PTAC Water Decision TREE

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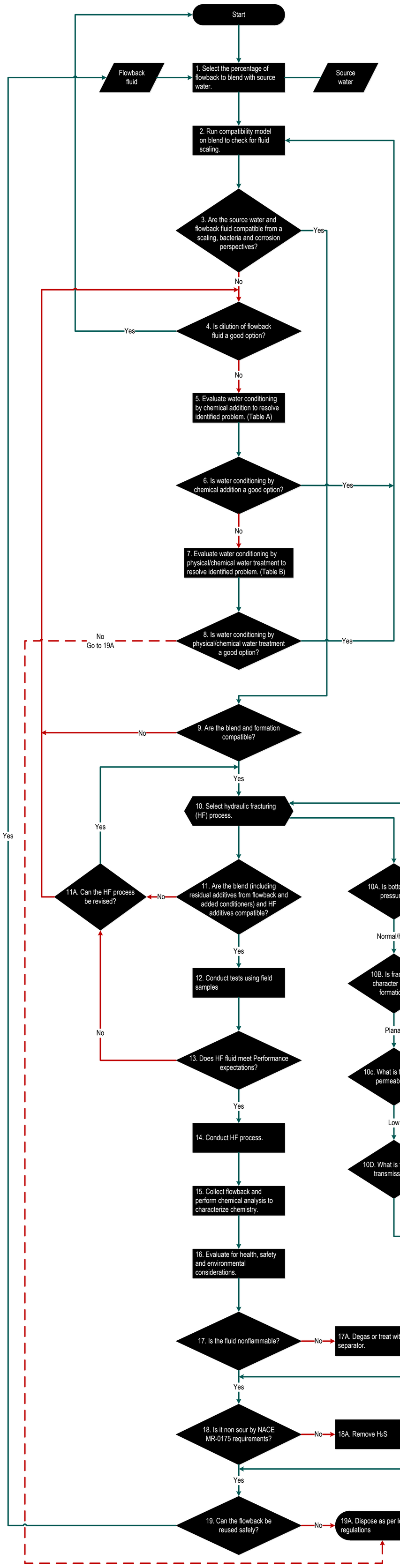

Table A—Water Conditioning by Chemical Addition

Occurring Problem	Remedial Options
Bacteria	Ozone Glutaraldehyde Quaternary Amine
Scaling Tendencies	Scale Inhibitor
Dissolved Iron	
Corrosion	Corrosion Inhibitor
Hydrogen Sulfide	
Oxygen	
Clay	Potassium Chloride Tetramethyl Ammonium Chloride Quaternary Amine

Note: See Appendix A Fracturing Fluid Flowback Reuse Project

Table B—Water Conditioning by Physical/Chemical Treatment

Occurring Problem	Remedial Options
Bacteria	Electro Coagulation Oxidation
Suspended Solids	General Gravity Settling Filtration Flotation Hydroclone Electro Coagulation
Organics	Electro Coagulation Oxidation
Hardness (scaling)	Chemical precipitation Electro Coagulation
Dissolved Solids	Ion Exchange Reverse Osmosis Evaporation
Temperature	Heat Exchange

Note: See Appendix B Fracturing Fluid Flowback Reuse Project

Table C—Slickwater

Water Quality	Range	Problem	Remedial Options
Temperature (degC)	3–40	Temp for safe handling of fluid at surface lower temperatures may cause freezing problems	Use a hydration unit for mixing of water and friction reducer
pH	5.0–8.0	pH < 5 may cause prolonged hydration pH > 8.0 may result in inadequate gelling	NaOH or HCl
Chloride (mg/L)	<90,000	High chloride concentration inhibits hydration. Greater amounts of friction reducer maybe required.	Mechanical vapour recompression, ionization, reverse osmosis, electrocoagulation
Hardness (mg/L $CaCO_3$)	<15,000	Divalent cations inhibits hydration	flocculation and coagulation, ion exchange, electrocoagulation
Concentration Factor for Residual Additive Ingredients	2	Friction reducer impact on formation	Breaker
Suspended Solids (mg/L)	50 (< 100 um)	Possible damage to reservoir	Settling or filtration

Table D—Linear Gels

Water Quality	Range	Problem	Remedial Options
Temperature (degC)	15–40	Lower temperatures may prolong the hydration of gel polymers	Passive cooling in tanks or ponds Heat exchanger
pH	6.0–8.0	A pH < 6 may cause prolonged hydration of gel A pH > 8 may result in inadequate gelling	NaOH or HCl
Chloride (mg/L)	<50,000	High chlorides concentration destabilizes the fluid and hydration	Mechanical vapour recompression (MVR), ionization, reverse osmosis (RO), electrocoagulation
Iron (mg/L)	<25	Iron degrades and breaks polymers in gels, causing premature breaking and crosslinking	Iron sequestration, oxidization
Sodium (mg/L)	<1000	Excess sodium destabilizes the fluid	Ion exchange, MVR, RO
Bacteria (CFU)	0	The presence of bacteria degrade the gel viscosity	Biocide, ozone
Concentration Factor for Residual Additive Ingredients	2	Polymer impact on formation and fresh additive	Breaker
Suspended Solids (mg/L)	50 (< 100 um)	Possible damage to Reservoir	Settling or filtration

Table E—Crosslink Fluids

Water Quality	Range	Problem	Remedial Options
Temperature (degC)	15–40	Temperature range for safe handling of fluid at surface and hydration of gel.	Passive cooling in tanks or ponds. Heat exchanger.
pH	6.0–8.0	pH < 6 may cause prolonged hydration of gel pH > 8 may result in inadequate gelling	NaOH or HCl
Chloride (mg/L)	<30,000	High Cl^- concentration destabilizes the fluid and creates problems with crosslinking	Mechanical vapour recompression (MVR), ionization, reverse osmosis (RO), electrocoagulation
Iron (mg/L)	<25	Iron degrades and breaks polymers in gels, causing premature breaking. Iron can also create premature crosslinking	Iron sequestration, oxidization
Alkalinity (mg/L $CaCO_3$)	<600	Acts as a pH buffer, so high concentrations of crosslinking activator may be needed	Ionization, mechanical vapour recompression, scale inhibitor
Sodium (mg/L)	<1000	Excess sodium destabilizes the fluid	Ion exchange, MVR, RO
Silica (mg/L)	<35	Excess silica may inhibit the crosslinking of polymer gels	
Bacteria (CFU)	0	The presence of bacteria degrade the gel viscosity	Biocide, ozone
Concentration Factor for Residual Additive Ingredients	Field Tests Required	Borate impact on control of crosslinking	Disposal of flowback or physical/chemical water treatment for dissolved solids
	2	Polymer impact on formation and fresh additive	Breaker
	Field Tests Required	Buffers impact on control of crosslinking	Disposal of flowback or physical/chemical water treatment for dissolved solids
Suspended Solids (mg/L)	50 (< 100 um)	Possible damage to reservoir	Settling or filtration

Table F—Viscoelastic Fluids

Water Quality	Range	Problem	Remedial Options
Temperature (degC)	20– 40	Temperature range for safe handling of fluid at surface	Passive cooling in tanks or ponds Heat exchanger
pH	5–12	Outside this range can effect properties of surfactants. Testing required	
Chloride (mg/L)	<33,000	Being outside of this range could affect the fluid quality and performance of standard chemistry. Alternative blends can be tested above this concentration.	Blending, mechanical vapour recompression, reverse osmosis, ionization, electrocoagulation
Suspended Solids (mg/L)	50 (< 100 um)	Possible damage to reservoir	Settling or filtration