


COMPARISONS OF ADVANCED WATER TECHNOLOGIES AND PERFORMANCE VALIDATION

BY CHIP WESTABY



CHALLENGES TO PRODUCED WATER SYSTEMS

- INCREASED WATER VOLUMES, RECYCLING AND REUSE OPTIONS
 - SPECIALIZED SOLUTIONS ARE NEEDED FOR SOME PROCESSES
 - UNIVERSAL DEFINITIONS AND PROCESSES REQUIREMENTS ARE NOT AVAILABLE
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PRODUCED WATER DISCHARGE VARIABILITY

- MOST WATER IS INJECTED FOR DISPOSAL
 - SOME RE-INJECTED FOR PRODUCTION
- WATER CONCENTRATIONS CAN BE FROM 0-99%
- OFFSHORE DISCHARGE ALLOWS SMALL OIL CONCENTRATION DISCHARGES
- RECYCLING / REUSE IS AVAILABLE IN SOME LOCATION
 - HIGH WATER QUALITY DEMANDS



CHANGES TO PRODUCED WATER METHODS

- ADDED PRODUCTION VOLUMES
- NEW UNPLANNED PRODUCTION METHODS
 - WATER FLOOD
 - POLYMER FLOOD



TERTIARY SYSTEMS

- TANKS AND GRAVITY VESSELS – PRIMARY SEPARATION
- ENHANCED GRAVITY / FLOTATION CELLS – SECONDARY SEPARATION
- FILTRATION, ADSORPTION, MEMBRANES – TERTIARY
 - SPECIALIZED AND NOVEL WITH FREQUENT INNOVATIONS
 - COMMON USES IN ONE REGION MAY NOT MEET OTHERS NEEDS
 - COULD BE OVER KILL FOR SOME PROCESSES

REVIEW OF SOME TERTIARY TECHNOLOGIES

- NEW TECHNOLOGIES EXPAND APPLICATION WINDOWS, REDUCE INSTALLATION AND OPERATING COST
- ORGANOCLAY
- SYNTHETIC WALNUT SHELLS
- ADSORBENT MEDIA
- BIMODAL MEMBRANES

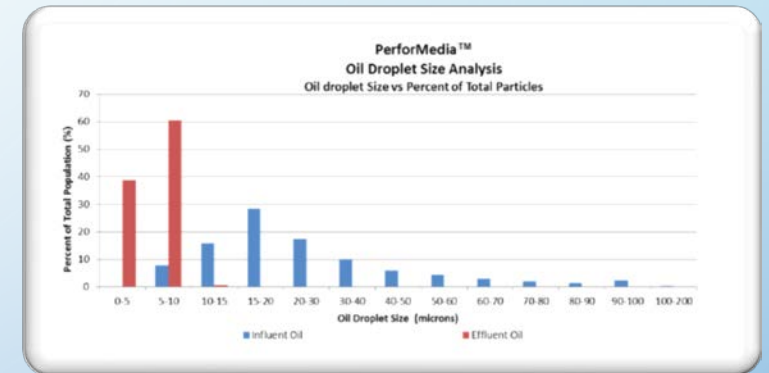
XEDIA



- ORGANOCLAY FILTER MEDIA
- FREE OIL REMOVAL
 - SOME DISSOLVED REMOVAL
 - BACK WASHABLE IN SOME PROCESSES
- INCREASE LOADING CAPACITY
 - REDUCED MAINTENANCE LABOR COSTS

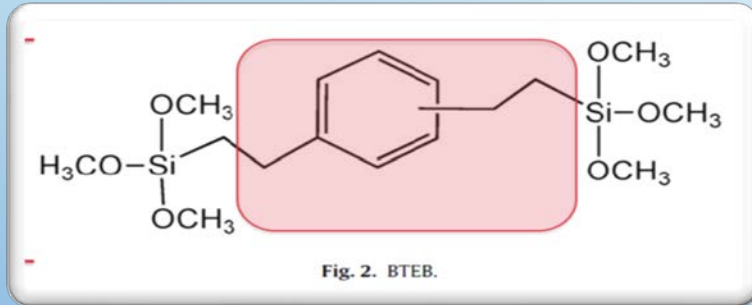
SIEMENS PERFORMEDIA

- SYNTHETIC NUT SHELL MEDIA
- FREE OIL & SOLIDS REMOVAL > 10 MICRONS
- REDUCED OPERATING COST IN POLYMER FLOODS

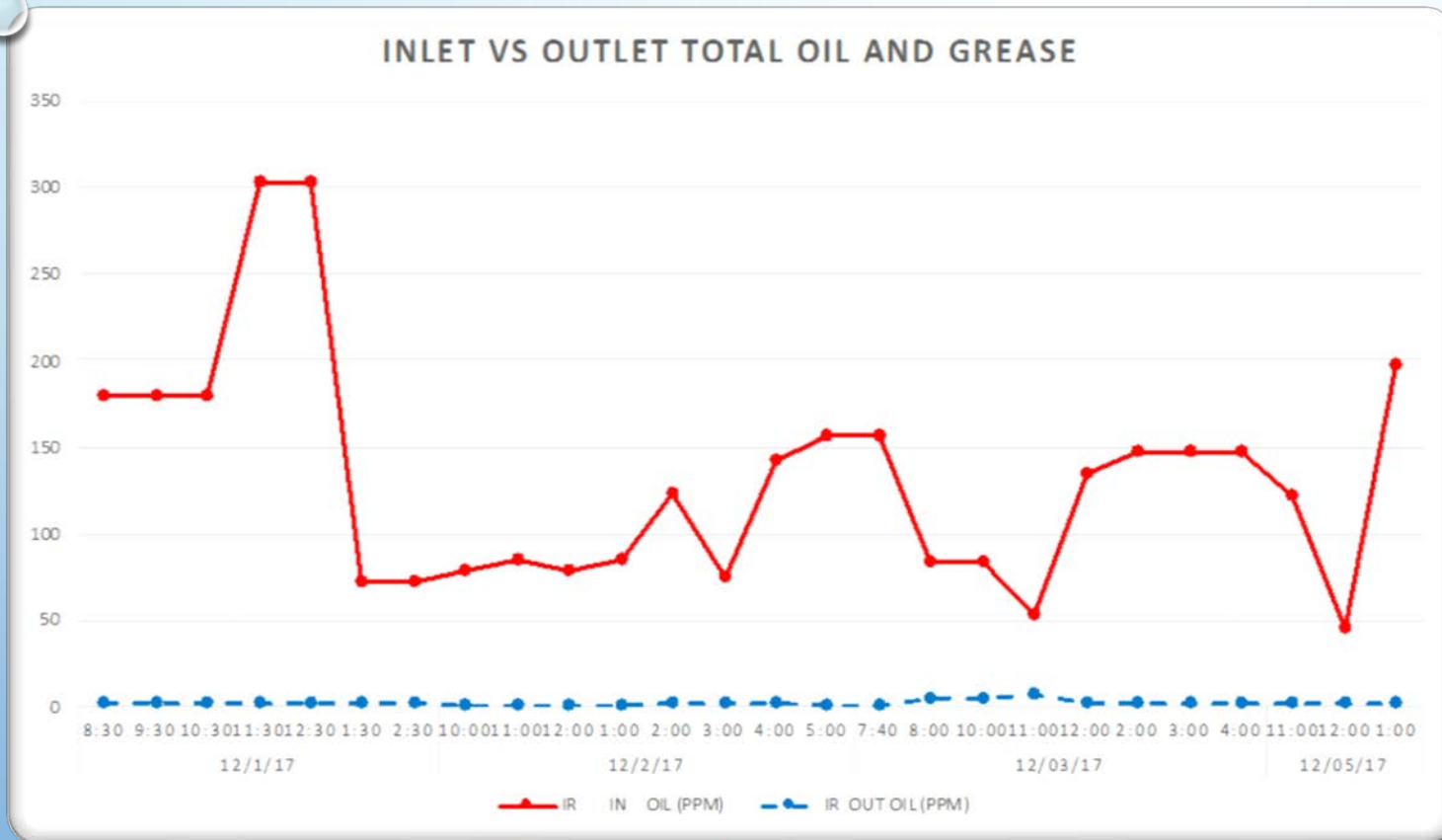


PROSEP OSORB

- ADSORBANT SILICON BASED MEDIA
- REMOVAL OF BTEX AND SOLUBLE HYDROCARBONS
- REGENERATION WITH STEAM OR METHANE



BALEEN BI-MODAL



- MEMBRANE TREATMENT
- SLOP AND FLOW BACK WATER TREATMENT
- SOLIDS, OIL & DISSOLVED
- BATCH PROCESS & SHORT INSTALLATIONS
- MEMBRANES USUALLY NEED CIP SYSTEMS

OIL DEFINITIONS

- NO UNIVERSAL DEFINITION
- METHOD DEPENDENT
- EPA 1664 –
 - 5 MG/L NON DETECT
 - NOT SENSITIVE TO LIGHT HYDROCARBONS
 - HEXANE EXTRACTION

OIL DEFINITIONS

- METHODS
 - INFRARED – DIFFERENT SOLVENTS USED DEPENDING ON ANALYZER
 - UV FLUORESCENCE – CALIBRATION TO TARGET HYDROCARBONS
 - OSPAR GC METHOD
 - PENTANE EXTRACTION
 - C-10 TO C-40 ONLY
 - BTEX NOT INCLUDED

FREE OR NOT FREE

- EMULSIONS ARE A MIXTURE OF OIL & WATER
 - PRIMARY SEPARATION - 1% - 5% OIL
 - SECONDARY SEPARATION - 50 – 150 PPM
 - TYPICALLY OIL WHICH CANNOT SEPARATE IN THE VESSEL
 - FREE OIL WILL BE SEPARATED

EXAMPLES

- NATURAL GAS CONDENSATES
 - HIGH BTEX CONCENTRATION
 - BENZENE IS HIGHLY SOLUBLE & VOLATILE
 - SOME WILL EASILY SEPARATE
 - SOME WILL DISSOLVE AND NEED TERTIARY TREATMENT TO REMOVE
 - WILL NOT BE MEASURED BY 1664 OR OSPAR GC METHOD
- BITUMEN – HEAVY OIL
 - NO SOLUBILITY, NOT EASY TO SEPARATE IN PRIMARY VESSELS
 - LOW SOLUBILITY IN HEXANE / LOW 1664 MEASUREMENT

TREATMENT METHOD VALIDATION

- CHOSE A MEASUREMENT TECHNOLOGY THAT MATCHES TREATMENT SYSTEM
- NO EVAPORATION FOR LIGHT GAS CONDENSATES
- SAMPLE PREPARATION
 - FILTER SAMPLE FOR DROPLET SIZE
 - ACIDIFY OR NOT FOR WATER SOLUBLE
 - SILICA GEL EXTRACT REMOVAL OF POLAR MOLECULES
 - CHOSE SOLVENT FOR FULL EXTRACTION
 - TOLUENE FOR BITUMEN

PROCESS CONTROL

- ON LINE MONITORS
 - CALIBRATION FOR FREE OR TOTAL OIL
 - WATER SOLUBLE / ORGANIC ACIDS USUALLY STABLE CONCENTRATION
 - CONTROL PROCESS
 - OPTIMIZATION OF ABSORBANT / BACK WASHABLE MEDIA
 - INDICATE BREAK THROUGHS OF MEDIA
 - SYSTEM VALIDATION
 - MEASURE OIL DIFFERENCE BEFORE AND AFTER

ACKNOWLEDGEMENTS

- XEDIA
- SIEMENS
- PROSEP
- VEOLIA
- BALLEEN
- ALL OTHER SUPPLIERS OF POLISHING SYSTEMS

THANK YOU

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