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## 1 INTRODUCTION

The operations in which acid, solvent or other chemical product are pumped into the well from a Well Stimulation Vessel (WSV) through the FPSO (not through a Drilling or Workover Rig) are known by Petrobras technicians as remote operations.

This section lists the fluids that can be used during these special operations. These fluids will be pumped into the formation for reservoir stimulation, removing organic/inorganic deposits or scale inhibition, by using WSV, installations on the FPSO and subsea equipment (risers, flowlines, and Wet Christmas Trees).

This is not extensive list, and the use of other fluids may be designed and required by Petrobras during the operation of the Field. Some typical commercial fluids compositions are mentioned but other formulations may be provided by different service companies.

## 2 COMPLETION SOLUTIONS

This Section lists the fluids that were used in completion of the wells and may return to production facilities.

Brine I:


Product	Concentration	Product description
Salt	24% m/m	Sodium Chloride
Surfactant	0,2% v/v	Ethoxylate and quaternary ammonium salts
Biocide	200 ppm	Glutaraldehyde

Brine II:

Product	Concentration	Product description
Salt	36% m/m	Calcium Chloride
Surfactant	0,2% v/v	Ethoxylate and quaternary ammonium salts
Biocide	200 ppm	Glutaraldehyde

Spent Acid:

Product	Concentration	Product description
Salt	23% m/m	Calcium Chloride
Surfactant	0,2% v/v	Ethoxylate and quaternary ammonium salts

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### 3 SCALE REMOVAL SOLUTIONS

This Section lists the fluids that may be pumped to the wells to remove well string/formation scale deposits or to inhibit scale deposition.

#### 3.1 Carbonate scale removal

**Aqueous Solution I, with Acetic Acid 20% m/m as main product:**


Product	Concentration	Product description
Acetic acid 98%	20% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt

**Aqueous Solution II, with Formic Acid 10% as main product:**

Product	Concentration	Product description
Formic acid 85%	10% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt

**Aqueous Solution III, with Acetic Acid 13% and Formic Acid 9% as main products:**

Product	Concentration	Product description
Acetic acid 98%	13% m/m	Acid
Formic acid 85%	9% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants

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**Aqueous Solution IV, with EDTA 10% m/m chelating agent as main product:**

Product	Concentration	Product description
EDTA diammonium salt	10% m/m	Chelant
Water or completion fluid	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Wetting agent	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants

**Aqueous Solution V, with EDTA 10% m/m and EGMBE as main products:**

Product	Concentration	Product description
EDTA diammonium salt	10% m/m	Chelant
Water or completion fluid	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Corrosion inhibitor	0,5% v/v	Amine-based corrosion inhibitor
EGMBE	10% v/v	Ethylene glycol monobutyl ether

**Aqueous Solution VI, with GLDA 20% chelating agent as main product**

Product	Concentration	Product description
GLDA monosodium salt	20% m/m	Chelant
Water	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Corrosion inhibitor	0,5% v/v	Amine-based corrosion inhibitor
EGMBE	10% v/v	Ethylene glycol monobutyl ether


  

**Aqueous Solution VII, Hydrochloric acid 10 % m/m as main product:**

Product	Concentration	Product description
Hydrochloric acid 32%	10% m/m	Inorganic acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants

**3.2 Sulfate scale removal**

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### Aqueous Solution VIII, with chelating agent as main product:

Product	Concentration	Product description
EDTA tetrassodium	10% m/m	Chelant
Water or completion fluid	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Wetting agent	0,1% v/v	Wettability modifier

### Aqueous Solution IX, with chelating agent as main product:

Product	Concentration	Product description
DTPA pentapotassium salt	10% m/m	Chelant
Water	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Wetting agent	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants

## 3.3 Organic scale removal

### Solvent mixture I, Xylene as main product:

Product	Concentration	Product description
Xylene	100% v/v	Aromatic solvent


### Solvent mixture II, mixture with diesel:

Product	Concentration	Product description
Butylglycol	10%	Solvent
Diesel	90% v/v	Aliphatic solvent

### Solvent mixture III, hydrocarbon solvents mixture

Product	Concentration	Product description
Xilene	50% v/v	Aromatic solvent
Diesel	50% v/v	Aliphatic solvent

### Solvent mixture IV, DBX mixture of solvents:

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Product	Concentration	Product description
Diesel	45% v/v	Aliphatic solvent
Butilglycol	10% v/v	Biodegradable solvent
Xylene	45% v/v	Aromatic solvent

### 3.4 Carbonate scale inhibition

**Aqueous Solution X, scaling inhibitor as main product:**


Product	Concentration	Product description
Scaling inhibitor	10% m/m	Polyphosphonate, polyacrylates or polysulphonates
Water	QPS	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants

### 3.5 Sulfate scale Inhibition

**Aqueous Solution XI, scaling inhibitor as main product with pH adjuster:**

Product	Concentration	Product description
Scaling inhibitor	10% m/m	Polyphosphonate, polyacrylates or polysulphonates
Water or completion fluid	QSP	Diluent
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt surfactants
Sodium hydroxide	QSP pH = 5 a 6	Alkali

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## 4 RESERVOIR STIMULATION SOLUTIONS

This Section lists the fluids that are usually pumped to the well in reservoir stimulation operations.

### Aqueous Solution XII – Acetic Acid 20% m/m as main product

Product	Concentration	Product description
Acetic acid 98%	20% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt

### Aqueous Solution XIII - Formic Acid 10% m/m as main product:


Product	Concentration	Product description
Formic acid 85%	10% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Ethoxylate + quaternary ammonium salt
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt


### Aqueous Solution XIV, with Acetic Acid 13% m/m and Formic Acid 9% m/m as main products:


Product	Concentration	Product description
Acetic acid 98%	13% m/m	Acid
Formic acid 85%	9% m/m	Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants

### Aqueous Solution XV, Hydrochloric acid 15% m/m as main product:



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<b>Product</b>		<b>Concentration</b>	<b>Product description</b>	
Hydrochloric acid 32%		15% m/m	Inorganic acid	
Water			Diluent	
Corrosion inhibitor			Amine-based corrosion inhibitor	
Emulsion preventer			Isopropanol + quaternary ammonium salt surfactants	
<b>Aqueous Solution XVI, HCl 10% m/m - based viscoelastic divergent</b>				
<b>Product</b>		<b>Concentration</b>	<b>Product description</b>	
Diverting agent		10% v/v	Viscoelastic surfactant	
Hydrochloric acid 32%		10% m/m	Inorganic acid	
Water		QSP	Diluent	
Corrosion inhibitor		1% v/v	Amine-based corrosion inhibitor	
Emulsion preventer		0,2% v/v	Isopropanol + quaternary ammonium salt surfactants	
Viscosity breaker		0,2% v/v	Ethoxylate, paraffin and mineral oil mixture	
<b>Aqueous Solution XVII, HCl 5% m/m - Polymer-based acid system as a diverter</b>				
<b>Product</b>		<b>Concentration</b>	<b>Product description</b>	
Friction loss reducer		2% v/v	Hydro soluble polymer	
Hydrochloric acid 32%		15% m/m	Inorganic acid	
Water		QSP	Diluent	
Corrosion inhibitor		1% v/v	Amine-based corrosion inhibitor	
Emulsion preventer		0,2% v/v	Isopropanol + quaternary ammonium salt surfactants	
Temperature activated polymer breaker		1% m/v	Calcium peroxide	
Viscosifying		5% v/v	Hydrosoluble polymer	
Crosslinker agent		0,2% v/v	Inorganic salt	

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<b>Aqueous Solution XVIII, Emulsified HCl 15% m/m acid system as main product:</b>			
<b>Product</b>	<b>Concentration</b>	<b>Product description</b>	
Hydrochloric acid 32%	15% m/m	Inorganic acid	
Water	QSP	Diluent	
Diesel		Aliphatic solvent	
Corrosion inhibitor		Amine-based corrosion inhibitor	
Iron Scavenger		Chelating agent	
Emulsifier		Surfactant	
Friction loss reducer		Oil base friction reducer	
<b>Aqueous Solution XIX, with Acetic Acid 13% m/m, Formic Acid 9% m/m and HF 1,5% m/m as main products:</b>			
<b>Product</b>	<b>Concentration</b>	<b>Product description</b>	
Acetic acid 98%	13% m/m	Acid	
Formic acid 85%	9% m/m	Acid	
Hydrofluoridric Acid Water	1,5% m/m	Acid	
Water	QSP	Diluent	
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor	
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants	
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants	
<b>Aqueous Solution XX, with Acetic Acid 20% m/m and HF 1,5% m/m as main products:</b>			
<b>Product</b>	<b>Concentration</b>	<b>Product description</b>	
Acetic acid 98%	20% m/m	Acid	
Hydrofluoridric Acid	1,5% m/m	Acid	
Water	QSP	Diluent	
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor	
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants	
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants	
<b>Aqueous Solution XXI, with HCl 15% m/m and HF 1,5% m/m main products:</b>			

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Product	Concentration	Product description
Hydrochloric acid 98%	15% m/m	Acid
Hydrofluoridric Acid		Acid
Water	QSP	Diluent
Corrosion inhibitor	1% v/v	Amine-based corrosion inhibitor
Emulsion preventer	0,2% v/v	Isopropanol + quaternary ammonium salt surfactants
Surface tension reducer	0,1% v/v	Ethoxylate + quaternary ammonium salt surfactants

## 5 OPERATION CONDITIONS

The presented frequency and pumping time for each type of treatment may vary depending on well conditions. The values below must be considered as a reference based on usual Petrobras operations and/or estimates, considering an average pump rate for usual pumped volumes.

Operation Type	Operational parameters (per well)				
	Pumping time (h)	Well cleanup (h)	Frequency (jobs/year)	Pumping Temperature (°C)	Pressure (psi)
Carbonate Scale Removal	12	24	2	25 - 30	4000
Sulfate scale removal					
Organic deposits removal					
Carbonate scale Inhibition					
Sulfate scale Inhibition					
Reservoir Stimulation Solutions	15	48	0,5	25 - 30	4000