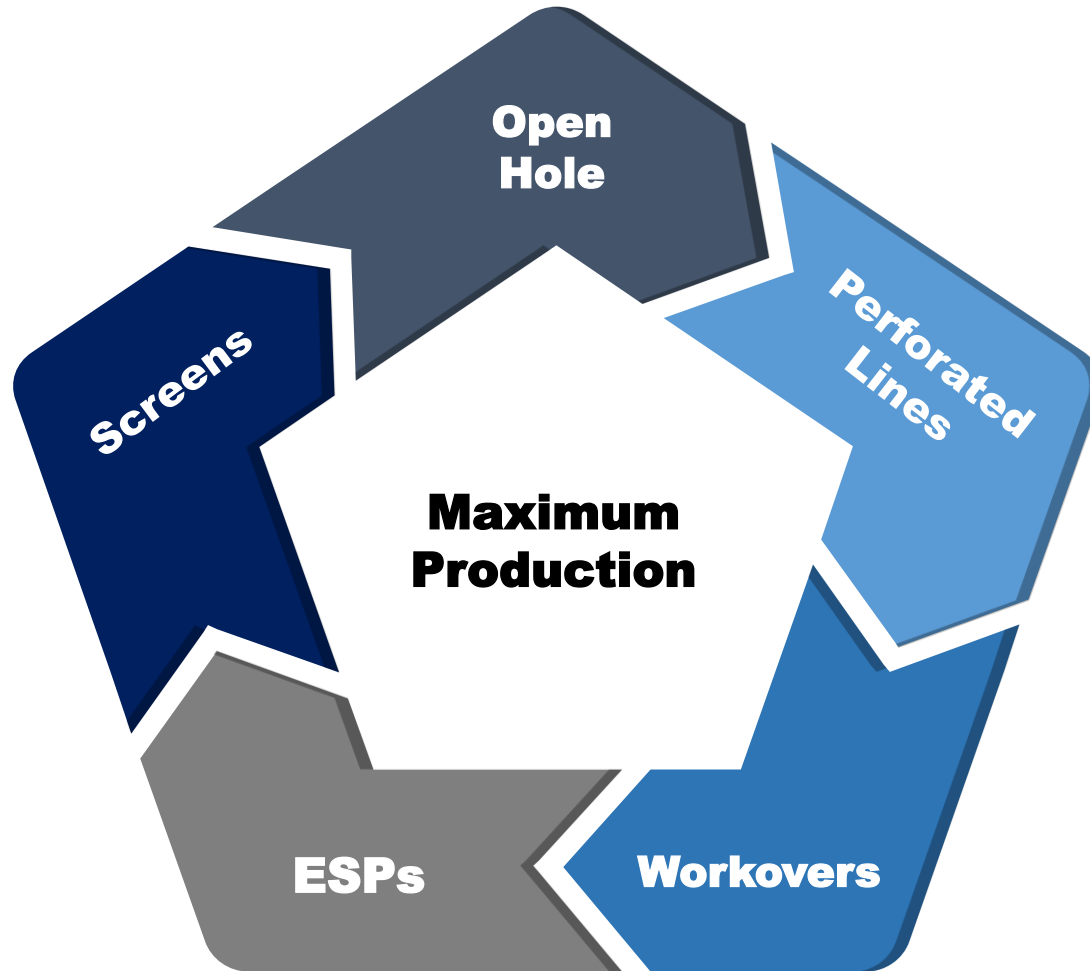


Well Bore Recovery Stimulation, Descaling, Wax Dissolving, Corrosion, Scale, And Wax Inhibition



Innovative Chemical Solutions
for Drilling, Completion, & Workover Wells

Common Well Problems

Natural damages include

- Fines migration
- Swelling clays
- Water-formed scales
- Organic deposits (wax or asphaltenes)
- Mixed organic/inorganic deposits
- Emulsion blockage / change of wettability

Induced damages include

- Drilling fluids either by chemical interaction of entrained solids.
- Plugging by entrained particles such as solids or polymers in injected fluids.
- Wettability changes caused by drilling, stimulation, or injected fluids, i.e., Emulsion Blockage

Well Integrity



- Leaking packers, casing, tubing
- Sustained Casing Pressure (SCP, HAP)
- Micro-annulus sealing
- Zonal isolation
- Water or gas shut-off
- P&A

More often than not, well damage is a result of a combination of the above problems and not just one single problem

SPE Papers by Operators about HDC Mk II™

BP UK

SPE 120762 -Recovery of an Oil Producer Severely Damaged by OBM....

After two failed acid/nano wash treatments, HDC Mk II™ increased production from 400 blpd to 4000-6000 blpd.

Shell Nigeria

SPE 199301-MS - A Novel Approach to Salvaging Well Completions with Mud Damage..

2 gas wells. After 3 failed acid jobs in each, HDC Mk II™ increased gas production 375%. In the paper, HDC Mk II™ is referred to as a “non-damaging stimulation fluid”.

ExxonMobil Research

SPE/IADC 105567 - Improved Method for Use of Chelation to Free Stuck Pipe....

Lab tests to increase permeability in a filtercake. The HDC Mk II™ is Agent A, the most effective, increasing permeability in a NAF (SBM) filtercake over 850 fold.

Aramco Labs

SPE 86501 - Evaluation of a New Barite Dissolver

Written by Al-Nasr, at the time the Head of Aramco Laboratories. “These tests were conducted using sandstone cores obtained from a deep gas well (300°F)”
Concluding “Only dissolver A was able to remove the damage induced by the drilling fluid. The new chemical does not require long soaking times.”

Stimulation

1. An effective combination has been a 2 stage treatment of **PentaFlow** and **HDC Mk II™**. (Other combinations may be used depending on the specifics of the well.)
2. Products can be deployed with rig, CT, or bull-headed depending on the well specifics and or equipment availability. Many jobs are bull-headed.
3. **The technique is pump and soak typically over a 24 hour period.**
4. Products are effective, non-corrosive, multi-functional, environmental benign, and safe to handle.
5. Both products have been / are Gold Banded in the UK CEFAS system.

Major Operator Malaysia

Stimulation

FIELD	WELL	PRODUCT	WELL PROBLEMS	SOLUTION	RESULTS
PMO	A	HDC Mk II + PentaFlow	Barite Problems. Well 10 MMscfd production. Treated with acid with well going to 0 MMscfd after acid treatment	Soaking with HDC Mk II for 26 hours	Well flowing 19 MMscfd after treatment with HDC Mk II (7 MMscfd with 19% choke)
PMO	B	HDC Mk II + PentaFlow PowerPickle	Skin damage during completions. Never produce.	Soaking with PowerPickle + PentaFlow + HDC Mk II for 26 hours	Well flowing 11 MMscfd after treatment with HDC Mk II
PMO	C	HDC Mk II + PowerPickle	OBM (barite) problem. 25 mmscfd production	Soaking PowerPickle + HDC Mk II for 26 hours	Well flowing 45 MMscfd after treatment with HDC Mk II
PMO	D	HDC Mk II + PentaFlow	Skin damage from barite. No oil production for 2 years	Soaking with PentaFlow + HDC Mk II for 28 hours	Well flowing to 813 bpd (150 bopd) after treatment with HDC Mk II
SBO	E	HDC Mk II + PentaFlow	Skin damage during workover (excessive lost circulation material). Unsuccessful acid job. Production 120 bpd	Soaking thru annulus bypass ESP for 48 hours with PentaFlow and HDC Mk II	Well flowing to 650 bpd after treatment
SBO	F	HDC Mk II + PentaFlow	Expected skin damage from excessive LCM. Production 40 bbls/d and declining (with 47% watercut).	Soaking with mixture of PentaFlow and HDC Mk II for 3 weeks due mechanical issue (typical programmed time 20-30 hrs, but having issue POOH plug)	Well flowing to 968 bbls/d after treatment with 5% watercut

Well F was awarded the **Production Success Story of the Year**

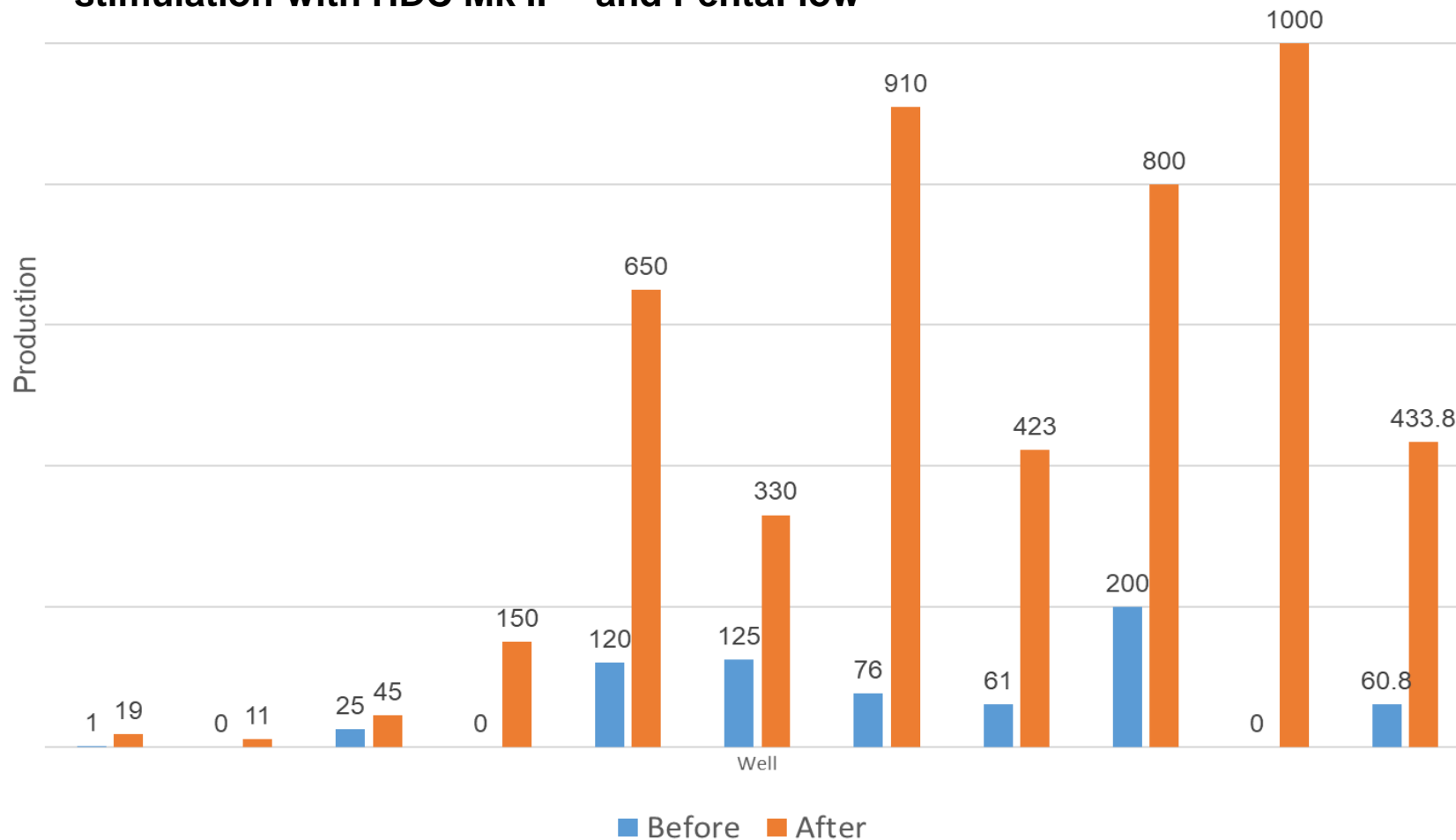
Major Operator Malaysia

FIELD	WELL	PRODUCT	WELL PROBLEMS	SOLUTION	REMARKS
SBO	G	HDC Mk II + PentaFlow	Expected high skin to unknown nature of well damage. Production 76 bbls/d with 96% watercut	Soaking with mixture of PentaFlow and HDC Mk II for 48 hours. Expected increasing in production after flowback.	Still haven't been well tested due to operational issue.
SBO	H	HDC Mk II + PentaFlow	Expected skin damage from operational in 2008. (LCM) Production 160 bbls/d with 75% watercut	Soaking with mixture of PentaFlow and HDC Mk II. Still in soaking condition till date.	Due to issue on surface gas lift compressor. The well still under vacuum.
PMO	I	OrangeWorks (CutClean)	Wax build-up. Production at 1800 bpd	Soaking with OrangeWorks solution with 48 hours. OrangeWorks did not give any damage to wireline tool.	OrangeWorks prevents wax reforming after 24 hours shut in. Production increase from 1800 bpd to 2000 bpd
SBO	J	HDC Mk II + PentaFlow	Near wellbore formation damage at sand face (K5.0 zone). Production 125 bbls/d with 75% watercut.	To remove near wellbore formation damage at sand face or GP. During actual treatment, soaking well with mixture of PentaFlow and HDC Mk II for 48 hours.	Well flowing to 330 bbls/d after treatment with 65% watercut
SBO	K	HDC Mk II + PentaFlow	Near wellbore formation damage at sand face (K5.0 zone). Well idling for almost 2 years. Production record 76 bbls/d with 45% watercut.	To remove near wellbore formation damage at sand face or GP. During actual treatment, soaking well with mixture of PentaFlow and HDC Mk II for 48 hours.	Well flowing up to 910 bbls/d after treatment with 57% watercut

Major Operator Malaysia

FIELD	WELL	PRODUCT	WELL PROBLEMS	SOLUTION	REMARKS
SBO	L	PowerPickle	Wax buildup. Production at 500 bpd with 80% watercut (100 bpd)	Dissolve wax with PowerPickle	Well flowing at 918 bpd at 74% watercut (236 bpd)
SKO	M	HDC Mk II + PentaFlow	Struggling in producing since completing the well. Suspected near wellbore damage. 61 bpd with 81% WC	Soaking with mixture of PentaFlow and HDC Mk II for 48 hours	Production increased to 423 bpd with 59% WC. (May 2013)
SKO	N	HDC Mk II + PentaFlow	Struggling in producing since completing the well. Suspected near wellbore damage. 5.7 bpd with 5.1% WC. Have issue with tubing leak (high CHP) during pumping.	Soaking with mixture of PentaFlow and HDC Mk II for 48 hours with adjusted pumping sequence/rate	No well test data due to surface valve malfunction. Early observation, THP increase to 800 psi from 0 psi . Well flowing with high oil content fluid. (May 2013)
SBO	O	HDC Mk II + PentaFlow	Well completed w/ GP and premium screens. Suspected near wellbore damage. 200 bpd with 0%WC.	Soaking with mixture of PentaFlow and HDC Mk II for 48 hours	Production increased to 800 bpd with 0% WC.
PMO	P	PowerPickle	Wax buildup. 458.5 bpd with 65.72% WC	Soak with PowerPickle for 24 hrs.	Production increased to 720.37 bpd with 75.66% WC
PMO	Q	HDC Mk II + PentaFlow	121 bpd with 70% watercut.	Soak with 60 drms each of PentaFlow and HDC Mk II for 24 hours.	Production increased to 203 bpd with 75% watercut.
PMO	R	HDC Mk II	Well suddenly died due to scale (suspected barium scale) build up at gas lift valve.	Pumped pickling fluid and followed by soak 78 drms of HDC Mk II for 24 hours.	Production revive to original 1000 bpd via gas lift assisted.

Over 600% average increase in production for wells in stimulation with HDC Mk II™ and PentaFlow



In addition, over 25 screened wells have been treated with HDC Mk II™. By dissolving the filtercake behind the screen, production was seen to be increased 2-3 times.

HDC Mk II™

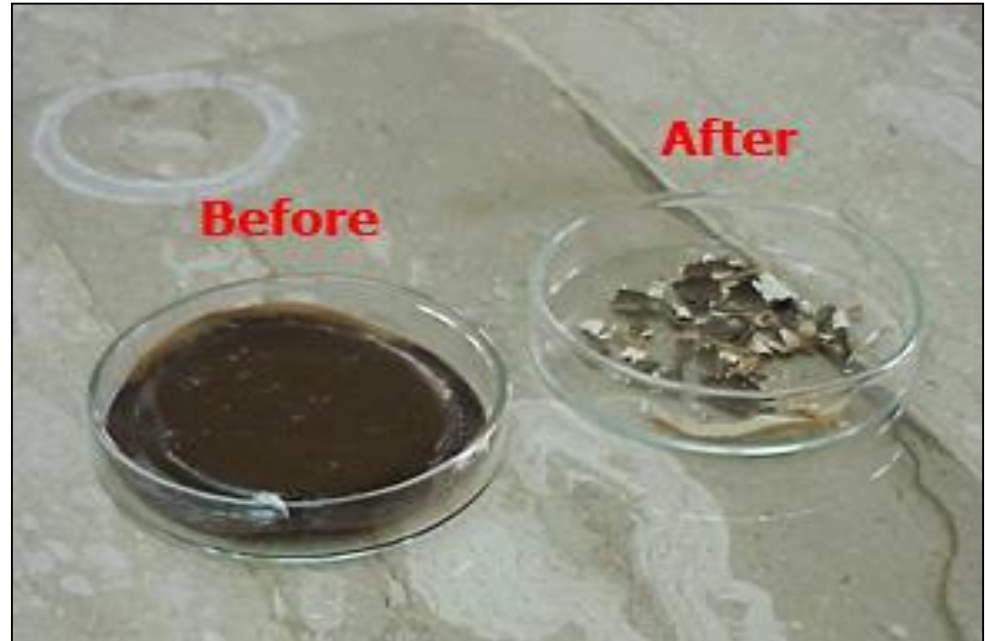
- ❑ Non-damaging stimulation fluid and powerful descaler
- ❑ A mix of chelating agents with catalysts and reaction accelerators
- ❑ Dissolves Barite, Calcium Carbonate, Strontium Sulphate , Calcium Sulphate, cellulosic LCM
- ❑ No precipitates or gaseous by-products
- ❑ Non corrosive
- ❑ Leaves surfaces water wet
- ❑ Alkaline solution (pH ~12.5) and 1.31 SG
- ❑ Environmentally benign
- ❑ Safe to handle
- ❑ Tends to de-emulsify and inhibitive to clays
- ❑ Non formation damaging (Hisham's SPE paper)



HDC Mk II™

Lab test by Shell Nigeria

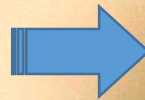
- ❑ After 6 hours soaking at 90°C, filtercake is 96% dissolved.
- ❑ HDC Mk II™ works equally well for WBM filtercakes



A chelant works by physically attaching itself to a metal ion (Ba, Ca, Mg, etc.) with two or more bonds thereby making it unavailable to react with other elements or compounds.

**Typical Barium Sulphate
scale (BaSO₄) in the tubing**

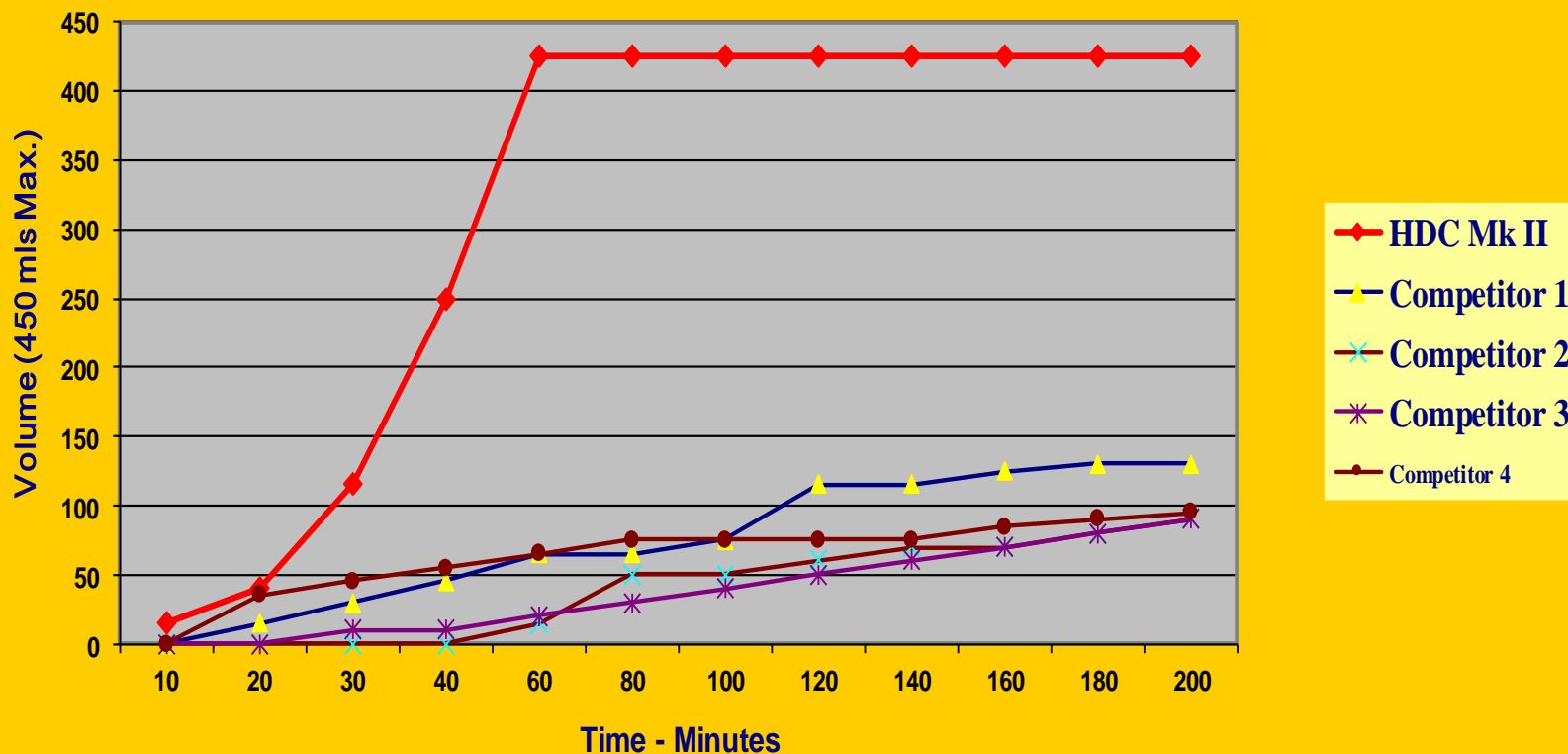
**13,000' of this level of
barium scale in 3 ½" tubing
can weigh up to 103 tonnes**



Treated with HDC Mk II™

BP Sunbury Results

OBM Filter Cake Breakdown - Volume Flow Through vs Time @ 250 deg. F



Not All Chelating Agents Are Created Equal

It is an increasing trend for companies to state they use chelates and even multichelates. Malic acid, tartaric acid, citric acid, NTA, HEIDA, HEDTA, EDTA, CyDTA, GLDA, and DTPA amongst others are chelants. They have been around for many years. What has prevented widespread adoption is these compounds exhibit a **low capacity** and dissolution rates **too slow** for the industry, but nevertheless are now being marketed for use. HDC Mk II™ dissolves 84 grms/ltr. DTPA, GLDA, and EDTA, the most powerful chelants in the market, dissolve a bit less than 30 grms/ltr, and are much slower.

HDC Mk II™ is the result of a 4 yr development project with the sponsorship of Amerada Hess and BP with multiple chelating agents, catalysts and a reaction accelerator that increases the speed over 10x, and the dissolve capacity 4-6x that of off-the-shelf chelants.

HDC Mk II™ vs HCL (Acids in General)

Acid first used in **1895**. Since, the improvements in the technology have been mainly with the corrosion inhibitors allowing a higher concentration of acid.

Historically, acids have shown a 32% failure rate

Corrosion inhibitors, clay inhibitors, de-emulsifiers, CaSO₄ scale inhibitors, iron control agents are used in acid jobs. **None of these chemicals are included to HELP your well, but to counteract the damage acid does to the well.**

- ☐ **HCL changes wettability thus causing emulsion blockage.**
- ☐ Creates fluorosilicate precipitates with Feldspars, Carbonates, and most clays.
- ☐ HCL causes carbonate liquefaction (softening), clay hydration and particle migration
- ☐ HCL is highly corrosive
- ☐ HCL can cause CO₂ and H₂S release
- ☐ HCL requires poses a significant HSE hazard

HDC Mk II™ causes NONE of the above problems

SLB Patent Application US7,192,908 B2

Composition and Method for Treating a Subterranean Formation

- With HCL and HF...dissolution is so rapid...is spent in...a few inches.
- These reactions produce solids...which can damage the formation...
- Chelating...based on EDTA have been used..to control iron precipitation and dissolve scale.
- In scale removal, high decline rates followed HCL treatments, but wells treated with EDTA maintained production.
- Sandstone matrix “stimulation” is often ineffective and...damaging.
- There is a need for fluids....that will not damage sandstone formations.
- A serious problem with mud acid is that when it contacts calcium ions, CaF_2 is precipitated.
- Re-precipitation...is responsible for much of the damage observed in sandstone matrix stimulation. Furthermore...will slow or stop the dissolution.

This excerpt is from SLB's online Oilfield Glossary.

A chemical used to bind metal ions to form a ring structure. Chelating agents stabilize or prevent the [precipitation](#) of damaging compounds. In the oil [field](#), chelating agents are used in [stimulation](#) treatments and for cleaning surface facilities. They are also used to treat or remove [scale](#) or weighting agents in [reservoir](#) drilling fluids. During [acid](#) or scale-removal treatments, various compounds may be dissolved in the [treatment fluid](#). As the acid reacts and the [pH](#) increases, reaction products may [precipitate](#) as a gelatinous, insoluble mass. Should this occur within the [formation matrix](#), it is almost impossible to remove and permanent [permeability damage](#) may occur. Chelating agents prevent precipitation by keeping ions in a soluble form until the treatment fluid can be flowed back from the formation during [cleanup](#).

HCL and HF

Feldspar

Contain sodium and potassium. The major concern is **fluosilicate precipitate**. K-Spars cause the most precipitation problems.

Zeolite

Ion-exchanging and **unstable in HCl**. It often contains sodium which can cause **fluosilicate precipitation** from spent acid.

Mica

Ion-exchanging and **unstable in HCl**. It contains potassium which can cause **fluosilicate precipitation** from spent acid.

Chlorite

Ion-exchanging and **unstable in HCl**.

Smectite

An ion-exchanging mineral that **swells** in fresh water.

Kaolinite

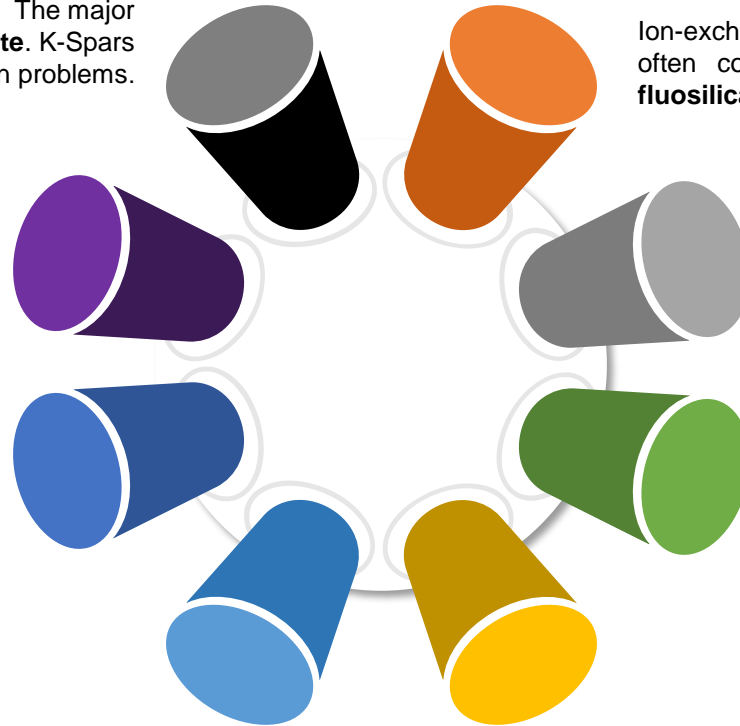
Causes **fines migration** problems. It disperses in fresh water and causes plugging.

Illite

Causes **fines migration** problems and is ion-exchanging. It contains potassium which can cause **fluosilicate precipitation** from spent acid.

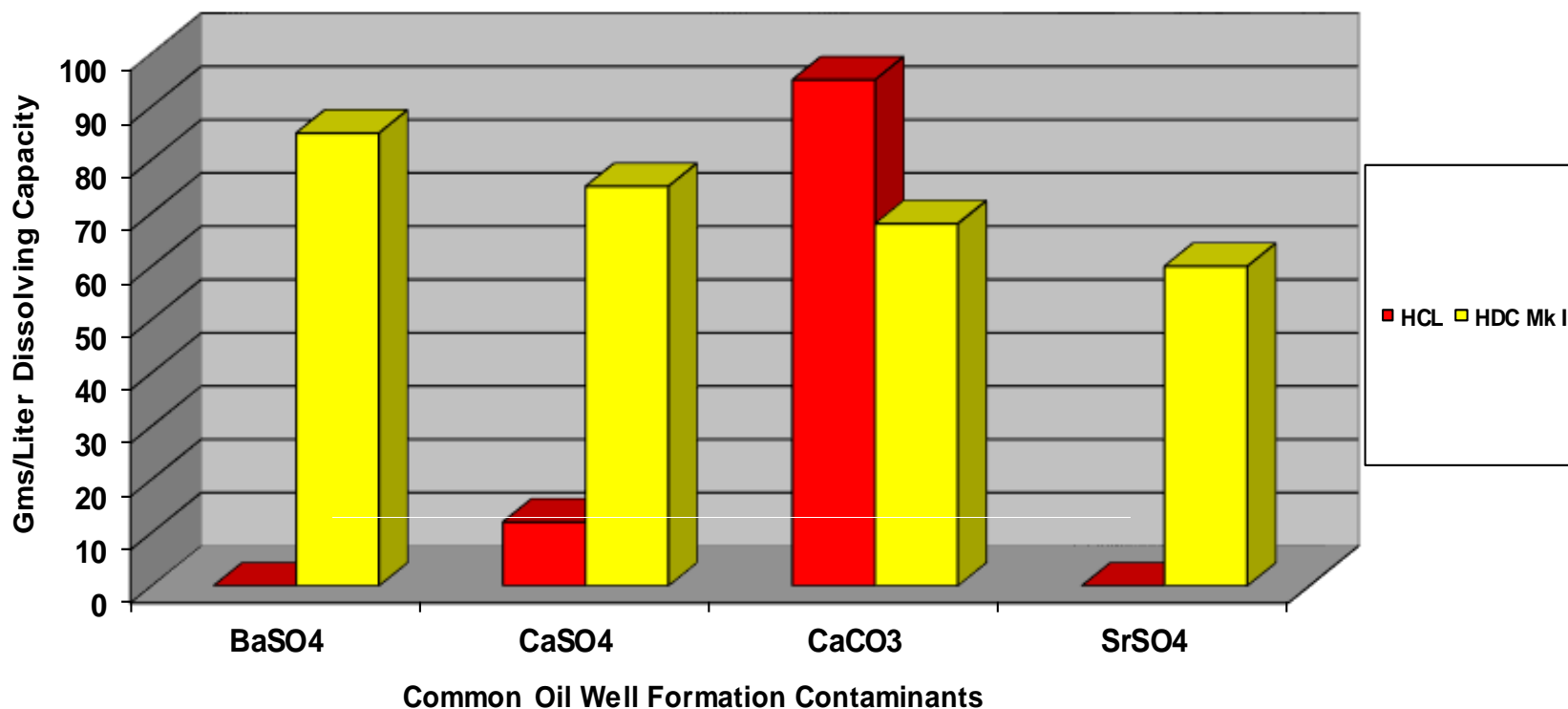
Carbonate

Consumes HCl and can cause **precipitation of fluosilicates and aluminum** from spent acid.



HDC Mk II™ vs HCL

HDC Mk II vs 18% HCL - Dissolving Properties



PentaFlow - A Chemical Shotgun

Multipurpose product containing:

- Solvent/surfactant to dissolve asphaltenes, waxes, and oil
- Dissolve emulsion blockages
- Organic acid to dissolve CaCO_3
- Clay inhibitor to break up compacted clays and surfactant to disperse clays
- Mildly corrosive
- Leave all surfaces water wet

PentaFlow was used about a year ago by BSP to dissolve a severely restricted pipeline at PID0334 pipeline

HDC Mk II™ for Differential Sticking

HDC Mk II™ was originally developed as a stuck pipe pill for differential sticking in an SBM/OBM. It works in WBM too. Currently, there are no effective stuck pipe agents for SBM/OBM. Current options are to circulate a base oil pill to decrease the hydrostatic, jar, and hope it comes free. Or try a surfactant pill to disperse the filter cake. Both are weak responses. By dissolving the filtercake, pressures are equalized and the pipe is freed.



SPE/IADC 105567

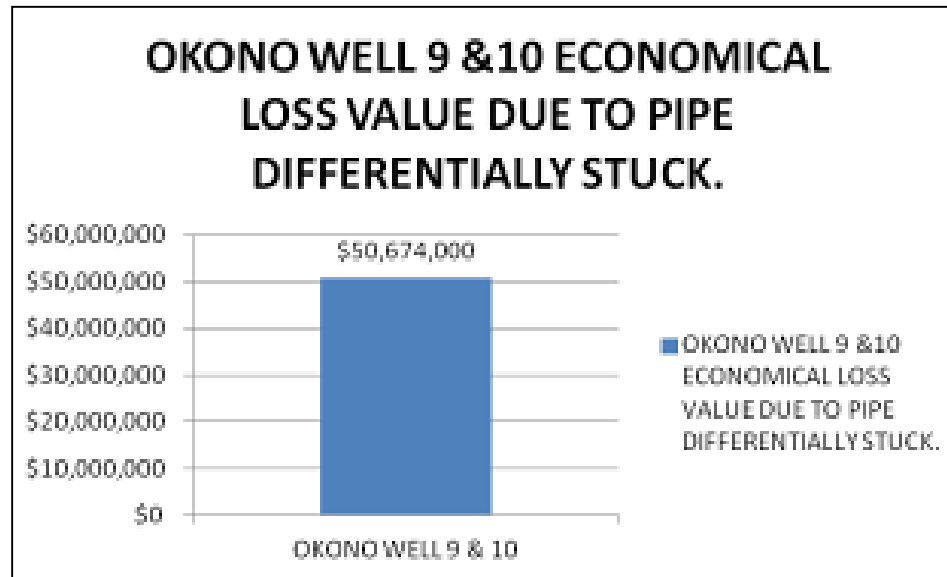
Improved Method for Use of Chelation to Free Stuck Pipe and Enhance Treatment of Lost Returns

John K. Montgomery, Stuart R. Keller, SPE, Nancy Krahel, ExxonMobil Upstream Research Company and Martin V. Smith, SPE, ExxonMobil Development Company

“....increased the permeability of a NAF filter cake 850 times. NAF's are well known for their ability to deposit thin, low-permeability filter cakes that reduce the risk of differential sticking. Yet, differential sticking still occurs and techniques to free the pipe have largely been ineffective.”

Stuck Pipe is the largest cause of NPT for drilling worldwide.

In the paper below, getting differentially stuck in 2 horizontal wells cost the operator an additional US\$ 50 million dollars.



Evaluation of Differential Pressure Sticking and Stuck Pipe in Oil and Gas Drilling Technology and Its Production Operations

Ekun S. Kayode, Oguogho Lami, Ambrose Alli University, Nigeria, 2020

Drilling Contractor's Statistics state...

"If a good chemical contingency is on board, you have a chance.

If you don't ...there's less than 10% chance....."

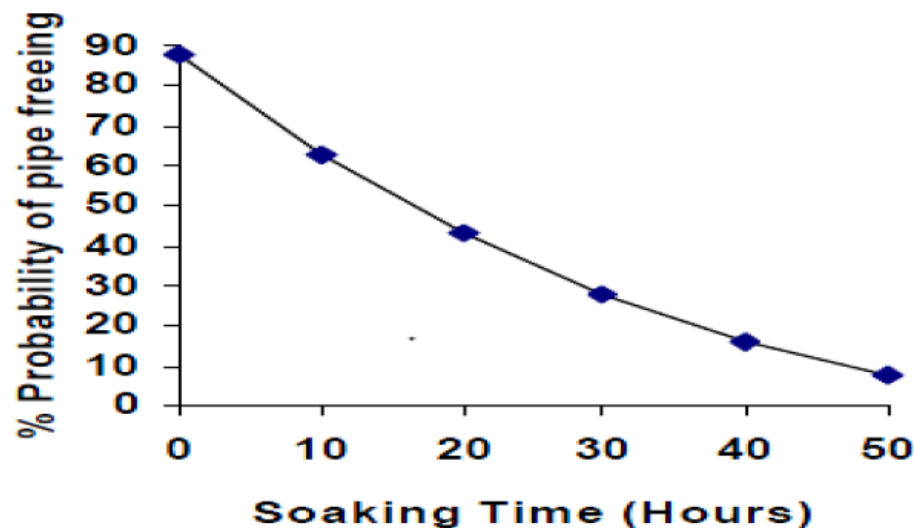


Fig 3. The graph of probability of pipe freeing against soaking time

Differentially stuck pipe becomes more stuck with time. It is important to spot the PRA as quickly as possible.”

Under static conditions, the rate of solids deposition increases which leads to a filtercake increase.

This is significant. The stuck pipe along the length of the DP/DC grows with time. That is why it is imperative to keep the stock on the rig site. If you wait for it to arrive in a day or two, it is too late.

Most of the industry believes there is no PRA for SBM/OBM fluids. There is.... HDC Mk II™

Pyrosol ES and PentaFlow

Iron Sulphide Scale Dissolving

The ESP had CaCO₃, Asphaltenes, Compacted Clays, and Iron Sulphide scale



We have treated hundreds of scaled ESP's insitu

Pyrosol ES

Scale Dissolving



The screen on the left was **100% blocked with:**

Asphaltene material – 30%

Iron Sulphide scale – 45%

Barium Sulphate scale – 25%

The same screen after a pre-flush with PowerPickle followed by low temperature (60°C) soak in **Pyrosol ES**

Results:

60 minutes - Inner Barrel cementation dissolved

120 minutes - 85% screen aperture clearance

180 minutes - 95% screen aperture clearance



Pyrosol ES - What is it ?

- **A mix of chelating agents with catalyst**
- Dissolves **Iron Sulphide** (FeS is the second most common scale), Calcium Carbonate, Strontium Sulphate, Calcium Sulphate
- Slightly acidic solution (pH ~5.5) and 1.15 SG
- Environmentally benign
- Safe to handle
- Non corrosive
- Tends to de-emulsify and inhibitive to clays
- Non formation damaging
- Gold Banded in UK CEFAS environmental ratings

HDC Mk II™, Pyrosol ES, PentaFlow

- Recover Damaged Wells
- Screen Recovery
- Formation De-Scaling
- Tubing, Valve, ESP, Pipeline De-Scaling
- Free Stuck Pipe (both HDC Mk II and PentaFlow have been successfully use for differentially stuck pipe.)
- Ideal Perforation Fluid (HDC Mk II)
- Dissolve wax and asphaltenes

PRODUCT	BENEFIT
PentaFlow	Dissolves asphaltenes, waxes, etc. Dissolves emulsion blockage Water wet all surfaces Dissolves CaCO ₃ Dehydrate Clays
HDC Mk II	Dissolves Barite and other sulphate compounds Dissolves CaCO ₃ and other carbonate compounds Dissolves 2-4 g/l of clay Dissolves cellulosics Tends to de-emulsify
Pyrosol ES	Dissolves Iron compounds including FeS Dissolves CaCO ₃ and sulphate compounds Tends to de-emulsify

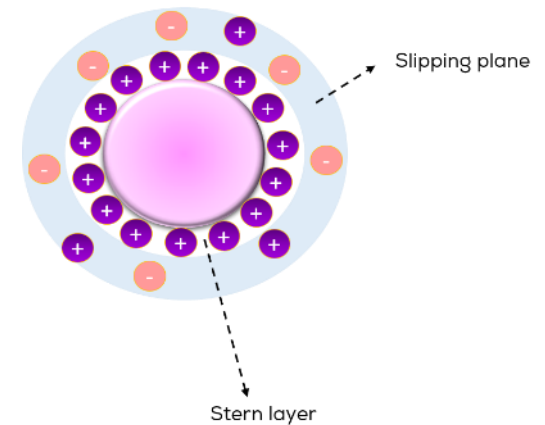
Scale and Wax Dissolving

ISSUE	PRODUCT
CaCO₃ Scale	PentaFlow, HDC Mk II, Pyrosol ES
Iron Sulphide	Pyrosol ES
Barium Sulfate	HDC Mk II
Wax, Asphaltenes	PentaFlow, OrangeWorks, PowerPickle, PMI-107
Wax and Corrosion Inhibition	PMI-107 (optional to add in an H ₂ S scavenger also, as PMI-107FA)

SandBar – the solution for Sand Production

SandBar, a unique, patented sand agglomeration chemical that when added to aqueous solutions, it rapidly **coats the solid particle surface** (metal oxides or anionic substrates like sand and formation fines). **SandBar** changes or **alters** the **Zeta Potential** of solid surface to an optimum range, hence providing an **ionic bond** between the particles and optimally aligning the sand particles. It also typically results in a higher permeability.

- ❑ Alters the zeta potential of solid surfaces to the **optimum range (between -20 & +20 mV)**
- ❑ Creates an **uneven or random charge distribution** on the surface of the solid particles.
- ❑ Promotes an environment of agglomeration with the sand and formation fines to prevent migration.
- ❑ Agglomerated material stays in the formation.



SandBar– Advantages

- ☐ Increases the maximum sand free rate (MSFR)
- ☐ Remains ductile **SandBar** does not risk damage to permeability like resin
- ☐ Minimizes/stops fines migration
- ☐ Leaves the formation water wet
- ☐ Does not reduce permeability (k)
- ☐ Re-treatment will not cumulatively reduce k
- ☐ Easy to apply
- ☐ Allows longer zones to be treated
- ☐ Superior alternative to resin treatments
- ☐ Unlike resins **SandBar** can effectively be used on long intervals

When **SandBar** is squeezed into the near wellbore it decreases fines migration and to increases the MSFR.

SandBar coats the sand aligning the particles to produce maximum permeability and eliminating sand production. Results also indicate it reduces water production while increasing flowrate of oil and gas.

Pretreatment Considerations

SandBar Formation Cleaner

A surfactant blend that removes oily residues, synthetic fluids, disperses oil and oil-coated solids thoroughly and completely, leaving a water wet surface after displacing, with no oily residue.

SandBar Acid Surfactant

A hydrolysing material that can be used to dissolve any calcium carbonate scaling should that be a possibility.

Microemulsion Technology to increase production in new or existing wells

Whilst nano technology emerged in the O&G industry as providing some significant advantages, it is now recognized by many that microemulsions have some advantages over nanoemulsions.

Microemulsions (ME) are thermodynamically stable o/w emulsions of mean droplet size approximately 100–400 nm, whereas nanoemulsions are thermodynamically unstable o/w emulsions of mean droplet size approximately 1 to 100 nm. In sum, ME's have a higher emulsion stability, produce excellent product distribution to the target area, and result in a pronounced breaking effect, amongst other advantages.

All of these different modes of action work together in a collaborative and synergistic way during the soak period to break down all the various commonly encountered damage mechanisms that might be present in any filter cake, skin damage and/or near wellbore damage, so all is dissolved and removed when circulated back to surface leaving the whole near wellbore region completely clean and basically in it's virgin state ready to produce again with no forms of blockage (damage) in the way.

Microemulsion Technology to increase production in new or existing wells

Using advanced surfactants, a variety of other chemicals can be used to produce ME's to solve many well problems, such as:

- Filtercake removal
- Stimulation
- Wax Dissolving
- Scale Dissolving
- Wax and Scale inhibition
- Reduce viscosity in crude oil
- Clean and prevent blockages in transfer stations
- Maintain flow assurance in wells, pipelines and pigging operations

Example: By using ME technology, the surfactants can be combined with an acid pre-cursor. When pumped to the target area, it will penetrate further into a reservoir than acid typically can, and combined with the advanced surfactant it ensures the formation stays waterwet (acids affect wettability and can cause emulsion blockages). And unlike acids, the surfactant fraction removes any oil coating on particles allowing the acid to work (acids alone cannot penetrate oil coatings).

Microemulsion Product Lines

Filtercake Removal

- SAS Breaker 162B
- SAS Breaker 162BB
- SAS Breaker F
- SAS Breaker A

Well Stimulation

- SAS Breaker 162SC

Chelating Agent

- SAS Breaker D

Catalyst

- SAS Breaker C

Wellbore Cleanup

- SAS Wellbore Clean 116 SC
- SAS Wellbore Clean 135 SC

Scale Removal & Treatment

- SAS Micro Clean J

Well Integrity Issues

Liquid Bridge Plug™

An Epoxy Resin System Used For Well Integrity

- Leaking Packers
- Leaking Casing or Tubing
- Sustained Casing Pressure (SCP) or HAP
- PNA



As LBP is immiscible in water and oil, many of the applications can be simply ***pumped into the wellhead and gravity dropped onto the problem***, a leaking packer or TOC for SCP problems.

Setting times can be either ***retarded or accelerated*** depending upon the dictates of the job. Typical timeframe is 24 hours.

Liquid Bridge Plug™

for leaking Packers, Casing, Tubing, SCP

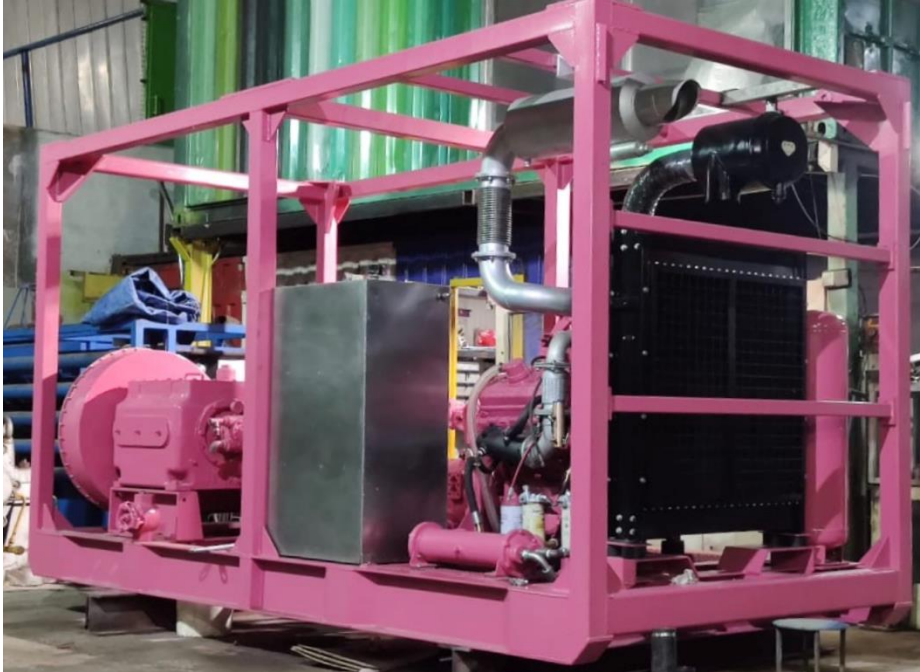
- Non-shrinking
- Not miscible in water or oil
- Not affected by CO₂ or H₂S
- Impermeable to gas
- Stable from 50°F to 550°F
- Over 200 times the tensile strength of cement
- 4 times the bonding strength of cement
- 4 times the compressive strength of cement
- Exothermic
- Can be weighted up with barite/silica flour
- Solids free (unless weighted)
- Multiple Patents

Liquid Bridge Plug™ – Materials

Products / Components	LIQUID BRIDGE PLUG (RESIN SYSTEM)
Liquid Bridge Plug Part A	Generically, Base Epoxy Resin. A special epoxy resin tailored for oil well applications. The material's viscosity has been lowered to +/- 250 cps to provide easy mixing and placement. The lowered viscosity is accomplished without associated volumetric shrinkage usually accompanying thinning of epoxy resin.
Liquid Bridge Plug Part B LT	Generically, Low Temperature Initiator. Product with ability to achieve hardening to temperatures as low as 10°C (50°F) in a controllable fashion without shrinking.
Liquid Bridge Plug Part B HT	Generically, High Temperature Initiator. Product with ability to achieve hardening to temperatures as high as 205°C (400°F) in a controllable fashion without shrinking.
PowerSurf	Generically, Surfactant for Resin Systems. A surfactant to clean equipment at the completion of a resin operation. Is non-ionic and compatible with anionic, cationic, other non-ionic additives
Barite	Locally sourced. Made to API Specification 13A.

Surface Mixing Tank

Small Volume



High Pressure Triplex
Pump ↑

Diaphragm Pump

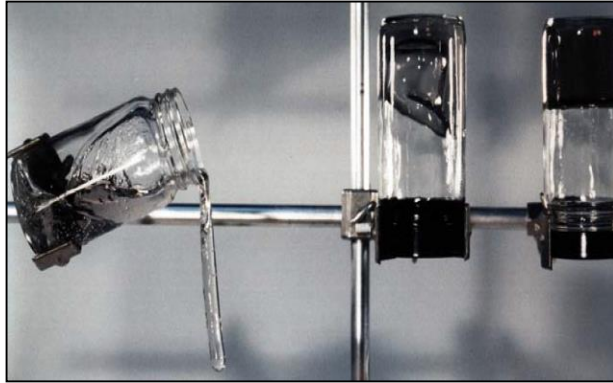


Poly Plug®

Cross-linked Polymer

Applications:

- Water & Gas shutoff
- Loss circulation
- Stabilize formations
- Casing leaks
- Perforation abandonment
- Gravel pack isolation
- Zonal abandonment



Waiting time to set up typically 4-8 hours, can be adjusted. Any left in the wellbore is simply washed out, no drilling necessary.

To-date, 17 wells treated for PTTEP Thailand for lost circulation when LCM and cement would not work.

Poly Plug®

Cross-linked Polymer

Poly Plug® is formulated with a high-molecular weight anionic polymer that produces a rigid, robust gel structure ideal for water or gas shutoff treatments into fractures, vugular, and high permeability formations.

Benefits:

- Total shut-off squeeze treatments that effectively seal off water or gas
- Effectively seals fractures, vugulars, weak zones, flowing, over-pressured zones
- Single sack product, pre-blended for ease of mixing
- Can be mixed and placed with standard rig equipment or cement blender
- Can be pumped through the bit, mud motors and MWD/LWD tools
- Does not harden sufficiently to stick pipe or side-track, so there is never a drill out problem
- Insensitive to CO₂ or H₂S
- Effective temperature range from 60°F to 400°F (205 °C)

Ultra Spacer

A cement spacer that prevents lost circulation

- ❑ **Ultra Spacer®** is a blend of functionalized polymers and bridging agents. **Ultra Spacer®** creates a barrier against the borehole wall, preventing penetration of fluid into the formation.
- Low rheology cement spacer that controls fluid loss to the formation, allowing cement to be circulated to higher depths
- Density & Rheology Controllable
- Prevents Fall Back and Lost Circulation
- Enhances removal of drilling fluids from the wellbore for a better cement bond
- ❑ **Ultra Spacer®** is mixed in a concentration of 15 lbs per 42 gallons of water. For cases in which fluid loss can be total and severe, **Ultra Spacer® Plus** LCM can be added to the spacer mix to enhance fluid loss prevention.

Ultra Spacer

A cement spacer that prevents lost circulation

Ultra Spacer® performs all regular cement functions with additional benefits such as:

- Compatible with 99% of the market's cement slurries and drilling fluids
- Incredible fluid loss properties for aiding in loss circulation
- Reduces formation damage from cement filtrate
- Prevents cement fallback to achieve higher tops of cement
- Temperature stable to 400°F
- Density controllable

78 wells treated so far with PTTEP Thailand

Over 2,000 wells treated worldwide

Ultra Seal Loss Circulation Products

A very wide variety of LCM and Wellbore Strengtheners

Ultra Seal® Plus is a blend of Ultra Seal® XP, Ultra Seal® C and additional sealing agents, **Ultra Seal® Plus** large particle array establishes a stronger initial bridge across the thief zone. The inclusion of these larger particles results in effective control of rigid type fractures, vugular, or unconsolidated formations possible.

Ultra Seal® Magnum is a modified version of Ultra Seal® Plus. The addition of additional synthetic Fibers makes **Ultra Seal® Magnum** capable of sealing large fractures > than 1/8" aperture width along with vugular formations. **Ultra Seal® Magnum** is designed to be pumped in pill form to solve total lost circulation.

Ultra Seal® Magnum AS is an acid soluble LCM based on the particle size distribution of the **Ultra Seal® Magnum**.

Ultra Seal® OBM is a unique blend of Ultra Seal® TG, mined hydrocarbon resin and proprietary ingredients. **Ultra Seal® OBM** is designed to aid in seepage control, wellbore strengthening and HTHP fluid loss control in oil-based mud systems.

PMI-107

Corrosion, Scale, and Wax Inhibition Phase Separation

PMI-107 is a negatively charged, amphiphilic compound specifically designed as a wax, scale, and corrosion inhibitor.

PMI-107 effectively “separates oil and water droplets”. which suspends all components, in the production stream to prevent formation of corrosion, scale, or wax accumulations.

PMI-107 has an affinity with steel and is adsorbed on contact surfaces to form a protective barrier film and reduce drag. It is this attribute that prevents scale, wax, and corrosion from building up.

SEPARATES PHASES

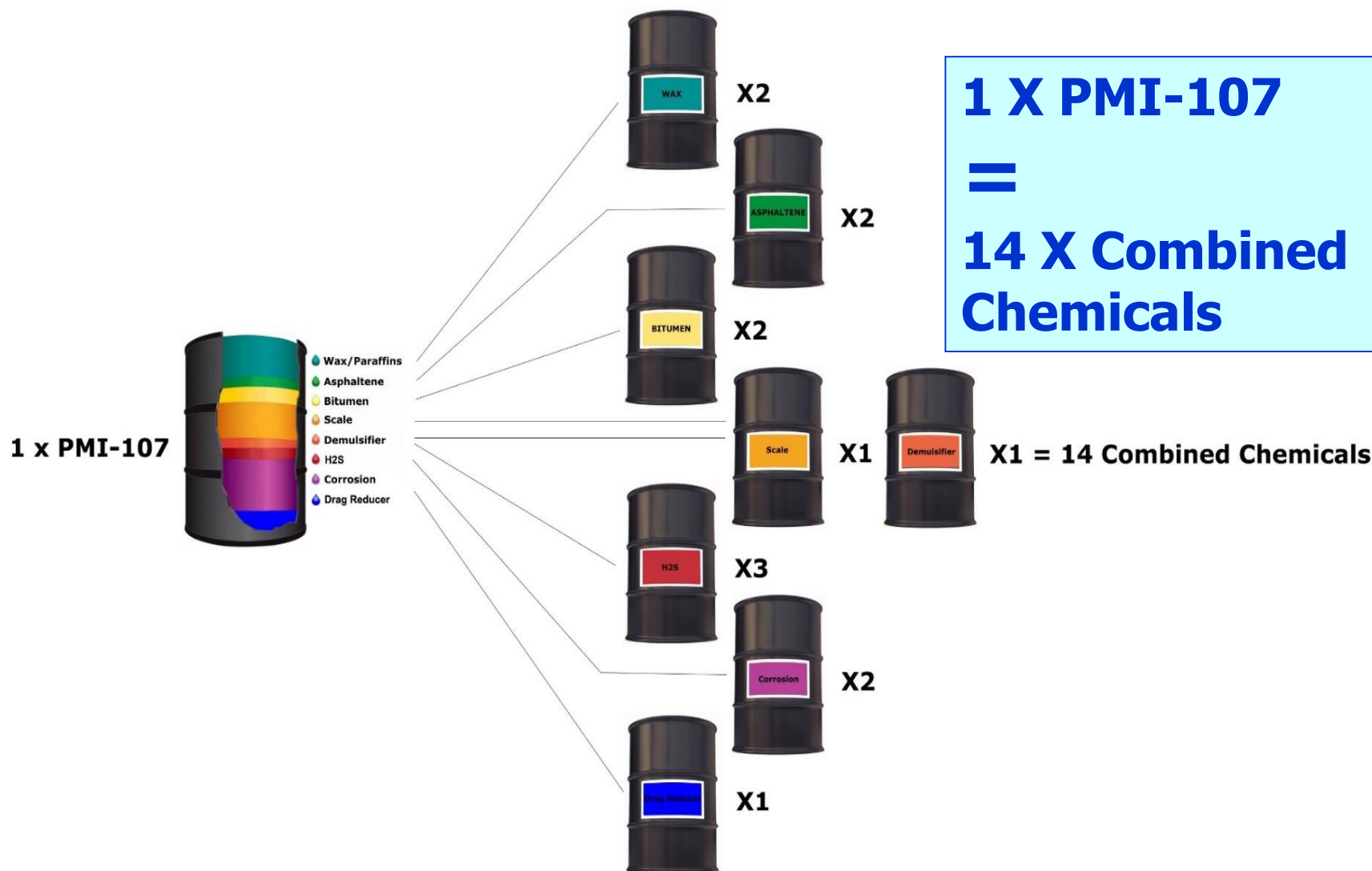
COATS METAL

INTERFERES WITH WAX & SCALE

PMI-107

- Single product – multi-functional anionic compound
- Corrosion control and prevention
- Paraffin / asphaltene control and prevention (incl. crystalline wax)
- Drag reducer
- PPD
- Mobilises Heavy Oils
- Cleans pipe lines, pumps, valves and equipment
- Cleans tanks and facilities
- Chemical injection services
- Well stimulation and work over
- Emulsion control and breaking
- Reduces maintenance down time
- Neutralises H₂S (PMI 107FA)

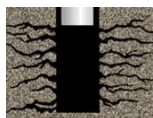
Cost Comparison using PMI-107FA



PMI-107FA

Replacement For TRIAZINE, XYLENE & TOLUENE

The Worlds First Non-Toxic, Environmental & Marine Friendly, Human, Animal Safe Combination Treatment.



Enhanced Oil Recovery (EOR)



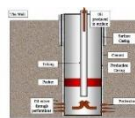
H2S Eliminate at source



Wax Inhibitor (WI)



Corrosion/Scale Inhibitor (CI)



Well bore/Perforation/Tube Cleaner



**Heavy Oil Mobiliser (DRA)
Improve flow/ reduce pressures**



Asphaltene Inhibitor (AI)



Demulsifier/Emulsion Breaker (EB)

Eliminate the requirement for highly expensive equipment and exotic metals/steels. *Reduce your chemical requirement To ONE PRODUCT!*

PMI-107FA is equally effective Downhole, Pipeline, Production, Storage, Road, Rail, and Marine Tanks.

PMI-107

Range of Applications

Well stimulation



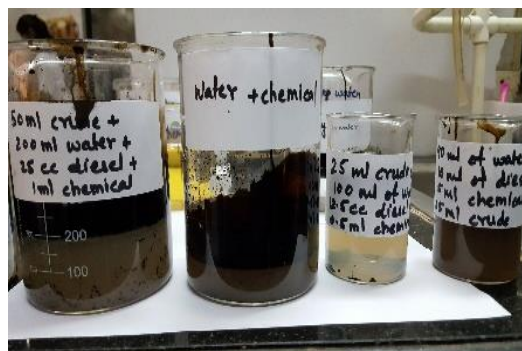
Heavy Oil



Pipeline Injection



Demulsifying



Pit Cleaning



Plant Cleaning



Tank



PMI-107

Superior field performance

Increased production

	Pre treatment	Post treatment with PMI-107	BPD Increase	Post-treatment production %
Well 31	296	461	165	156%
Well 42	33	227.7	194.7	690%
Well 56	77	336.1	259.1	436%
Total	406	1025	619	252%

The above are wells in Oman, thick, waxy, naphthenic, crudes where PMI-107 was injected at the wellhead.

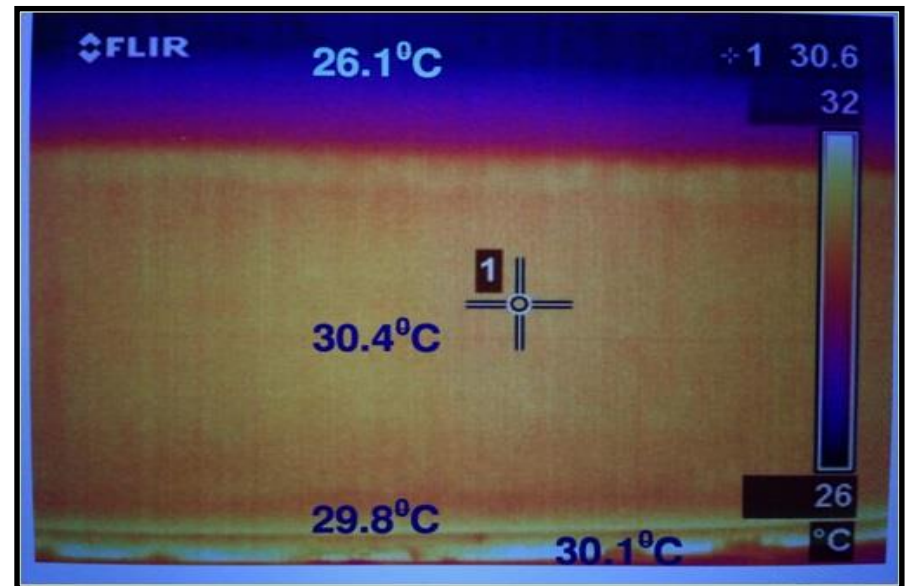
ROI was 96 hours

PMI-107

Superior Performance

West Burkha Field where two wells were brought back on line following replacement of a length of pipe blocked by a stuck pig. Production rate was increased from its previous level of 7000 bpd to 10,000 bpd. The tank capacity was 300,000 bbls, of which 10% was accounted for by BS&W. Without any further dosing anywhere in the system, over a period of just two weeks, 30,000 bbls of BS&W were recovered purely as a result of the circulation of crude inflow with its content of 250 ppm of PMI-107.

- Thermal image of a 300,000 bbl tank AFTER cleaning
- Tank cleaned remotely while tank stayed on-line.
- All organics re-suspended, and emulsions broken.
- **30,000 barrels of oil recovered.**



PMI-107 and PMI-107FA

Treating Common Problems

- Paraffin and asphaltene wax formation
- Pipeline plugging or restrictions
- Corrosion of pipeline, tanks and equipment
- Wax build up in wells, pipeline or plant facilities
- Scaling and emulsions
- Difficulties in removing H₂S
- Excessive pressure, reduced volumes
- Low productivity
- Mobilizing Heavy Oils
- High maintenance costs



- Made from Oranges
- Wax Dissolver, Solvent, and degreaser
- **Environmental Product of the Year 1998 in the UK**
- Gold Banded in the OCNS CEFAS system
- Just as effective, if not more so, than xylene or toluene, but without the harmful health and environmental problems
- A D'Limonene with a difference. Due to its unique manufacturing process, it is NOT considered a Marine Pollutant in the UK as almost all others are.

OrangeWorks

OrangeWorks is a proprietary mixture of orange oil derivatives, fully de-aromatized aliphatics and antioxidants. It is a formulation for **removing asphaltenes and paraffins**.

- **OrangeWorks** is designed specifically for asphaltene and wax deposits in production wells
- Regularly used as replacement for toluene / xylene
- Higher flash point than toluene / xylene
- Reduced soaking time to return well to production
- Can be flushed into production stream
- Used for cleaning rod and sucker mechanisms



Has been used by BSP for many years under the former name CutClean for tank cleaning.

UltraSeal ICS Fluid System

A Solution to the Challenges of Over-Balance Wellbores and
Multi-Pressured Well Sections



ICS Fluid System

Invasion Control System or Aphron System

Solids free drilling and completion fluid systems designed specifically for solving loss circulation problems while preventing formation damage and enhancing production

Prevent Differentially Stuck Pipe

Prevent losses in Depleted Zones, Fractured Formations, Vugular Formations

Multiple Pressured Zones – up to 7 ppg overbalance without losses or getting stuck

Sensitive Shales

Loosely Consolidated Formations

Prevent Formation Damage

ICS Fluid System

2 Phase Fluid System – think of it as a KCL Polymer system with a sophisticated emulsifier package

1. Non-damaging, highly effective pneumatic sealing Aphron Microbubble Aggregates make up the filter cake.

2. LSRV system (low shear rate viscosity)

Low PV

High YP

Flat Gels

High Low Shear Rate Viscosity

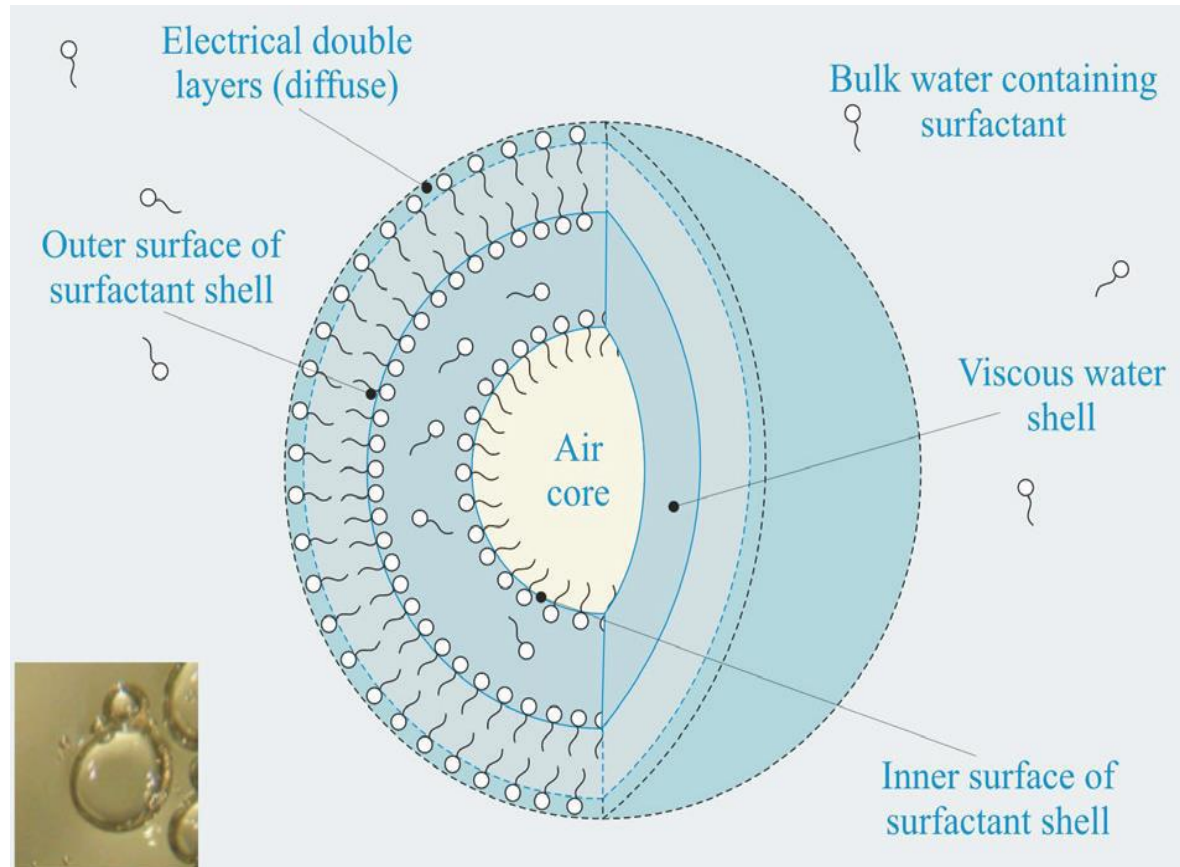
Shear Thinning

There is practically no fluid loss. The aphrons seal the micro-fractures just like sealing a depleted zone, etc. No fluid loss, no shale hydration or lubricating the micro-fractures.

ICS Fluid System

A conventional air bubble is stabilized by a surfactant monolayer.

The outer shell of an aphron consists of a much more robust surfactant tri-layer. This tri-layer is envisioned as consisting of an inner surfactant film enveloped by a viscous water layer; overlaying this is a bi-layer of surfactants that provides rigidity and low permeability to the structure while imparting a hydrophilic character.

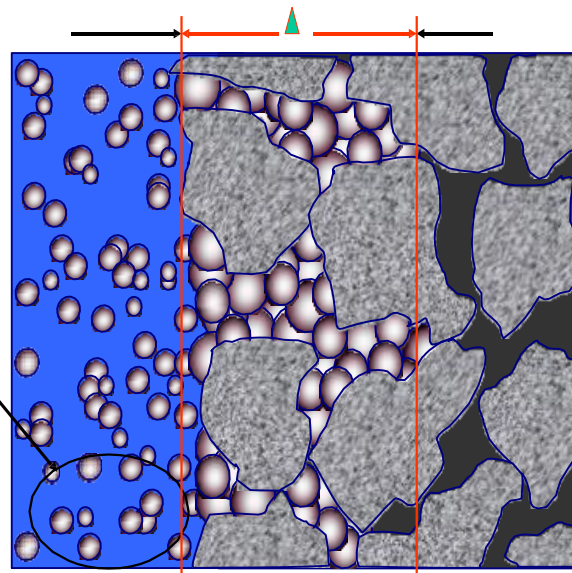


Hydrophobic exterior results in low affinity for each other and for mineral surfaces (conventional bubbles are water-wet)

The aphrons can withstand differential pressures of 6000 psi and can be enhanced up to 8000 psi.

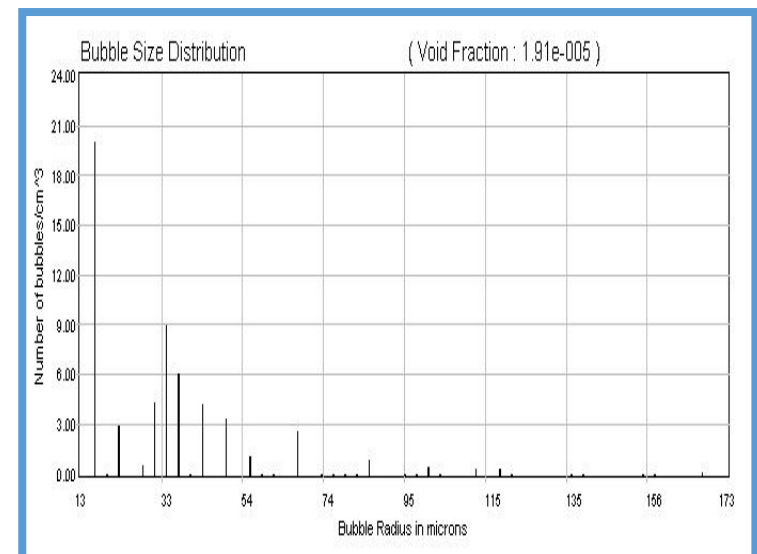
ICS Fluid System

Aphrons form a micro-environment in a pore network or fracture that behaves like a solid, yet flexible, bridging material. As is the case with any bridging material, concentration and size of the aphrons are critical to the drilling fluid's ability to seal thief zones. Generally contains 6-10% air volume. The aphrons generated at the drill bit are a diameter between 15 μm and 150 μm , which is typical of many bridging materials.



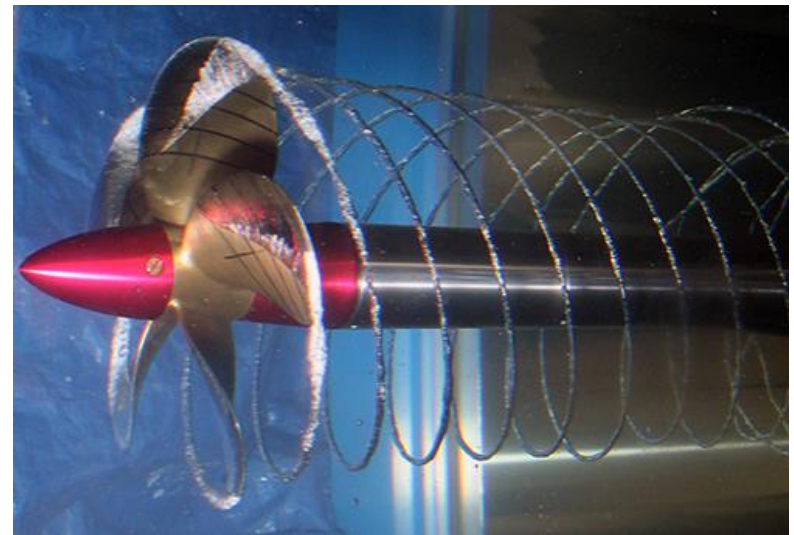
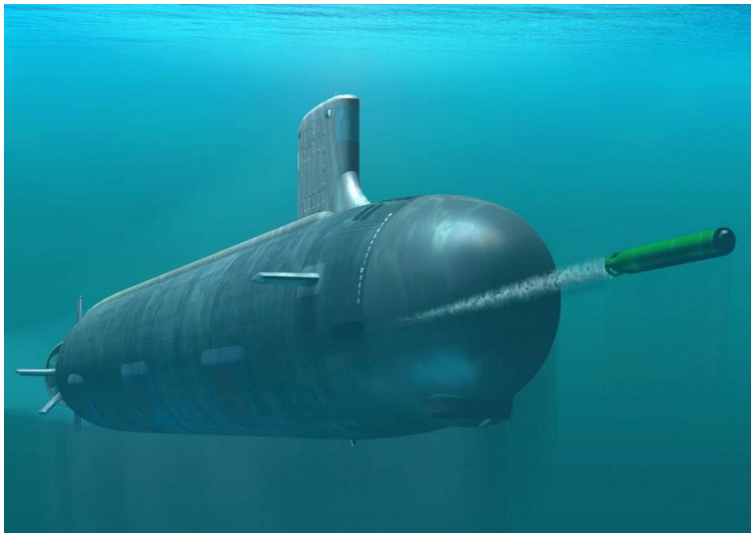
Aphrons

Low pressure,
fractured formation



ICS Fluid System Cavitation

The air comes from the water in the mud from the low pressure zone as it comes out the bit jets. A small amount can come from the jets in the mixing system.



ICS Fluid System

What types of losses can the UltraSeal ICS system handle?

The system can handle almost any type of losses

- **Porous formations** – UltraSeal ICS has sealed as high as 12 Darcy formations
- **Microfracture networks** – UltraSeal ICS seals micro-fractures as small as 500um throat size
- **Fractures** – UltraSeal ICS has sealed fractures as large as 25 mm throat size. And even larger with the assistance of small concentrations of conventional LCM
- **Depleted formations** – UltraSeal ICS can effectively seal with an overbalance as high as 7 ppg (840 kg/m³).

ICS Fluid System

2000 wells drilled worldwide, 500 of them replacing UBD

*Depleted Sands, Multi-Pressured
Lake Maracaibo, Venezuela*

*Vugular Dolomite
Eddy County, New Mexico*

Fractured Granite, Yemen

*Depleted, Fractured, Vugular Carbonate, Multi-Pressured
Offshore Angola, West Africa (Replaced UBD)*

*Multi-Pressured, Porous, Depleted, Fractured Sand/Carbonates
Atrush-Kurdistan, Iraq (Replaced UBD)*

ICS Fluid System Recipe

Product	Concentration	Function
Water/Brine	~94% by volume	Continuous Phase
ActiGuard	1-5% v/v	ActiGuard serves as a blending agent as well as a natural encapsulant for solids. 100% biodegradable.
Soda Ash	3-5 ppb	Soda Ash is the primary pH modifier.
KCl	20-30 ppb	Inhibition
UltraActivator	6 ppb	UltraActivator is both a pH buffer and a corrosive gas scavenger. It serves to scavenger O ₂ , H ₂ S and CO ₂ as well as maintain a stable pH.
UltraVis ICS	3-5 ppb	UltraVis ICS is a proprietary blend of organic viscosifiers that confers a flat gel structure in fresh and brine water.
UltraAphronizer ICS	0.5-1 ppb	UltraAphronizer ICS is an engineered blend of proprietary surfactants specifically designed to generate the energized micro-bubble sealant in the UltraSeal ICS System.
UltraEnhancer ICS	0.25-0.5 ppb	UltraEnhancer ICS is a specialized surfactant package designed to both increase the volume of micro-bubbles in the Ultra Seal ICS system as well as increase the bubble's surface strength. Use as needed.

ICS Fluid System

Situations Where ICS Excels

Wells with depleted zones, loss zones, or prone to differential sticking

- Situations in workovers **to temporarily seal a depleted zone.**
- In drilling when **both a high pressure and low (depleted) pressure zone are encountered in the same interval.** This avoids the need of an extra casing run.
- In drilling where large excessive mud losses are encountered which results in both large mud losses and large use of LCM material.
- In drilling situations with WBM's where **large amounts of CO₂ and/or H₂S** are encountered. This overwhelms most WBM's. This system does a much better job of neutralizing these acid gases.

ICS Fluid System

Alberta Clipper (N America)	MEG Energy (N America)	PDVSA (Venezuela)
Harvest Energy (N America)	Devon Energy (N America)	ARC Energy (N America)
Vermilion O&G (N America/ N Sea)	Sirte O&G (MENA)	Occidental (N America/MENA)
Murphy O&G (N America/MENA)	MEDCO (MENA)	Talisman (N America/MENA)
Total (MENA/Europe/W Africa)	TAQA (MENA)	GDP (MENA)
Repsol (MENA)	Benagadi O&G (Asia)	Sonangol (Africa)
Sonatrach (MENA)	LUK Oil (Russia)	EnCana (N America)
Shell Oil (N Sea)	ONGC (India/Asia)	Marathon Oil (N America/Arctic)
ConocoPhillips (MENA)	Oil India (India/Asia)	Husky (N America)
SunCor (N America/MENA)	PEMEX (Mexico)	Korean NOC (N America/ Kazakhstan/ S America)

ICS Fluid System

Prevention of Stuck Pipe

Solids Free **Prevention of Loss Circulation**

Depleted Zones / Kill Fluid / Completions

Fractured / Vugular Formations

Multi-Pressured Zones

Reservoir Protection

UltraStim IHB

Scale Inhibition

UltraStim IHB eliminates the formation of Carbonate and Sulphate Scales, e.g. Calcium Carbonate scale, Calcium Sulphate, Barium Sulphate, and Iron Sulphate scale for up to 6 months.

UltraStim IHB can be bullheaded into the well in liquid form.

OR

Simply dropped down the well is a timed release solid form

Other Problems Solved

Casing Clean-ups
Descaling ESP's
Water and Gas Shut-off
Scale Inhibitors

Dissolving SRB Damage
Treating Damaged Injection Wells
Wax Inhibitors
Corrosion Inhibitors

There are many other products besides the ones highlighted in this presentation

- PowerPickle
- PowerSurf
- Carbonite GP
- Carbonite HT
- DrilXpress
- Pro Blend
- EnviroMerc
- Poly Plug "Ultra Squeeze"
- Poly Plug Clear Gel LMW
- Poly Plug Clear Gel HMW
- X-Block Part A
- X-Block Part B
- X-Block Buffer
- DrilXpress
- Pro Blend
- EnviroMerc
- Ultra Spacer R
- Ultra Surf R
- Ultra Sperse
- Ultra Seal XP
- Ultra Seal TG
- Ultra Seal C
- Ultra Seal MAGNUM
- Ultra Seal XLR
- Ultra Seal XLD
- Ultra Seal Plus
- Ultra Seal XLA II