NATC North Africa Technical Conference & Exhibition

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Cairo, Egypt

SPE 164645-MS

Sand Management Methodologies for Sustained Facilities Operations

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ePROCESS technologies

Society of Petroleum Engineers

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10 Years of Progress

Facilities San 2002

- SPE Gulf
- 74 attend
- U.S., Can

Top 5 Techno

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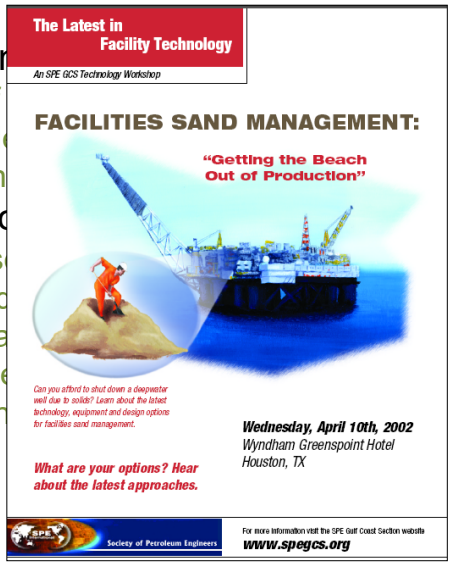

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Presentation Outline

- Natural vs. Artificial Solids
- Produced Solids Management
  - Production Limits
  - Downhole Control
  - Surface Facilities Conventional
  - Surface Facilities Separation Focused
- Subsurface vs. Surface Control
- Multiphase Desander
- Application Examples
  - Shallow Water, Onshore, and Deepwater

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Introduction

All Wells Produced Solids
- Quantity, concentration, or size critical

Sustained Production Requires Controls
- When production/maintenance impacted

Exclusion – Subsurface Control

Inclusion - Surface Handling
- Allows for increased production

Integrated Teams
- Completion and facilities engineers

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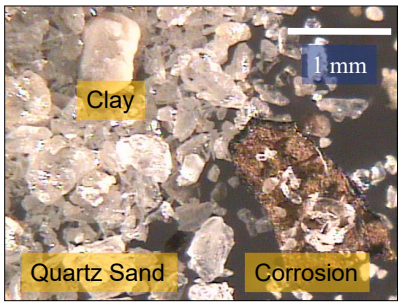
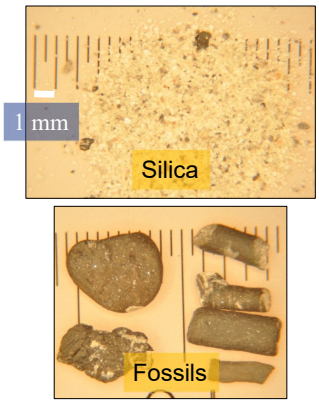
Produced Solids

Inorganic, Insoluble, Particulate Material

- Not asphaltenes, paraffin, wax, or resin
- Not precipitates or scales



Fixed Platform, Indonesia



Deepwater South China Sea

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Natural Solids

Indigenous Reservoir Material

Sand and Clay

High Angularity, Small to Medium Particle Size, Average Specific Gravity

Initial Production High (burst)

Continuous Production Low Steady-State

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Artificial Solids

Introduced by External Intervention
- Frac sand, proppant, drill mud, cement fines, corrosion product, gravel pack, injection fines, etc.

Higher Specific Gravity, Rounder Shape Factor, Larger Average Particle Size

Can Be Handled as Planned Event

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Properties

Property	Sand	Clay	Frac Prop	Corr. Product	Gravel Pack
Specific Gravity	2.5-2.7	1.8-2.9	2.6-3.6	5.5-6.0	2.6-3.0
Shape Factor	0.2-0.5	0.1-0.3	0.5-0.9	0.1-0.5	0.5-0.9
Size Range (μm)	50-500	5-30	150-3000	10-10000	250-3500
Concentration (ppmv)	5-150	<5	0-10000	<2	0 (unless failure)

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Produced Solids Management

Production Limits
- Reduce oil/gas production to sand free production rate

Downhole Equipment
- Prevent sand ingress at reservoir face

Surface Facilities: Batch Separation
- Deal with sand on batch basis as part of maintenance and production

Surface Facilities: Continuous Separation
- Solids removal as unit process

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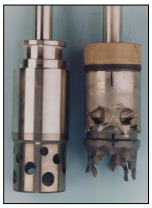
Production Limits

Maximum Sand-Free Production Rate
Minimal CAPEX Investment
Reduces Inflow = Reduces Revenue
Sand Production Map is Moving Target
Use Sand Monitoring/Measuring Probes
Dilute with Low Sand Producers
Wait Until Equipment Fails



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Downhole Equipment

Exclude Sand from Entering Wellbore
- Screens, slotted liners, gravel pack, chemical consolidation, or combination

Accepted Technology
- Well Studied and Widely Available

Installed During Initial Completion or Retrofit
Low CAPEX but High Installation Cost
Reduces Inflow & Introduces Skin Damage
Eventual Mechanical Failure

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Surface Facilities: Conventional

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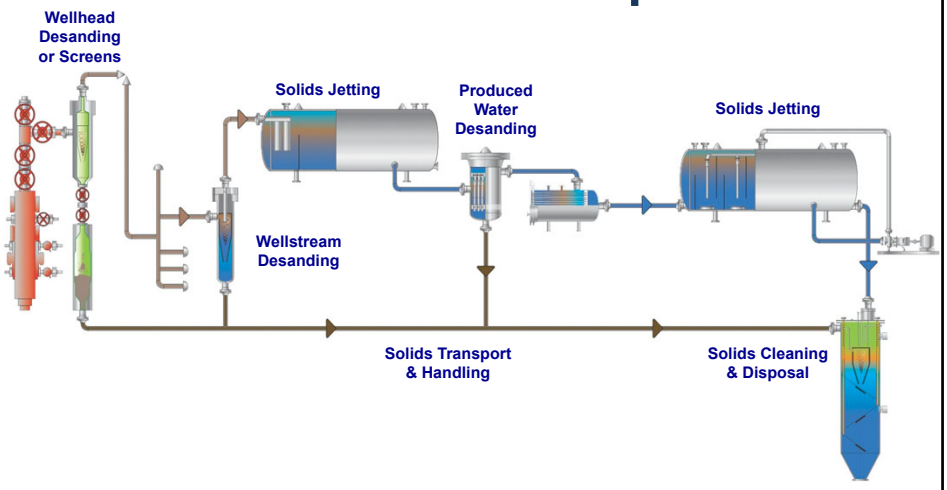
Surface Facilities: Separation



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Subsurface Vs. Surface

Performance:
- Efficiency, lifetime, failure mode

CAPEX/OPEX:
- Equipment, installation, energy, consumables, effect on oil/gas production

Subsurface: Gravel Pack

Surface: Multiphase Desander

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Gravel Pack

Workhorse of Oil & Gas Production
- Handles natural solids only

Allows Particles 50-125 µm to Pass
- Settling velocity 1.6 m/s, thus particles are produced

Failure (erosion/collapse) Not Predictable

Equipment CAPEX Low, Installation CAPEX High
- Rig mobilization and downtime

Reduced Inflow Due to Skin Formation
- Up to 25% Reduction for New Installations
- Higher drawdown, increased collapse potential

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Multiphase Desander

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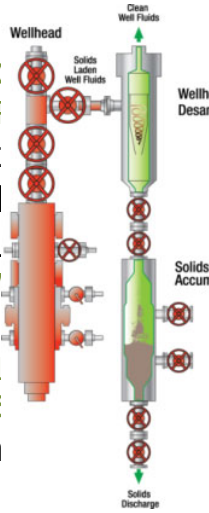

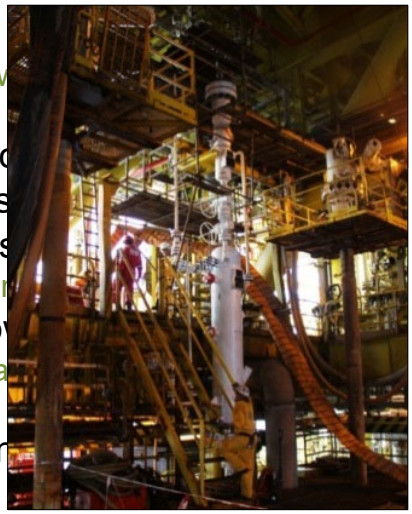

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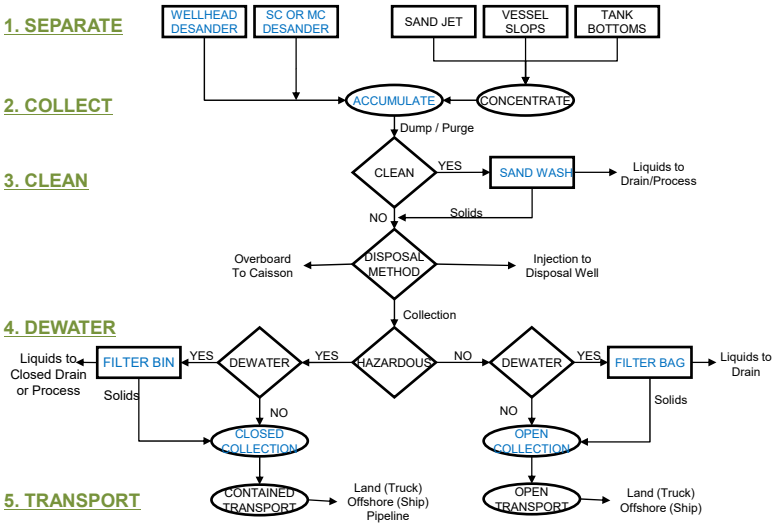
Facilities Sand Management Methodology



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Application Examples

Shallow Water
- Caspian Sea Oil Well

Onshore
- Indonesia Gas Wells

Deep Water
- South China Sea Oil Wells

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Shallow Water

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- ΔP and 23 µm separation

Sand Plugging and Skin Factor Reduction
- Oil production increased 500 BPD

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Onshore

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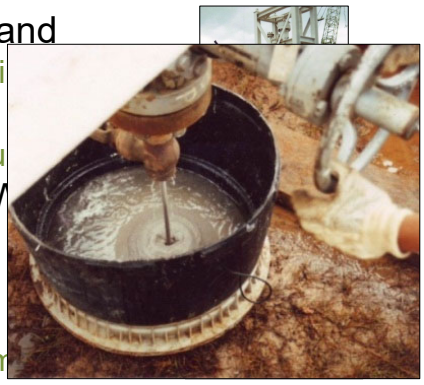

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Deep Water

Floating Facility (1300 m)

- 2000 kg/d separated and treated

Oil Production Increase (5000-7000 BPD)

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Summary

- Integrate Surface Sand Management into Sand Control Portfolio
- Natural and Artificial Solids Production Requires Different Control Methods
- Exclusion Methods (gravel packs/screens) Provide Majority of the Sand Control
- Inclusion Methods Improve Inflow
- Multiphase Desander Allows Marginal Wells to Produce More Vigorously

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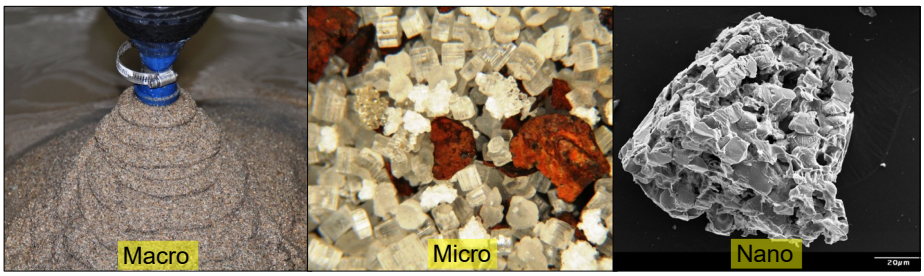
SPE 164645-MS • Facilities Sand Management • Hank Rawlins

Thank You / Questions



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