

Development and Validation of an AMD Water Treatment Process for Source Water Use

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Thanks To:
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Winner Water Services
Pennsylvania Department of Environmental
Protection
Pennsylvania Department of Community &
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Industry participants in the stakeholder group

Agenda

AMD Background Information



Project Objectives



Project Results to Date



Acid Mine Drainage (AMD): water typically containing sulfates and metals which is formed in areas of mining activity.



	Low	High
Flow Rate (gal/min)	0.4	35,000
pH	2.7	7.3
Sulfate (ppm)	34	2,000
Iron (ppm)	0.05	512

➤ Considered an environmental liability

AMD as an Alternative Water Source

- Advantages

- Reduces an environmental liability
- Reduction of potable water use
- Provides positive environmental message
- Year round availability at a relatively constant temperature

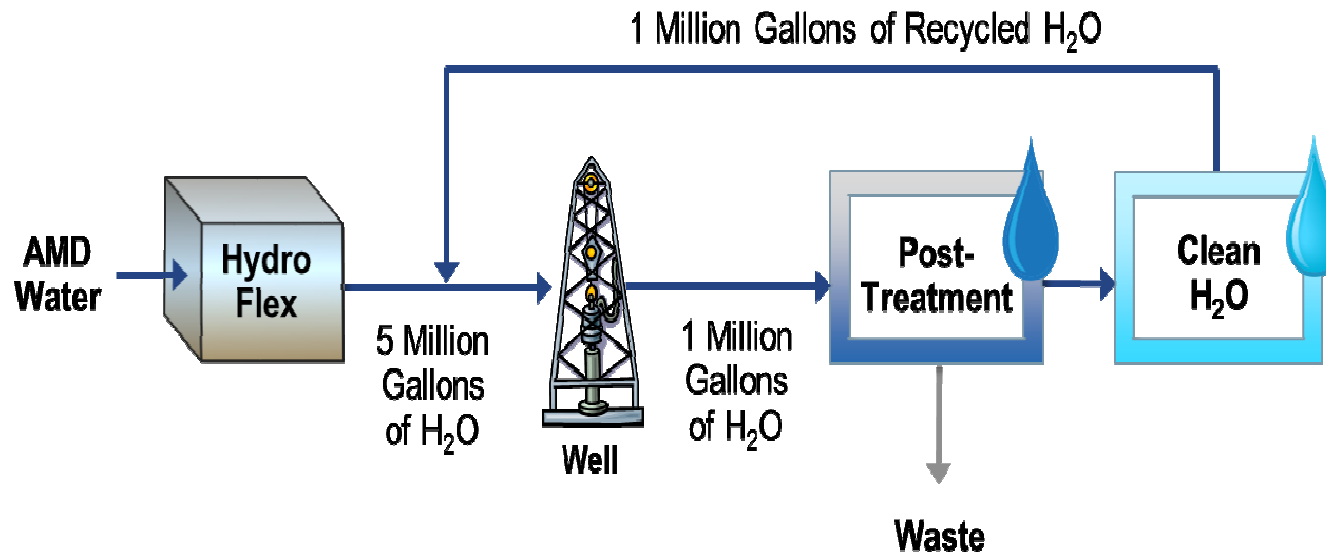
- Challenges

- Proximity
- Water Quality
- Permitting requirements for use, transport, and storage
- Liability concerns

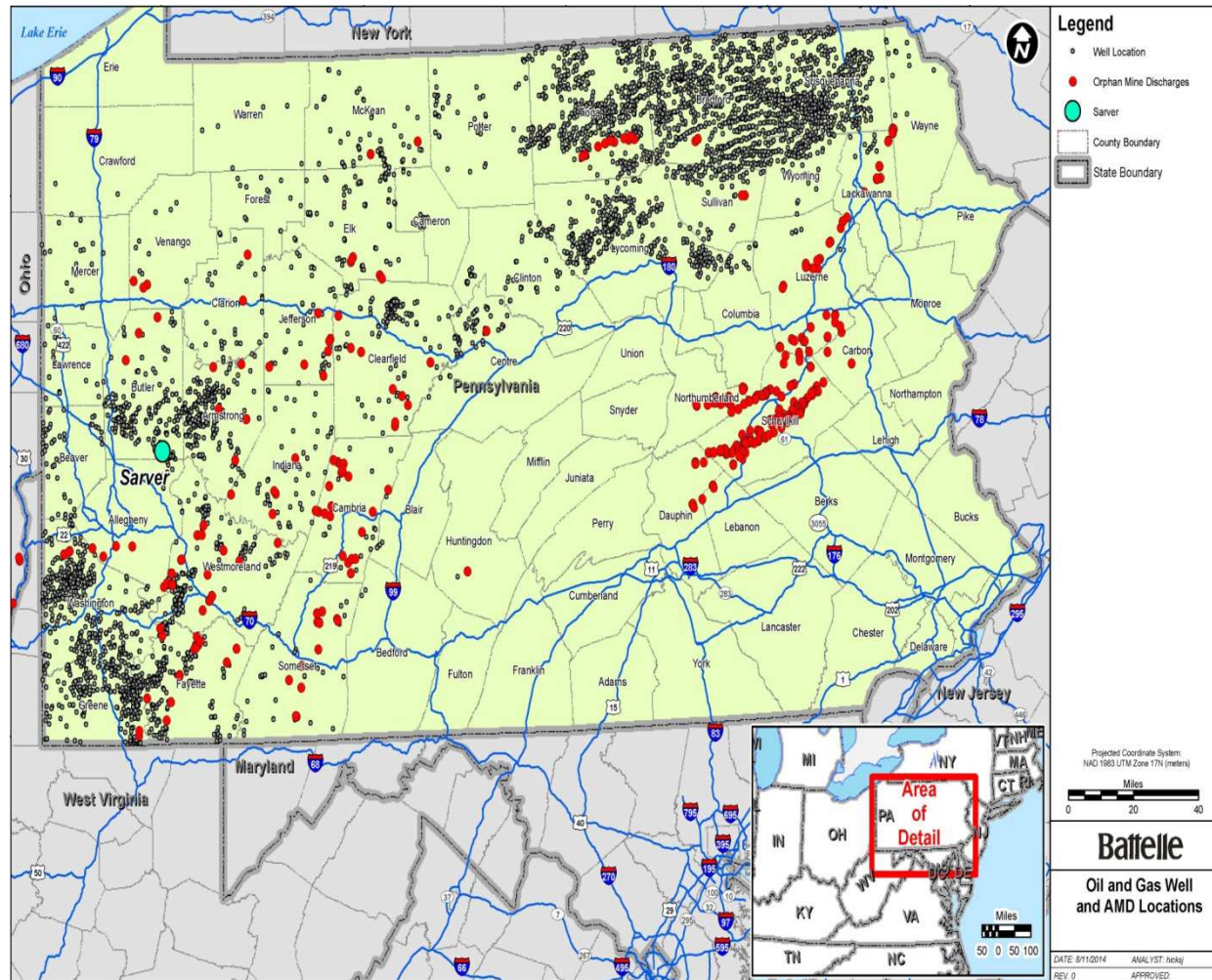
DOE sponsored project to address challenges of using treated AMD in HF operations

- Objectives

- Optimize an innovative treatment process (HydroFlex) to support use of AMD water for unconventional resource development
- Evaluate byproduct use in existing flowback water treatment processes
- Address environmental, regulatory, and commercial implications for use of AMD as source water



AMD sources can be found in close proximity to current well sites.



Project approach to optimize water treatment

Laboratory testing identifies optimal field operating conditions to meet water quality requirements

Demonstrate start-up and readiness of field demonstration unit at initial operating conditions

Two field test campaigns planned:

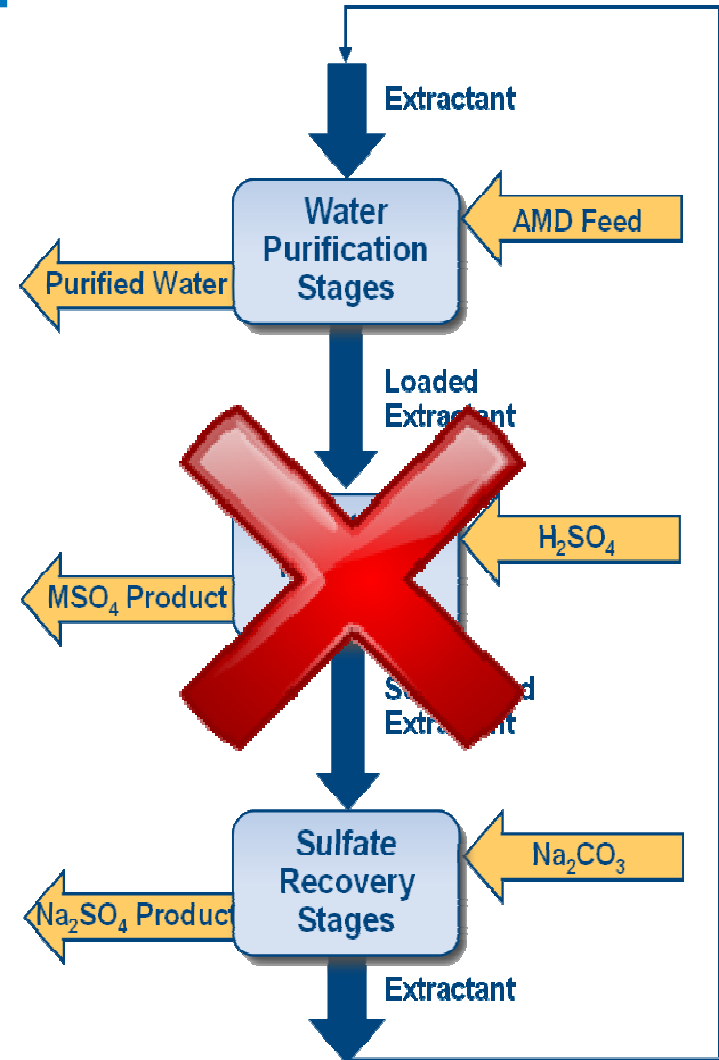
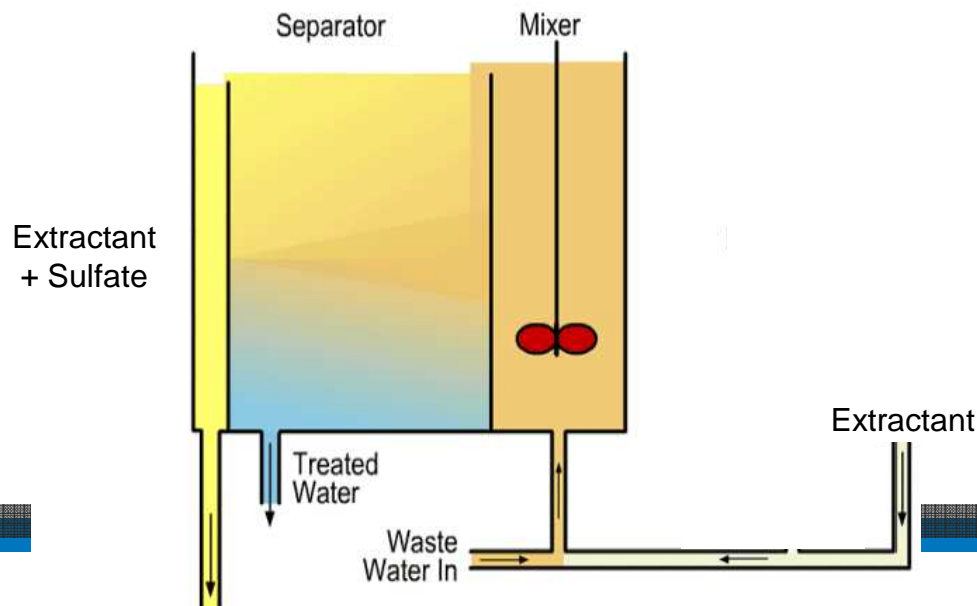
- Optimize operating parameters to meet water quality requirements
- Optimize parameters for operating cost reductions

Stakeholder Guidance



HydroFlex technology provides a flexible, cost effective water treatment approach

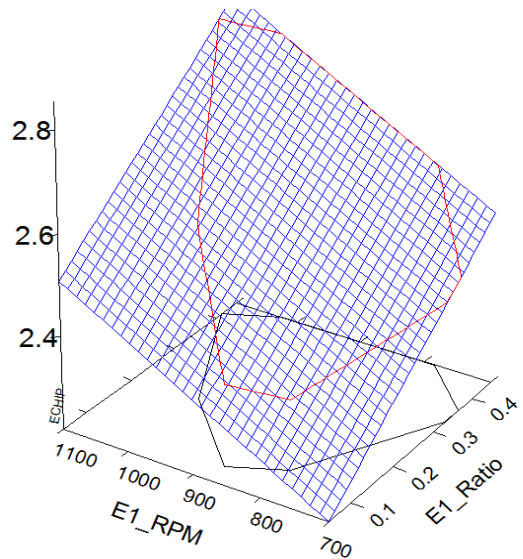
- Based on commercial liquid-liquid extraction processes
- Tunable process chemistry
- Minimal pretreatment requirements (no membranes)
- High water recovery
- Ambient T&P



DEFOA-06

Lab scale testing conducted to optimize HydroFlex process parameters

- Both batch and continuous tests were conducted to optimize:
 - Mixing time
 - E:A ratio
 - Chemical dosing rates



Lab testing results were aligned with target water quality values confirmed by stakeholders

Parameter	Observed	Target
Sulfate, mg/L	160	< 300
Carbonate, mg/L	410	< 400
Calcium, mg/L	< 5.0	< 100
Carbonate Usage, lb/kgal feed	~10	-
Water Recovery, vol%	>99%	-
Byproduct Generation, gal/kgal feed	~14.7	-

Field demonstration unit is currently being prepared to support pilot scale testing



Initial water quality data in agreement with lab results



Regulatory and Liability Concerns

- Address current regulatory requirements for AMD use
 - Site operation under Consent Order and Agreement (COA) from the PA DEP
 - Ability to store treated water as fresh water
- Address potential liability concerns for AMD users
 - Protection to site operator for AMD treatment
 - No anticipated extension of liability to customers



Path Forward: Optimization of HydroFlex for providing source water to O&G industry

AMD
source
water

Optimize Sulfate
removal in
extraction section



Flowback
Recycle

Validate utility of
sulfate byproduct
for softening of
flowback waters



Optimize operation
of sulfate stripping
section to produce
a marketable
byproduct

Questions?