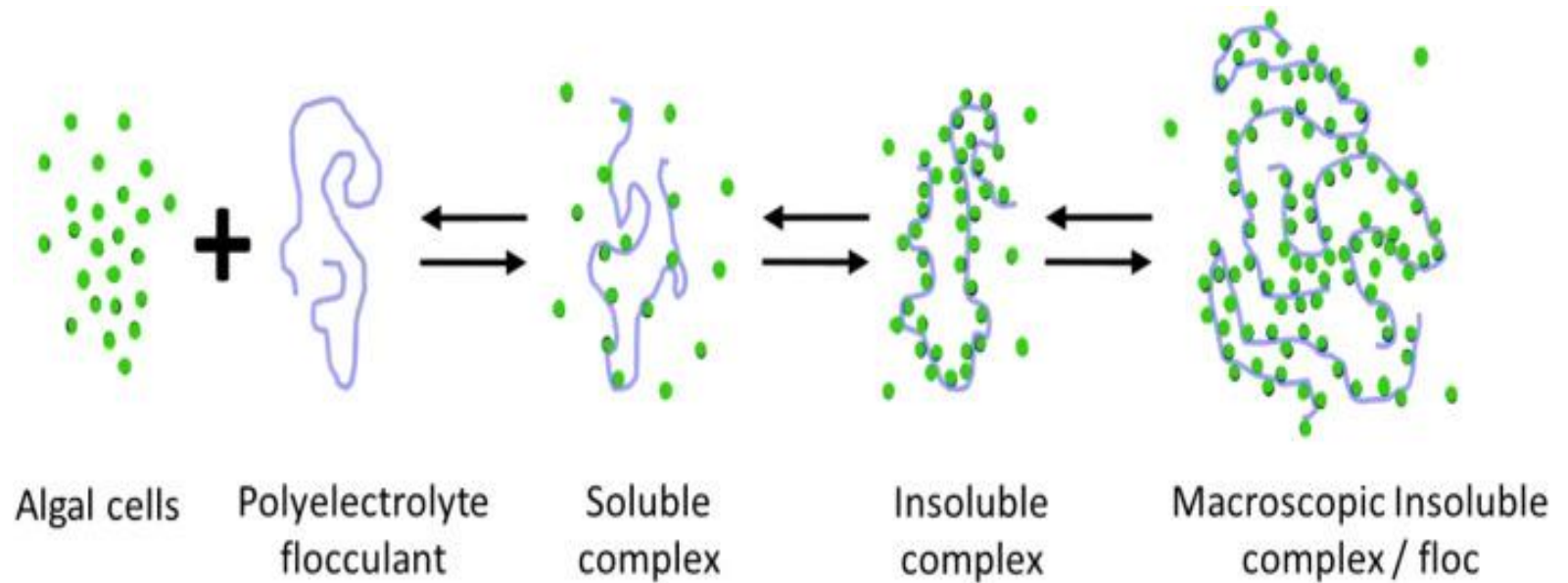
# Basic Chemistry

## Coagulation (Charge Balancing)

### Charge Neutralization/Colloid Destabilization



# Flocculation



# Sedimentation (Size Matters)

**Equation 2.2: Stokes' Law**

$$V_s = \frac{g(\rho_s - \rho_w)d^2}{18\mu}$$

**where**

$V_s$  = terminal settling velocity of the solid particle

$g$  = gravitational acceleration

$\rho_s$  = density of settling particle

$\rho_w$  = density of water

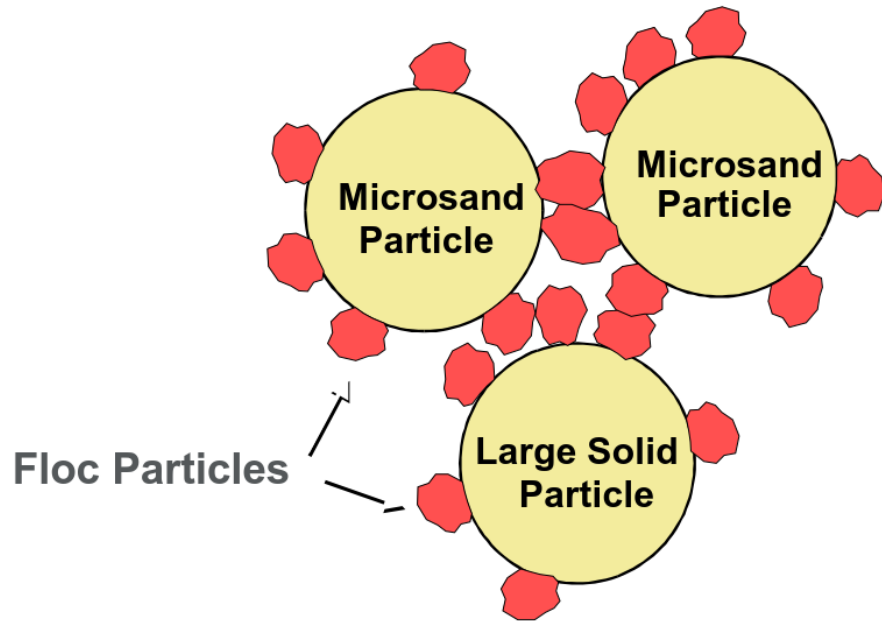
$d$  = diameter of particle

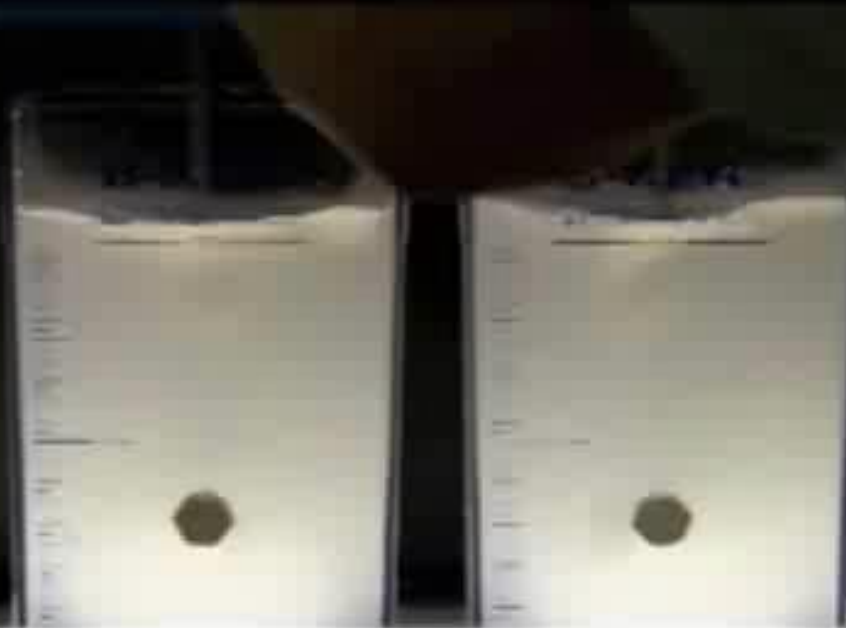
$\mu$  = dynamic viscosity

# Ballasted Flocculation Basics

## Ballasted Flocculation Steps:

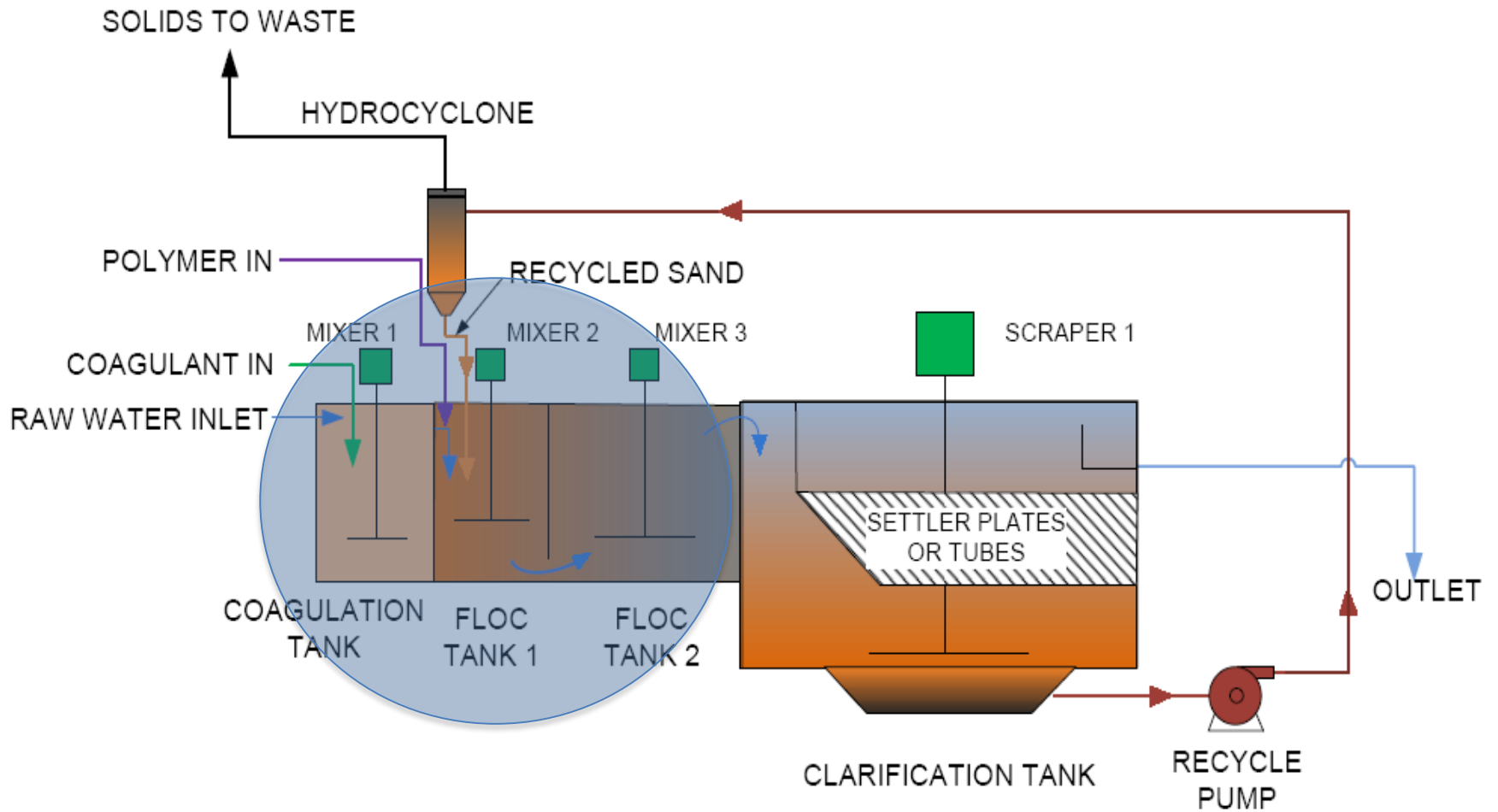
1. Add coagulant to balance charges
2. Add ballast and polymer
3. Mix to allow ballast and particles to flocculate
4. Settle dense ballasted floc
5. Collect settled solids
6. Separate floc and sand
7. Recycle sand back into process





***Bench Scale Demonstration for Ballasted Flocculation***  
Standard Flocculation vs. Ballasted Flocculation

# Mixing and Residuals Collection

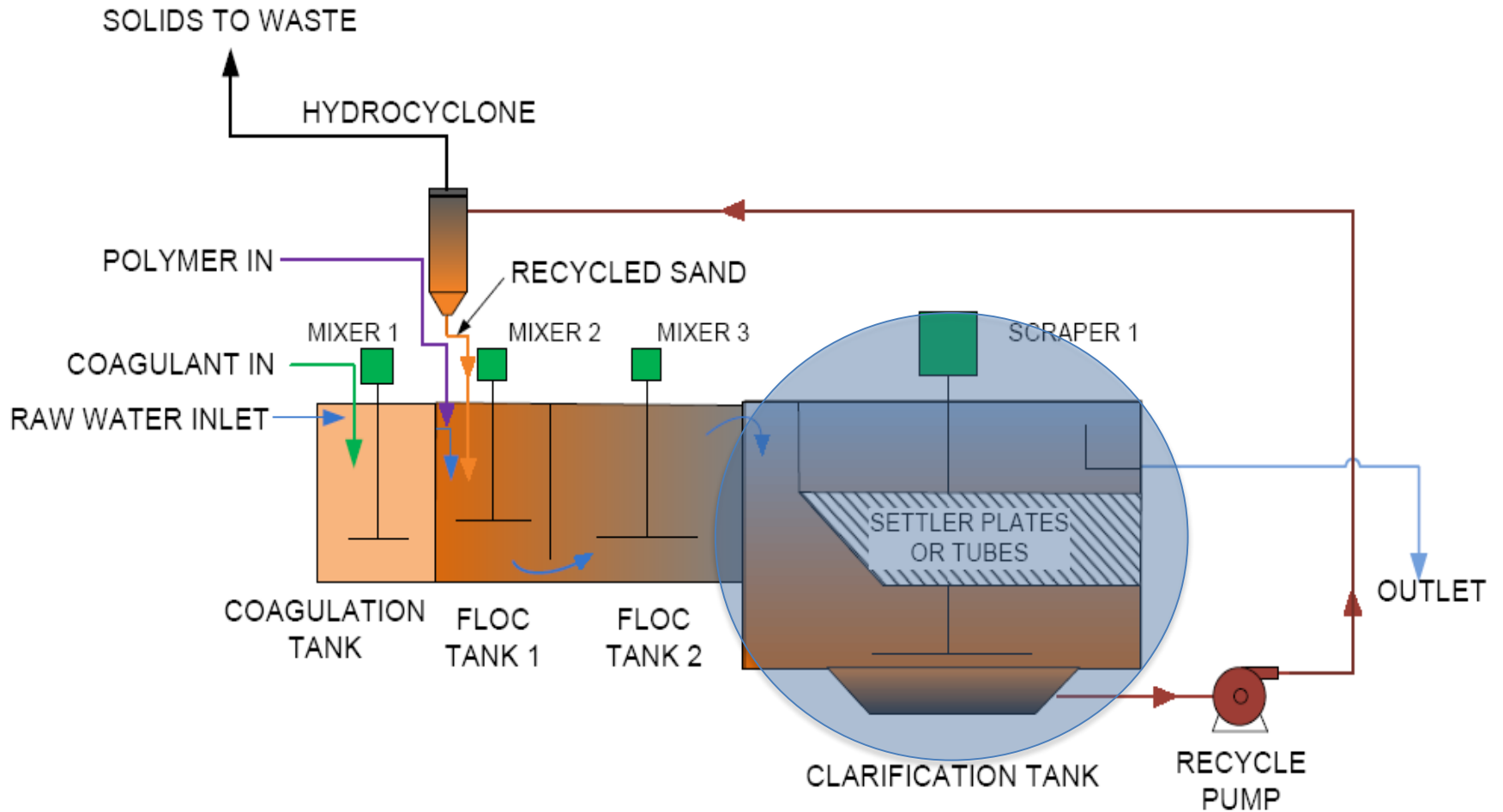


# Mixing and Residuals Collection



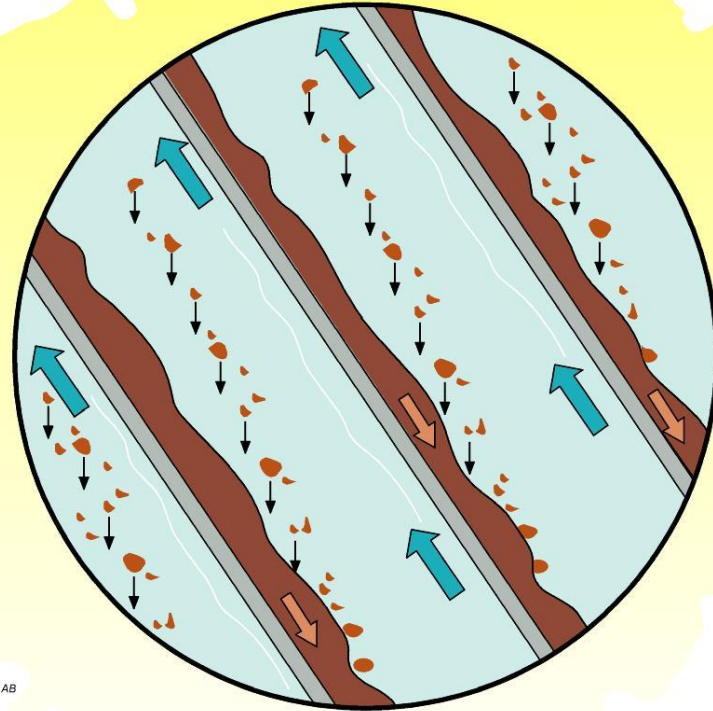


# Rapid Settling and Solids Collection

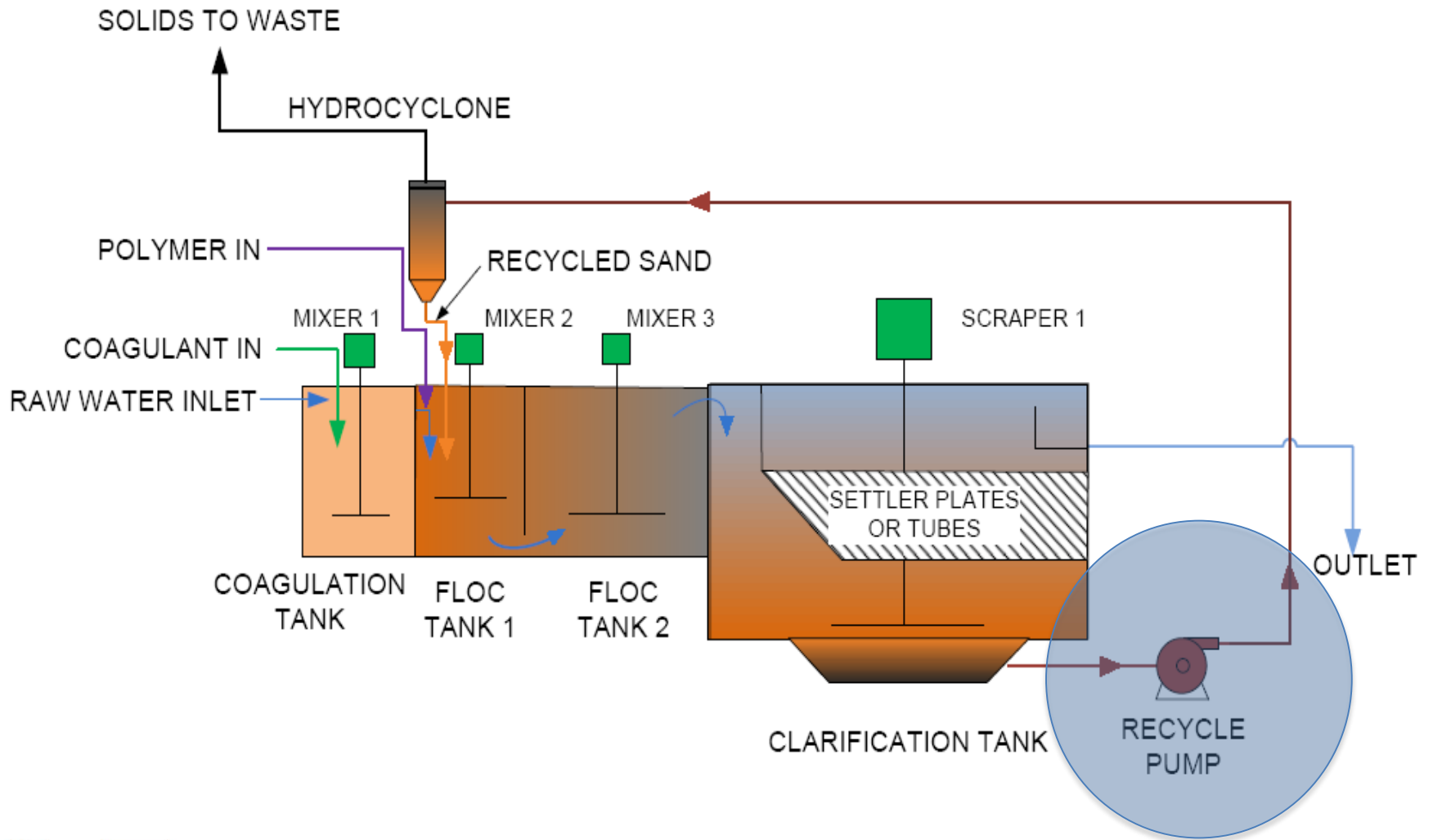


# Tube Settlers Counter Current Flow

Tube Settlers Distribute Flow and Help Capture Residual Floc



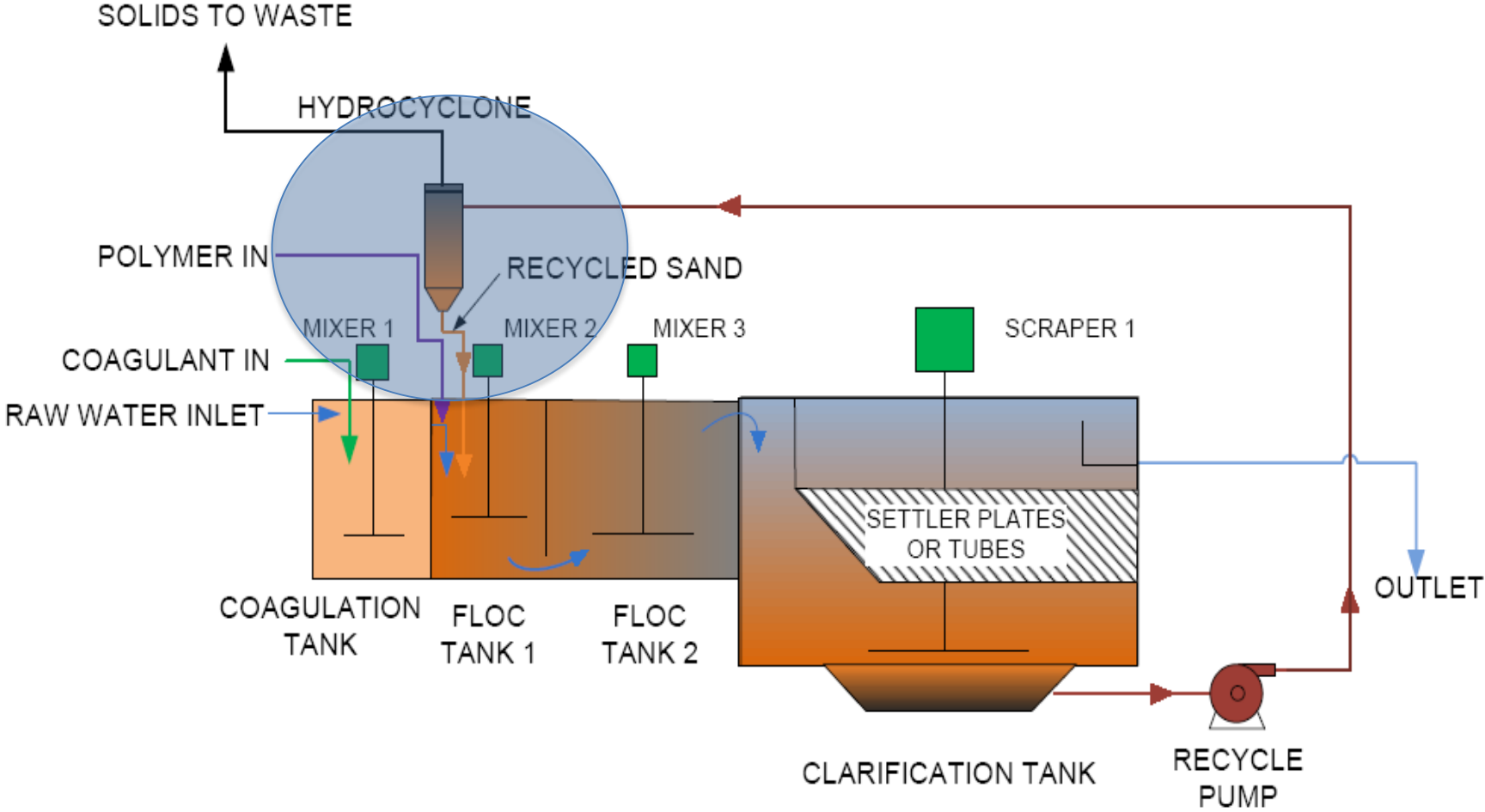
# Solids Recycle



# Sand Pumps



# Separation of Micro-sand and Floc



# Sand Separation



## **Ballasted Flocculation Benefits**

Small footprint

Rapid start-up

Stable treatment process

Treat a variety of water qualities and flow rates

Exceptional removal rates

## Case Study – Refinery Indonesia

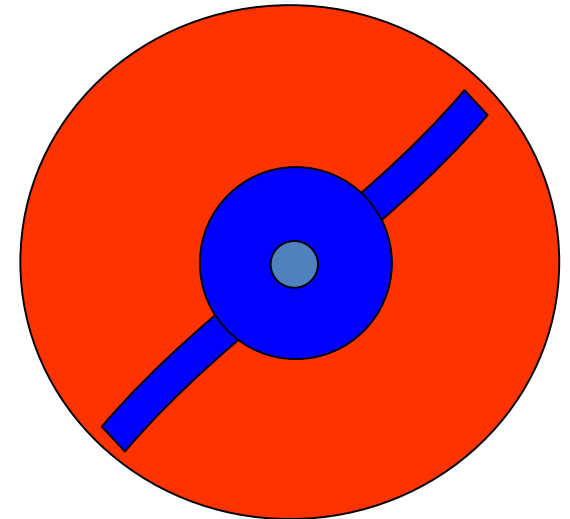
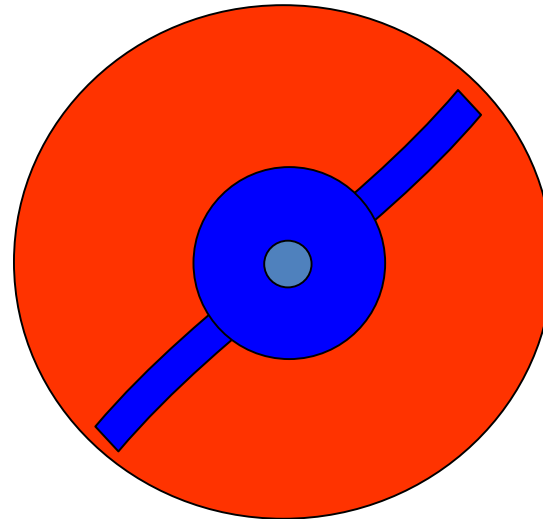
Original Design: 4 – 40M dia. solids  
CONTACT Clarifiers

Each clarifier treating 2,270 m<sup>3</sup>/hr

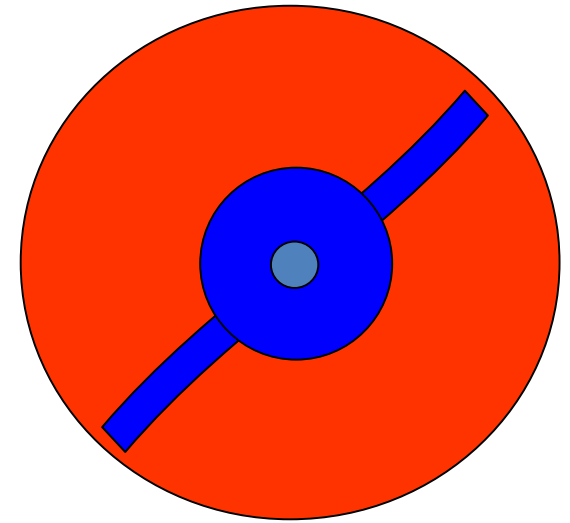
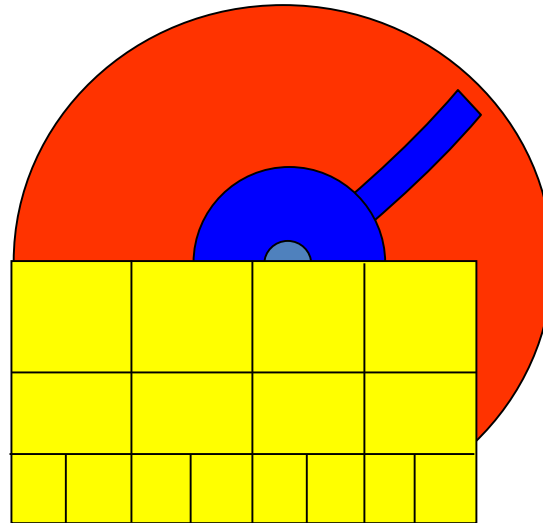


# Case Study – Refinery Indonesia

Solids Contact  
Footprint:  
83M x 83M



Ballasted  
Flocculation  
System Footprint:  
36M x 20M



# Ballasted Flocculation Applications

## When to apply:

Municipal applications using Ferric/Alum and Polymers.

Industrial applications where flocculation/clarification is needed.

- NTU/TSS Removal
- TOC Removal
- CSO Treatment
- RO Pretreatment
- Cooling Tower Makeup
- Chemical Feed Makedown
- Tertiary Phosphorus Removal
- Color Removal
- Algae Removal
- Boiler Feed Makeup
- Industrial Process Water
- Pump Seal Water

# Summary

Small footprint

Rapid start-up

Stable treatment process

Treat a variety of water qualities and flow rates

Exceptional removal rates (<2 NTU in the effluent)

Thank you for your time