

Produced Water Treatment to Enhance Oil Recovery

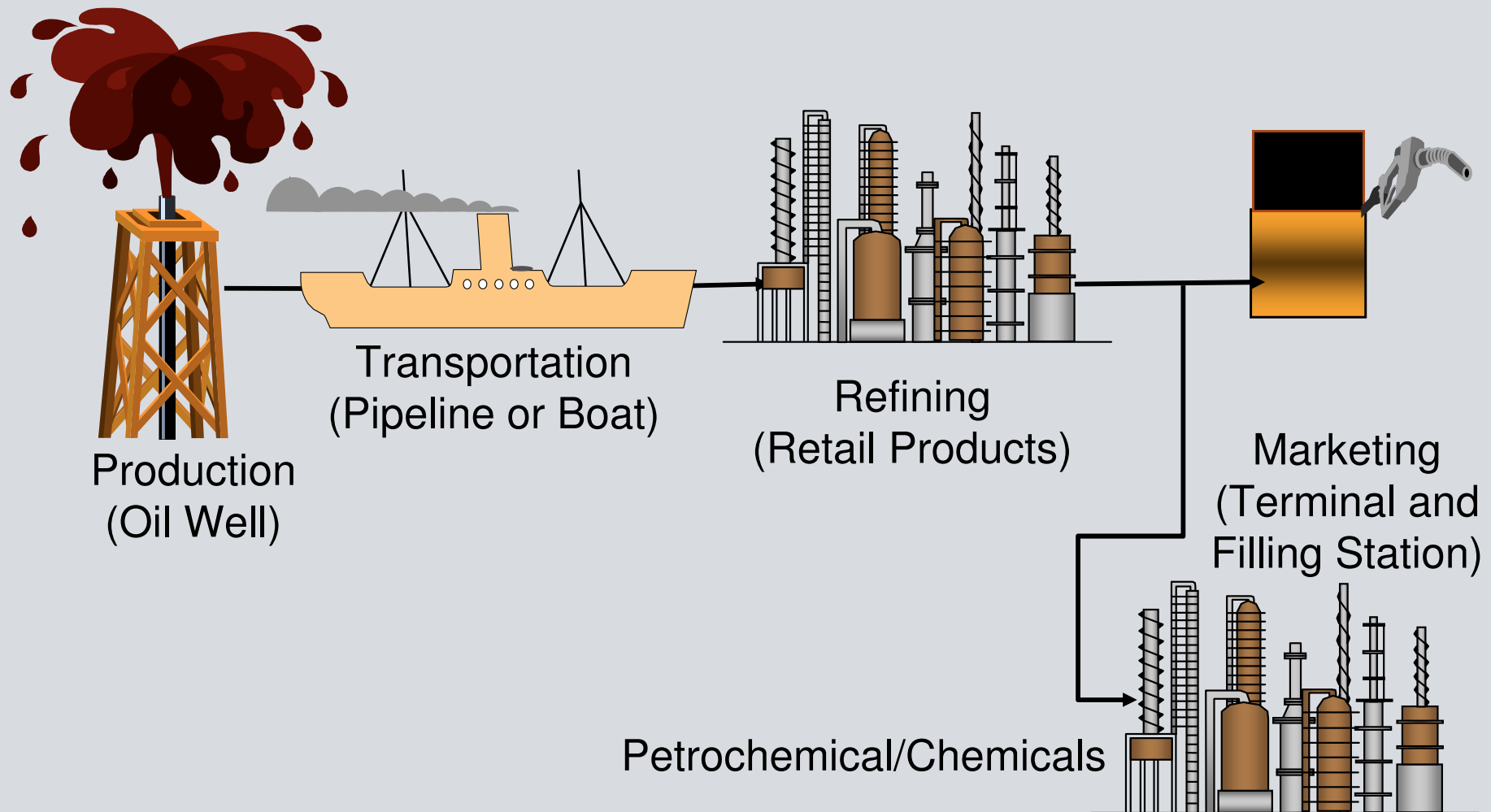
Siemens Oil & Gas
Water Technologies

Content

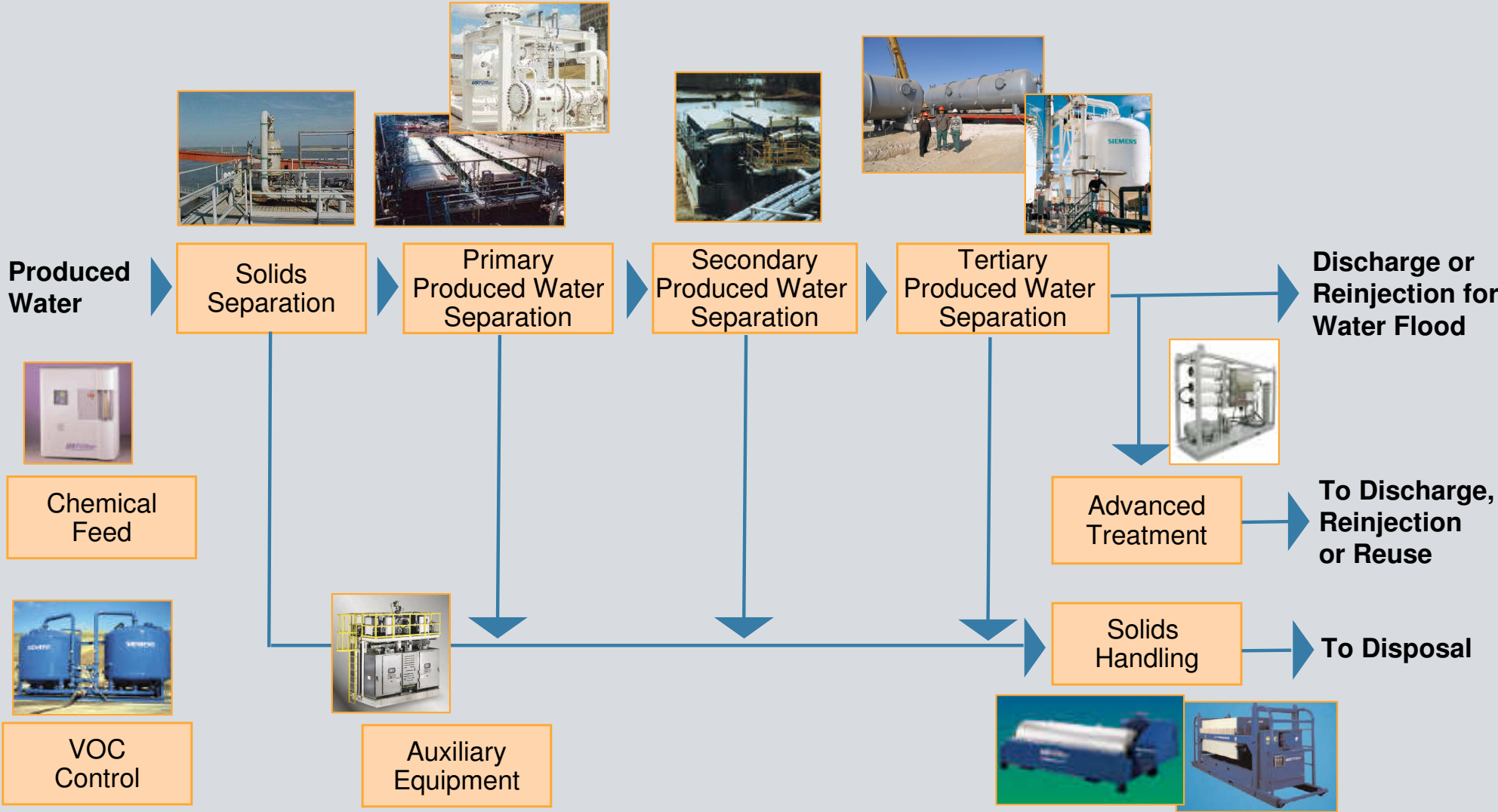
- Up-stream Water Treatment
 - Produced Water Treatment
 - Water Injection/Reinjection
 - Steam Assisted Gravity Drainage
- Downstream Water Treatment
 - Process Water Treatment
 - Wastewater Treatment



Serving All Sectors of the Petroleum Industry



Oil & Gas Production Produced Water Treatment Process Map



Oil & Gas Production Produced Water Treatment

Solids Separation

- Wellhead Solids/Liquid Hydrocyclone

Primary Produced Water Separation

- Corrugated Plate Separators (CPS)
- API Separators
- Solid/Liquid Hydrocyclone
- Liquid/Liquid Hydrocyclone

Secondary Produced Water Separation

- Induced Gas Flotation Separators
- Dissolved Gas Flotation Separators



Oil & Gas Production Produced Water Treatment

Tertiary Produced Water Separation

- Walnut Shell Filters
- Media Filters
- Cartridge Filters
- Activated Carbon Filters

Advanced Treatment

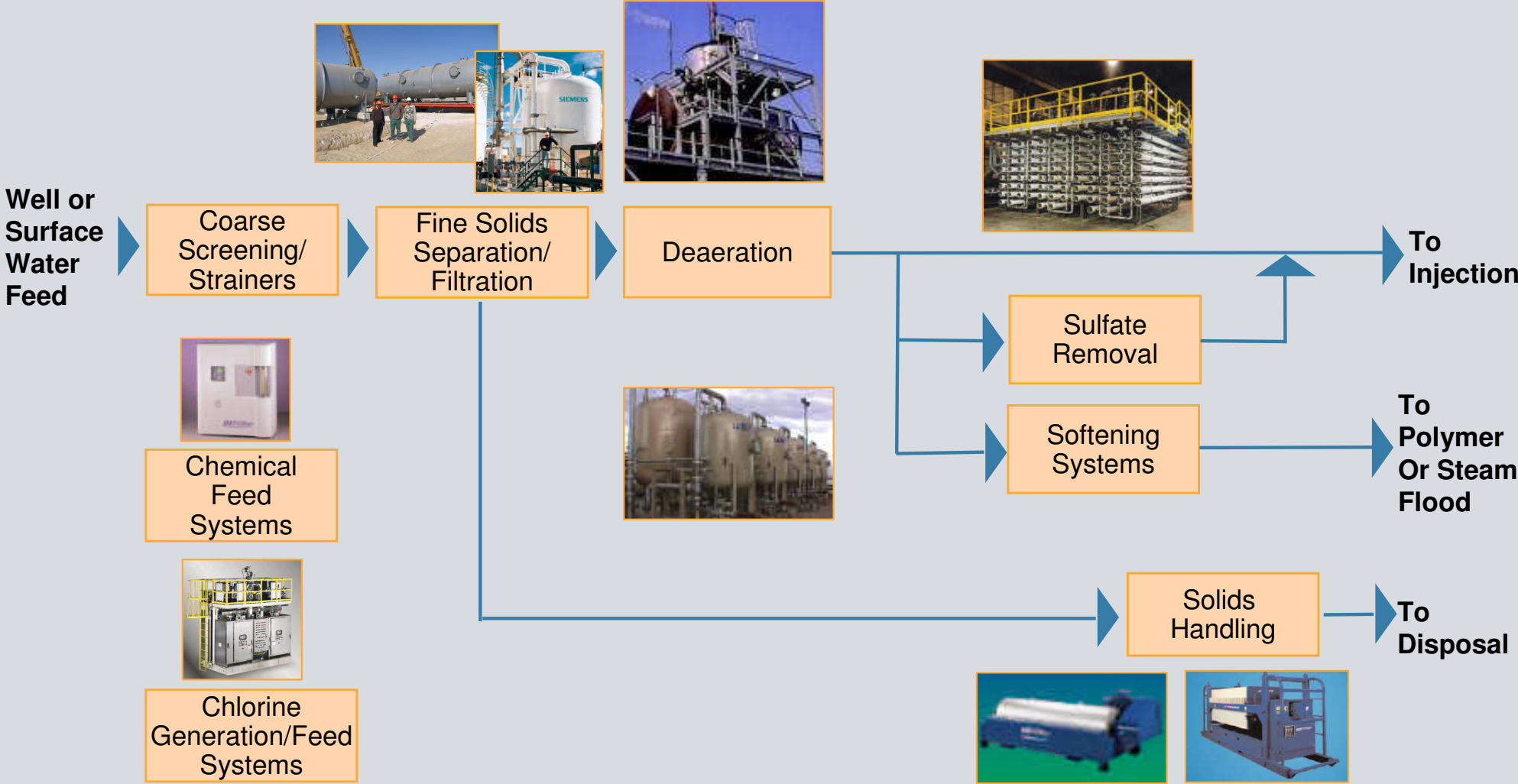
- Biological Treatment
- Membranes

Solids Handling

- Gravity Thickeners
- Filter Press
- Belt Filter Press



Oil & Gas Production Water Injection/Reinjection Process Map



Oil & Gas Production Water Injection/Reinjection

Coarse Screening

- Back Flushing Strainers
- Traveling Water Screens

Fine Solids Separation/Filtration

- Media Filters
- Gravity Clarifiers
- Solids Contact Clarifiers
- Absorption Clarifiers
- Microfiltration Filters

Deaeration

- Vacuum Dearators
- Degasifiers



Oil & Gas Production Water Injection/Reinjection

Sulfate Removal

- Sulfate Removal Systems

Softening Systems

- Brine Softeners
- Weak Acid Cation Softeners

Solids Handling

- Gravity Thickeners
- Filter Press
- Belt Filter Press
- Centrifuges

Chemical Feed Systems

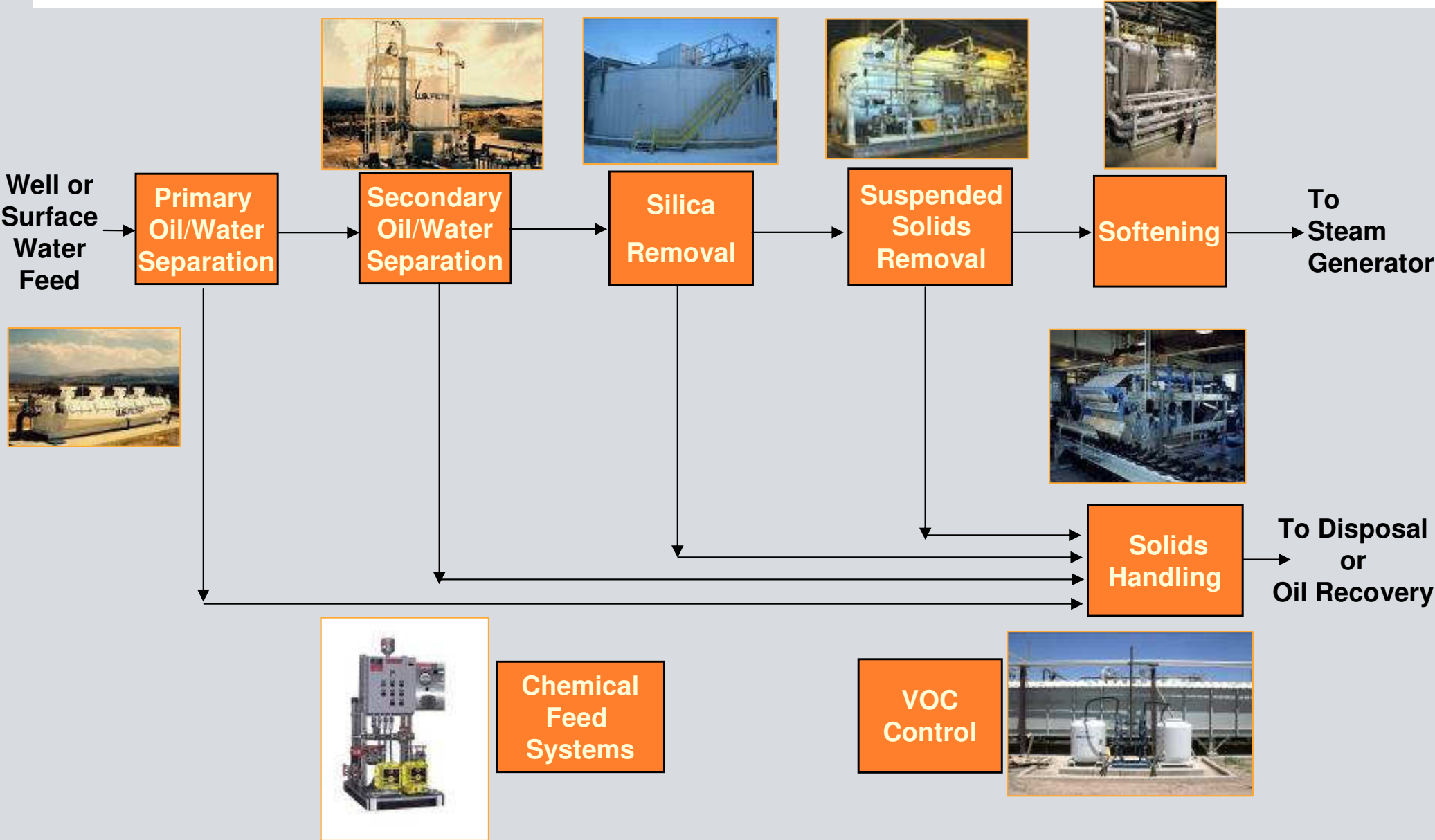
- Chemical Feed Systems

Chlorine Generation/Feed Systems

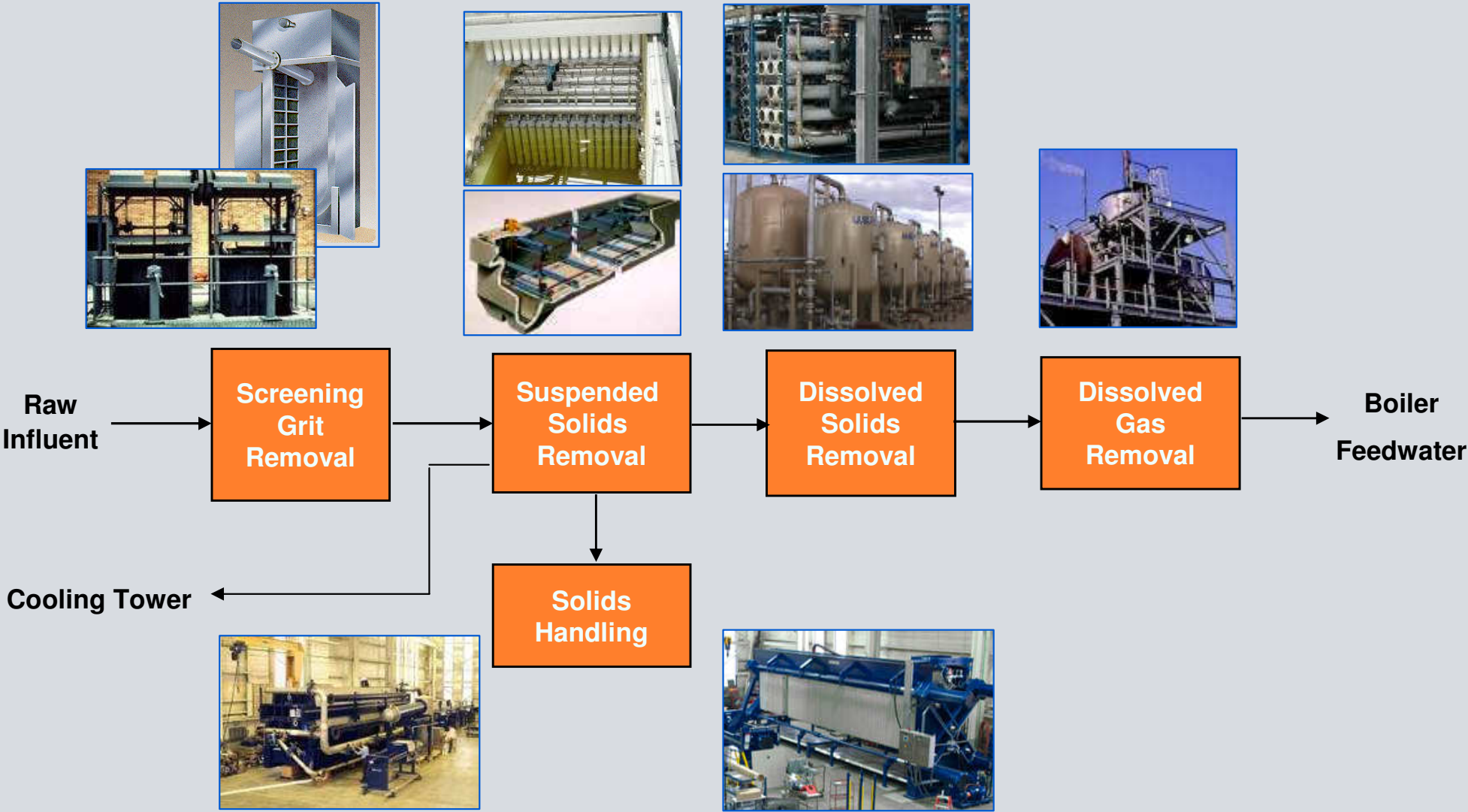
- Electro-Chlorination Systems



Oil & Gas Production Steam Assisted Gravity Drainage (SAGD)



Petroleum Refining and Petrochemicals Process Water Treatment



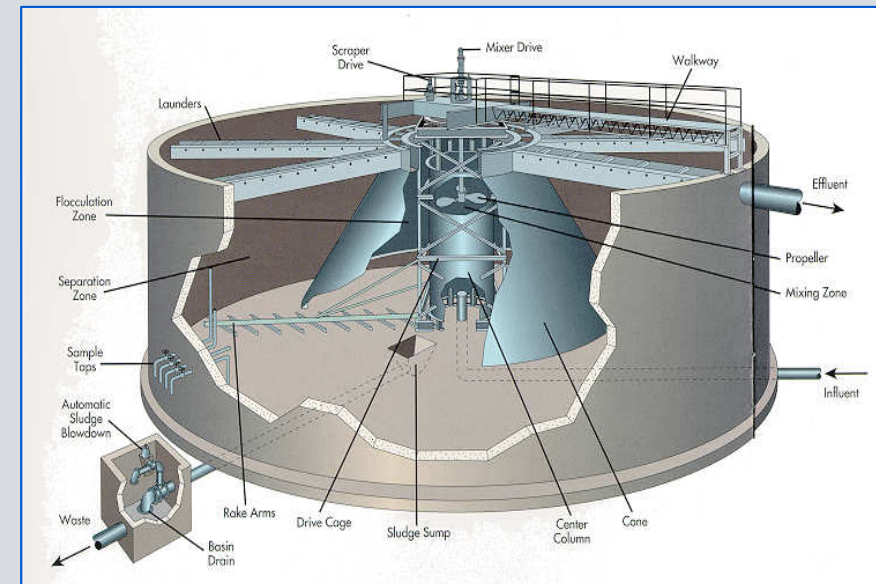
Petroleum Refining and Petrochemicals Process Water Treatment

Screening/Grit Removal

- Bar Screens
- Trash Rakes
- Traveling Water Screens

Suspended Solids Removal

- Solids Contact Clarifiers
- Absorption Clarifiers
- Circular and Rectangular Gravity Clarifiers
- Gravity Filters
- Pressure Filters
- Microfiltration



Petroleum Refining and Petrochemicals Process Water Treatment

Dissolved Solids Removal

- Hot and cold softeners
- Demineralization
- Continuous Deionization
- Reverse Osmosis
- Condensate Polishers

Dissolved Gas Removal

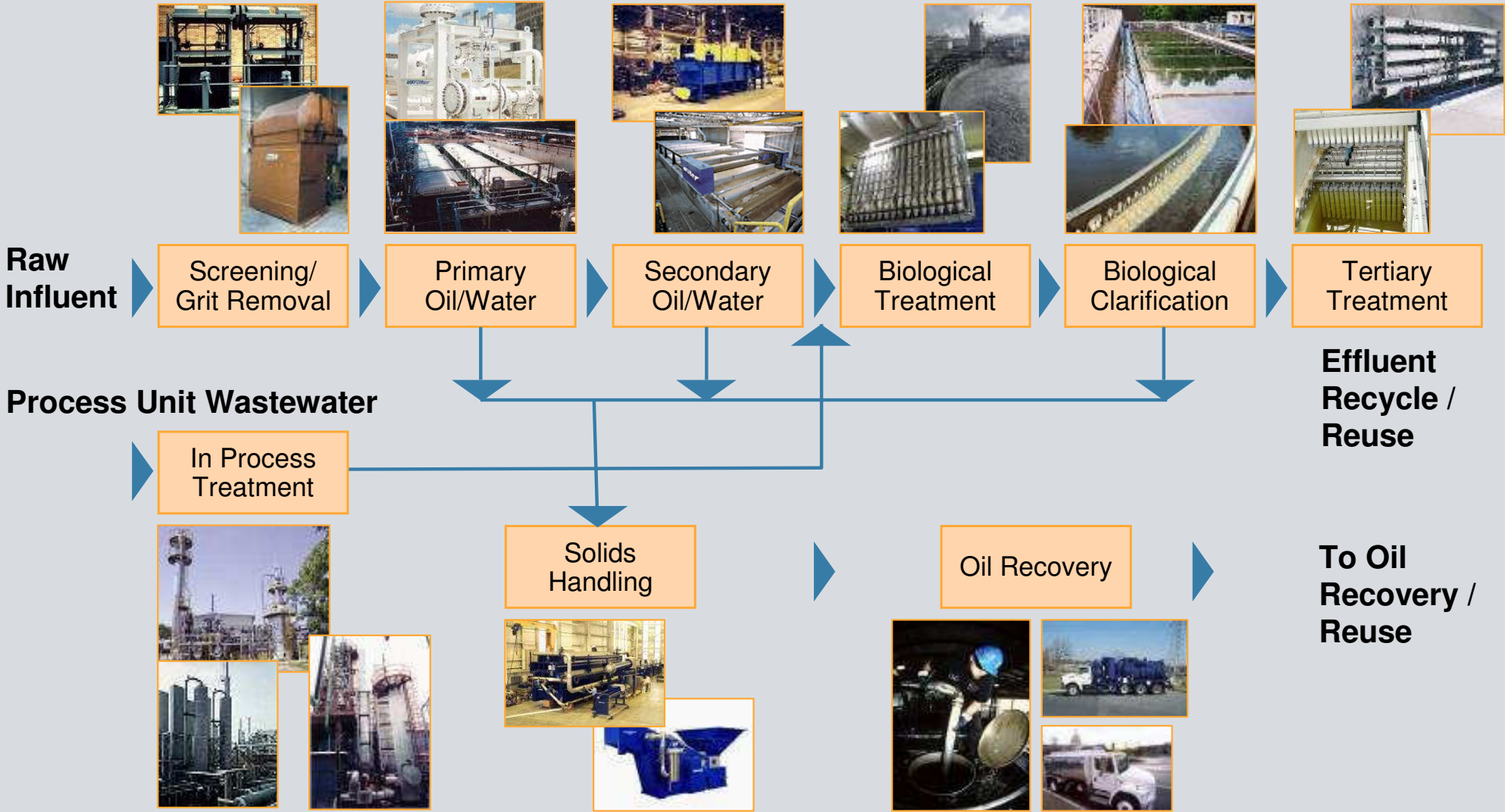
- Degasifiers
- Deaerators

Solids Handling

- Belt Filter Press
- Filter Press
- Gravity Thickener
- Centrifuges



Petroleum Refining and Petrochemicals Typical Wastewater Treatment System



The Petroleum Industry Leader in Technology and Application Experience

SIEMENS

Technologies Developments for the Refining and Petrochemical Industry

- Introduced Tow-Bro Clarifier - 1928
- Introduced API Separator - 1937
- Introduced Wet Air Oxidation - 1950
- Introduced DAF Separator - 1953
- Introduced RBC/SBC - 1969
- Introduced PACT® System - 1972
- Introduced Jet Aeration - 1981
- Introduced GAC Fluid Bed - 1987
- Over 1500 Installations Worldwide



Petroleum Refining and Petrochemicals Wastewater Treatment Technologies

Screening/Grit Removal

- Bar Screens
- Grit Collectors

Primary Oil/Water Separation

- API Separators
- Corrugated Plate Separators
- Hydrocyclones

Secondary Oil/Water Separation

- DAF/DGF Separators
- IAF/IGF Separators
- Walnut Shell Filters



Thank you for your attention!

