CASE HISTORIES

Case Histories Contents & Cross References

The Case Histories presented here are, for the most part, unique applications of the chemicals in differing completions and surface configurations. These have been selected on that basis in order to prevent repetition. Also note that in many cases at the time the product was known as HDC Mk II the name which has since been changed to HDC MARK II with new marketing initiatives. The manufacturer is still the same.

Well Intervention Chemical Case Histories

Part I of this booklet contains the specification sheets about the WellTech product line used in either cased hole well bore clean up, or in the company's intervention and stimulation operations.

Part II of this manual presents case histories as a reference guide to the different applications for which the Company intervention chemistry has been deployed. Although some Operators are named in these documents, where identification of specific fields or wells is not allowed, these are omitted. If details of these identifiers are requested in writing to the company, we will endeavour to contact the Operator responsible and make the request on behalf of the individual or company asking for it. These are examples only.

As a general guideline, the products used in these case histories are:

Pyrosol ES – Iron Sulphide and Carbonate Dissolver

HDC MARK II – Mud Barite, Barium, Strontium, Carbonate Compound Dissolver

PentaFlow – Mud Cake Remover, Emulsion Breaker, Carbonate/Sulphide Scavenger

PowerSurf – Oil and Synthetic Based Mud Dissolver

PowerPickle® – Oil Based Mud, Pipe Dope and Multi-purpose Hydrocarbon Dissolver

OrangeWorks – Heavy Oil, Paraffin, and Multi-purpose Solvent

Part I

Product Specification Sheets

Product Specification Sheet

1. PRODUCT NAME *Pyrosol ES*

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

Pyrosol ES is a multipurpose sulphide scale and dissolver used to remove hard particularly non-biogenic sulphide scales from production streams in oil and gas and or water injection wells, or used to dissolve carbonate filter cakes in addition to sulphide scales in open hole, tubing and other oil and gas facilities.

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Clear Fluid
Odour	:	Slight.
pH	:	5.5
Boiling point	:	>100° C
Melting point	:	<0° C
Flash point	:	> N/A
Decomposition temp.	:	N/A
Auto ignition temp.	:	N/A
Solubility (water)	:	Soluble.
Density	:	1.145

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers

5. SHELF LIFE

Shelf life is dependent on storage conditions but is estimated to be between 3 and four years at 20º C or between 2 to 3 years if stored above this temperatue.

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Product Specification Sheet

1. PRODUCT NAME *HDC MARK II*

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

HDC MARK II and variants are proprietary manufactured dissolver solutions designed to remove high volumes of solid sulphate and carbonate solids from oil and gas down-hole and surface facilities. Although all HDC® brands dissolve barium, strontium and calcium sulphate to some extent, the different brands are used to target differing well bore environments and indeed surface facility environments. HDC MARK II and its variants are high weight/volume dissolvers of barium and calcium compounds in their scale state whereas HDC MARK II series dissolvers are more suitable for down hole "dirty" conditions resulting from oil or water based mud deposition. Although the products are largely interchangeable, more efficiency is attained by selecting the dissolver for the correct environment. The products react quicker in warm environments (> 40º C) but are largely not temperature dependent to reach depletion with normal reactions within 24 hours at elevated temperatures.

2a. TYPICAL DISSOLVING CAPABILITIES:

Chemical	BaSO4	SrSO4	CaSO4	CaCO3
HDC MARK II	71.5 g/l (raw)	43 g/l(scale)	49 g/l (scale)	71 g/l (pure)

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Clear to Light Amber
Odour	:	Slight. organic
pH	:	>12
Boiling point	:	>100° C
Melting point	:	<0° C
Flash point	:	> N/A
Decomposition temp.	:	N/A
Auto ignition temp.	:	N/A
Solubility (water)	:	Soluble.
Density	:	1.25 to 1.45 depending on requirement

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers

5. SHELF LIFE

Shelf life is dependent on storage conditions but is estimated to be between 3 and four years at 20º C or between 2 to 3 years if stored above this temperature.

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Product Specification Sheet

1. PRODUCT NAME *PentaFlow*

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

PentaFlow is a proprietary mixture of organic and inorganic acids and solvents. It is a multipurpose polymer, carbonate particle and scale dissolver which can be applied to oil and gas facilities with particular applications in open hole and production well cake breaking applications. With in-built corrosion sequestration and de-emulsifiers – it is widely used to break or prevent emulsion blockage and to scour metal ions from the well target. Used Neat as pre-flush or open hole cake breaker.

2a. PRE-FLUSH FUNCTION

Emulsion Breaking; Polymer Dissolving; Metal Sequestration; Water Wetting; De-Oiling

2b. WELL BORE FUNCTION

Carbonate Dissolver; Mud Cake Breaker; Clay Control

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance stored above 30ºC	:	Clear to pale blue – can be multiphase if
Odour	:	Slight.
pH	:	1.25 ± .35
Boiling point	:	>86° C (solvent phase)
Melting point	:	<0° C
Flash point	:	> N/A
Decomposition temp.	:	N/A
Auto ignition temp.	:	N/A
Solubility (water)	:	Soluble.
Density	:	1.128 ± .15

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers

5. SHELF LIFE

Shelf life is dependent on storage conditions but is estimated to be between 3 and 4 years at 20º C or between 2 to 3 years if stored above this temperature.

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Product Specification Sheet

1. PRODUCT NAME *PowerSurf*

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

PowerSurf is a highly active water wetting agent designed to prevent agglomeration of oil or synthetic based mud when they come in contact with water or brine.

PowerSurf is a water soluble blend designed to remove the final film of oil and ensures that metal surfaces are water wet. The product is compatible with both weighted and un-weighted spacers and exhibits little or no foaming.

PowerSurf can be used for removing synthetic or oil based mud and "sludge" from gravel pack screens.

3. PHYSICAL AND CHEMICAL PROPERTIES

Vapour Pressure mm Hg @ 20^{o}C	:	Less than 1
Solubility in water	:	Soluble at 25°C
Specific Gravity @ 15^{o}C	:	1.03
Volatility by Weight %	:	50-54
pH	:	6.5-7.5
Appearance	:	Clear liquid
Odour	:	Bland
Flash Point (PMCC)^{o}C	:	93°C

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers or specialty containers on request

5. SHELF LIFE

Shelf life two years if kept in original sealed packaging out of direct sunlight

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Product Specification Sheet

1. PRODUCT NAME *PowerPickle*

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

PowerPickle is a complex blend of solvents specially selected to be effective at dissolving and dispersing pipe dope and oil based mud prior to well stimulations and gravel packs. It has the ability to displace the organic surfactants that hold the pipe dope together and release the oil wetted solid fillers. The solvent effectively removes the very persistent viscous "sludge" which is formed when residual oil based mud is contacted with water.

PowerPickle is designed to be user friendly so that it is safe to use and dispose of. It contains no aromatic hydrocarbons or chlorinated hydrocarbons, and is classified as non-flammable, biodegradable and has a Gold Band rating in the North Sea.

3. PHYSICAL AND CHEMICAL PROPERTIES

Vapour Pressure mm Hg @ 20^{o}C	:	1
Solubility in water	:	<0.01 at 25^{0}C
Specific Gravity @ 15^{o}C	:	0.78 @ 15.5^{0}C
Appearance	:	Clear liquid
Odour	:	Sweet
Flash Point (PMCC)^{o}C	:	62.8
Auto Ignition ^{o}C	:	Greater than 200
Explosive Limits % air @ 25^{o}C	:	lel 1.0, uel 8.0 @ 15.5^{0}C
Products of Combustion	:	Strong oxidizers

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers or specialty containers on request

5. SHELF LIFE

Shelf life two years if kept in original sealed packaging out of direct sunlight

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Product Specification Sheet

1. PRODUCT NAME ***OrangeWorks***

2. COMPOSITION / INFORMATION ON INGREDIENTS AND APPLICATIONS

ORANGEWORKS is a proprietary mixture of a proprietary blend of orange oil derivatives, fully dearomatised aliphatics and antioxidants. It is a formulation for removing oily and waxy accretions in production pumps and pipelines.

2a. Used to remove heavy wax, Asphaltine depositions in the well bore or surface facilities.

2b. Used to remove oil deposits from well bore matrix in stimulation operations

3. PHYSICAL AND CHEMICAL PROPERTIES

Boiling Range IBP @ 10mm Hg ^{0}C	:	199 Dry Point ^{0}C 250
Vapour Pressure kPa @ 20^{o}C	:	0.10
Vapour Density (Air = 1)	:	4.5
Solubility in water	:	Insoluble
Specific Gravity @ 15^{o}C	:	0.80
Volatility by Volume % @ 20^{o}C	:	100
Evaporation Rate (n - butyl acetate = 1	:	0.06
pH	:	7.0
Appearance	:	Clear, mobile, Orange liquid
Odour	:	Orange
Flash Point (PMCC)^{o}C	:	69
Auto Ignition ^{o}C	:	Greater than 200
Explosive Limits % air @ 25^{o}C	:	0.6 - 8.0
Products of Combustion	:	Oxides of carbon, water vapour

4. PACKAGING

Supplied in 200 Litre plastic drums or 1000 litre plastic IBC containers or specialty containers on request

5. SHELF LIFE

Shelf life two years if kept in original sealed packaging out of direct sunlight

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Part II

United Kingdom & Europe

Production & Well-Bore Intervention Case Histories

- Barite Dissolving: Production Recovery
- ESP Recovery
- Water Injection Recovery
- Barium, Strontium Scale Dissolving

Case History 2.1
HDC MARK II
ESP – OBM Blockage UKCNS

- **Horizontal EV – ESP**
- **Pre-Packed Screen Completion**
- **OBM – Dolomite / Barite Mud Solids**
- **Bull-Head Operation**

The well treated here was drilled as an EV installation with a Baker Centralift ESP set above approximately 900' of horizontal sand screens. The ESP and facilities were constantly blocked off with mud solids feeding through the screens – and probably lodged inside them as well. Cleaning with HCL/HF and competitor barite dissolvers had proven ineffective in cleaning the well up. The client decided to use HDC MARK II behind a PentaFlow pre-flush. This was done with the ESP cleaning up to 22,000 bpd (up from a previous high of 11,000 bpd with blockages causing shutdown) without blockages and solids.

This well was drilled and completed in May 2004. It was suspended in heavy synthetic based drilling fluids for several weeks before being displaced to a "clean" SBM and completed with pre-packed screens. The well never cleaned up properly with the ESP constantly overloading with solids which testing indicated were carbonate and barite sourced from the drilling fluid.

Very large volumes of HCL were used to remove the carbonate solids with U104/U105 pumped to remove the barite. As these failed a competitor barite dissolver was pumped with no improvement seen.

The operational program using HDC MARK II and PentaFlow was quite straightforward as it entailed bull-heading PentaFlow ahead of the HDC MARK II with a small spacer in between. The PentaFlow was allowed to soak across the target for 90 minutes then displaced into the well with HDC MARK II behind. The HDC MARK II was divided into two soak stages.

The first HDC MARK II soak was designed to lie inside and just outside the well bore for 8 to 12 hours. The second volume of HDC MARK II was designed to push the first soak outwards (being theoretically still active) with the new volume displaced fully into the well bore so coverage was extended outside and inside the screens – up to 24 inches from the bore itself. After the last displacement the fluids were allowed to soak for 24 hours.

The ESP was started with the well cleaning up gradually (the HDC MARK II being denser is harder to lift), and the well eventually cleaning up to 22,000 bpd – up 10,000 bpd from the previous best production seen. This was and is being maintained without solids and ESP pump over loading since the job was done in March 2005.

Subsequent to this operation, two more ESP's in the same condition were fully recovered for the same client between 2006 and 2007 contributing to a total of 60,000 bfpd during II operations.

July 2001

Case History 2.2
HDC MARK II: Injector- Schielhalen

- **New Drilled Well With SBM**
- **Moderate temperature (148ºF)**
- **Gravel Packed Water Injector**
- **HDC MARK II Breaker System**

This well was drilled using synthetic oil based mud in the North Sea off Shetland. The concept of the field trial was to attempt to inject through the oil based mud cake without the normal procedures of producing the well conventionally to remove the filter cake by placement of the HDC MARK II chemical in the screens.

This was deemed to be particularly challenging as this had never been successfully done before and the BHT of the well at 148° F was deemed to be very low for an unconventional or conventional dissolver of any sort.

The well was completed and the HDC MARK II placed across the screens using coiled tubing. The CTU was pulled and the chemical was allowed to soak for 24 hours before injection was attempted.

When the well was put on injection, it was established at a high back pressure (± 2000 psi) with a constant rate. The pressure was deemed to be higher than expected although this part of the field and this formation had not been injected before and the productivity of the operation was still largely in doubt.

In order to determine if the filtercake had indeed been removed, the well was cleaned up conventionally using CTU/EDTA/Acid and produced – with poor results. Injectivity went to zero indicating that the acid treatment had in all probability compromised the formation and the EDTA had no effect as well.

The decision was made to perforate through the screens to establish exactly what the injectivity of the formation was. This was done and it was found that the injection rate perforated was identical to the rates and pressures established with the original clean up of the HDC MARK II product – indicating that it had in fact, yielded total Cake dissolution and maximum injectivity at the outset.

Although the well was not in an ideal location for a injector, the establishment of the HDC MARK II as a filtercake dissolver which could eliminate the need for CTU use and conventional flow back and clean out using OBM, has been established – even at low bottom hole temperatures.

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References: Alan Austin – BHI 01224 – 720000 or 01224- 226000
Alistair Roy – BP 01224-832000
Alan Twynam - BP TwynamAJ@bp.com

September 2001

Case History 2.3
HDC MARK II – Kerr McGee – Gryphon P4 – Gravity Feed via FPSO

- **Sub-Sea Well Head**
- **Horizontal**
- **BOT Excluder Screens**
- **Acid Damage – 100% Production Loss**
- **Gravity Feed Deployment**

The P-4 well was drilled in 2002 being badly damaged in the process using oil based mud with high losses. The well was subsequently acidised after producing circa 600 bopd – 2 x 10,000 gallon treatments. The net result was full production loss. The well was tied back via the sub-sea manifold as programmed before bringing the FPSO on with the well standing idle until late 2004 when an attempt to recover some production was made using HDC MARK II. The operation was a partial success but the lifting of the well had to be discontinued due to problems with gas lift and the subsea choke. The well was flowed from zero to 750 bopd when lifting stopped – with a build rate of 50 – 80 bopd when the operation was halted.

The Gryphon wells are located in a high permeability, high porosity sand reservoir with enough clay elements to make acid use a high risk operation. The problems on P4 were initially caused by high volumes of oil based mud being lost during the drilling phase, then aggravated by severe acid incompatibility with the oil mud and the formation itself- resulting in the well being killed.

HDC MARK II and **PentaFlow** were compatibility tested and selected for a trial never attempted before which consisted of a gravity displacement from the FPSO through the production riser. Lab simulations were made which indicated that the PentaFlow and the HDC MARK II being far heavier than the seawater currently in the string would “flip” and displace themselves into the well over a relatively short period of time. However, as the well was nearly 3000’ horizontal, the exact location and ability of the fluids to access the toe of the well was questionable. Lab simulations indicated that in fact if displaced at two distinct time frames (a day apart), the Heavier HDC MARK II would almost certainly hydraulically push the PentaFlow into the well through the toe.

The displacements were performed as programmed, however it was necessary to leave the fluids soaking in the well for over two weeks due to production issues on other wells. When the well was lifted, using gas lift from an adjacent well, the well flowed back some HDC MARK II and liquids and gradually began to flow oil – building up to 450 bopd. Although 1000 psi differential pressure could be applied to the well – the design of the gas lift was such that sustained differential could not be maintained and the well could not be shocked or unloaded which was deemed necessary to really clean the heavier fluids from the deeper horizontal sections. Due to operational problems the lift had to be

abandoned with the well unable to flow on it's own. The well was re-accessed in January 2005 and gas lifted – with immediate oil flow building up to 750 bopd at a steady increasing rate from 50 bopd when the gas lift again had to be abandoned due to subsea manifold choke problems.
As work-overs and major maintenance was due, it was decided to side track the well when the rig arrived. Although the well could not be cleaned up due to operational issues, the exercise was considered a success with the well theoretically able to produce at its peak had sustained gas lift been available.

Ref: dcorkey@kmg.com

December 2001

Case History 2.4
PentaFlow + Pyrosol ES: Injector Recovery

- **New Drill - Water Injector**
- **Moderate temperature (148ºF)**
- **Sulphide Matter and Biological Grunge**
- **Bull Head**

This well was a side track from an existing injector which had dropped off injectivity quite rapidly in 2003. The sidetrack used a non-damaging water based drill-in fluid weighted with carbonate. Upon completion, injection was poor with high back pressure and little injectivity. Subsequent HCL and HF jobs did nothing to improve the well. Pulsonics were run in an attempt to clean it up but nothing was achieved. Flow back of the well revealed viscous black grunge from the well bore.

It was determined that the well was placed back into the area of the previous injector – where a bacterial biomass had been created previously and sulphide scale had built up substantially. As such a treating regime of PentaFlow – to break through the hydrocarbon and biological complex coating the near well bore, followed by Pyrosol ES which would operate on the exposed sulphide matter remaining.

The operation entailed stage placement of the PentaFlow near the well bore for 90 minutes then displacing the Pyrosol ES into the screens and near well bore.

The drop in pump pressure when the PentaFlow reached the formation (this is common) was very dramatic with the well taking fluid at an extreme rate. This weakening of the back pressure became more marked as the operation continued.

After 24 hours when placed on injection, the well took 50,000 bwpd – from 9,000 bpd previously. This tapered off to 35,000 bpd.

It was learned later that the well had been used to feed a nitrate into the reservoir in an attempt to sweeten sour crude in an adjacent producer. This was found to cause more complications later on but certainly explained the initial problems seen on this well.

Case History 2.5
HDC MARK II Production Recovery – Kerr McGee CNS

- **Recent Well**
- **Moderate temperature (148ºF)**
- **Damaged By OBM**
- **Bull Head**

This well was drilled and put on line as an oil producer in 2000. The well was completed conventionally with BOT screens. The well was thought to be impaired by the OBM drilling fluid used blocking the screens or the skin as well.

The well was bullheaded with 4,000 liters of HDC MARK II and allowed to soak overnight. The well was opened and allowed to cleanup under its own pressure. The well cleaned up within 48 hours, doubling the production from the pre-job levels and attaining a theoretical 90% rate for the well at that time.

The well was a high angle oil producer short screen completion.

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Case History 2.6
HDC MARK II – BP – Harding ISX13

- **Oil Based Mud Blocked Screens**
- **Failed Acid Nano Wash Operations**
- **Bull Head operation**

BP in the UKCNS drilled a horizontal oil producer in the Harding field in 2006. Designed to produce an initial 10,000 bopd from a 2000' reservoir section before water break through, the well was compromised due to the collapse of the lower hole because of chronic shale instability. With less than 400' of reservoir exposed (and that included the water leg), the initial expectations were of 4000 bopd. However the well was found to be badly impaired and produced 400 blpd.

The damaging mechanism was determined to be whole synthetic oil based mud (SOBM) compressed around the screen completion, combined with possible solids drop out. Coiled Tubing intervention was carried out in late 2006 with solvent/acid based Nano wash systems. Eventually multiple attempts with an acid/surfactant/ solvent system were unsuccessful. This treatment fluid was aimed at disrupting and removing any oil wet solids and / or calcium carbonate. Although the well had been displaced to a carbonate based SOBM prior to completion, contamination by the original barite weighted drilling fluid was was determined to be the main causative blocking agent in the well.

In 2007 BP chose to use an advanced **HDC MARK II** based barite/carbonate dissolver system behind a **PentaFlow** pre-flush system in an attempt to recover the well. The operation was performed in September 2007 without CTU in a simple bull head operation. The well immediately improved in productivity and the PI increase from the start of the operation has been increased from 1.5 to a current PI of 7.5.

The stimulation using HDC MARK II was repeated with the PI doubling until no gain in PI was seen. Overall the operation was deemed a huge success with the well producing 4000 bfpd up from 400 bfpd previously. The fact that this was accomplished with a bull head operation made the result that much more outstanding.

BP co-authored an SPE paper on this well and is listed in the archives as SPE 120762.

Case History 2.7 – February 2009
UKCNS
PentaFlow – Pipe Release Case History ConocoPhillips

- **Oil Based Mud**
- **6" Open Hole**
- **Drill String Stuck at 18000'+**

The drilling string became stuck during drilling operations at 18,196'. The well did experience minor fluid losses during the event and the drill string was worked whilst waiting for the **PentaFlow** *to arrive on board. Although the string was jarred and worked during the delay, no evidence of the pipe coming free was seen.*

After becoming stuck the **PentaFlow** was ordered out to the location. Once on location, a 60 bbl pill of **PentaFlow** was prepared and pumped ahead of a base oil spacer. When **PentaFlow** made contact with the formation, it was noted that the losses increase slightly.

The string was jarred and rotation became possible shortly after the contact with the **PentaFlow**. The string jarred free shortly thereafter and was pulled successfully without any renewed sticking incidence.

The contact time from the first **PentaFlow** contact to the string being freed was under three hours.

Reference: Allan Cameron Allan.Cameron@contractor.conocophillips.com

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Part III

USA

Production & Well-Bore Intervention Case Histories

- Barite Dissolving: Production Recovery
- ESP Recovery
- Water Injection Recovery
- Barium, Strontium Scale Dissolving

Case History 3.1
HDC MARK II Mobile Bay

- **Vertical Gas Producer**
- **Conventional Completion**
- **Total Scale Blockage Above Perforations**

The client's deep hot gas well in Mobile Bay has a history of complex scale formations. Typically, the scales have been removed using acid complexes. But it was known that not all the scales were acid soluble. This led up to an increased volume of acid insoluble solids building up in the well until production failed completely with CTU and/or wire line unable to access the well perforations at all. Bailer samples confirmed what the fluid modeling predicted, that barium scales were present with a variety of other complex minerals such as fluorites and carbonates.

Laboratory testing indicated that **HDC MARK II** would be the product of choice for removing these particular scale species. CTU was used to place the chemicals above the obstruction where it was allowed to soak in excess of 24 hours. During the latter phase of the soak periods, the well began to pressure up indicating that communication with the perforations had been re-established.

At the end of the soak period, the well was cleaned and the blockage totally removed. The well was producing at its best gas rate possible.

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Case History Shell USA 3.2
HDC MARK II, Offshore Louisiana –Oil and Gas Well Recovery

- **Aged Oil and Gas Producer**
- **Vertical Conventional Liner**
- **Perforated with Pre-Packed screen**
- **Dual Stage Perforation Bull-Head**
- **CTU Placement & Well Flow Back**

The client's well had lost some production capability through apparent scale build up. From the well history, it was apparent that the scale build up had been gradual. The drop off and failure of the well suggests (theoretically) that some seed scale or process may have accelerated the damaging process resulting in the decline. Having stated this, it was also possible that the build up through the life of the well may have been a direct or contributing factor to the loss of production.

The chemistry of the scale was determined to consist of Barium/Strontium oxides, sulphate. The program implemented was built around the use of several staged placements and soaks of **PentaFlow** and **HDC MARK II**. This dissolver was used to access the well at the perforations and near well bore from 18,006'- 18,246'.

Initially coil tubing was run with a jet blasting tool and the well was jet blasted to the bottom of the prepacked screen assembly. This procedure provided for the cleanup of the inside of the production assembly while allowing the chemical to clean up the outer portion of the screens, gravel pack, perforations and perforation tunnels.

The soaks were done in stages through the coiled tubing as this allowed direct spotting of the dissolving chemicals, without having to bullhead a lot of fluid back into the formation.

The different soak periods were required during the placement of the two chemicals as a single stage bullhead would be unlikely to achieve a uniform placement of the fluid over the severely scaled area. In addition, the **HDC MARK II** could become depleted before the area was totally cleaned. By staging displacements, cleaning and access was optimized.

The program was implemented with the zone being cleaned – with large amounts of scale removed from the well – and production restored, achieving an increase of 1.5 mmcfpd of gas, 1400 bopd and 100 psi of pressure.

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Part IV

Asia

Production & Well-Bore Intervention Case Histories

- Barite Dissolving: Production Recovery
- ESP Recovery
- Water Injection Recovery

Case History 4.1
HDC MARK II - OBM Barite Dissolving
Petronas Carigali – Resak A10S

- **HT Gas Well (325ºF)**
- **Deviated**
- **Dual String Completion**
- **OBM – Settled Barite + Acid Damage**
- **Conventional Perforated Liner**
- **Multi-stage Bull Head Through Short String**
- **CTU N_2 Gas Lift**

Summary: Resak A10 was designed to produce 25 mmscfd, but only produced 10 mmscfd and falling. After pumping 13.0 ppg OBM to kill the well, 250 bbls of acid was pumped. Production dropped to below 1 mmscfd. Besides damage from acid, it was also believed that some of the barite from the OBM had settled and covered some of the perforations. In an attempt to recover some production, a year later almost 70 bbls of HDC MARK II was bullheaded into the well over 26 hours resulting in production of 7 mmscfd.

Resak A10 is a dual string gas producer drilled by Carigali offshore Terengganu in 1999. The well was completed as a dual string completion to isolate a higher pressure reservoir at the bottom from intermediate production zones above.

Due to communication between the completions and lack of heavy brine, the well was killed and suspended in 13.0 ppg OBM. On re-entry, it was found that most of the perforations (in both zones) were partially buried under settled barite and OBM.

In the upper zone, coiled tubing could not be used to attempt a wash out, so the zone was acidized with 250 bbls of SWIK Halliburton formulation.

The zone was originally designed to produce 25 mmscfd. At the time of acidizing, the zone was producing between 10 and 7 mmscfd and falling. After acidizing, the production dropped to less than 4 million, dwindling to less than 1.5 mmscfd by June 2002 with over 200 bpd water.

In preliminary meetings and subsequent lab confirmation by Petronas, it was agreed that a cost effective trial using HDC MARK II would entail attempting to recover some of the buried perforations, and reversing if possible some of the HCL damage. Due to the high volume of acid used it was felt that attempting to reach the complete step out radius of the acid impact on the initial treatment stage was too expensive on an experimental basis.

The HDC MARK II job design was a staged bullhead operation through a cement unit. The job design was based on staged displacements of HDC MARK II over three hour intervals in a “dissolve” – “wash” – “dissolve” sequence to induce removal of barite from the lower perforations and flowing through them as the chemical depleted. The final stage

consisted of displacing the entire volumes into the formation and static soaking for 12 hours. The entire operation was completed in 26 hours.

At the end of 26 hours, a partial nitrogen gas lift was used although the well began cleaning up naturally. Within 24 hours of lifting, the well was producing 4.5 mmscfd, going up to 6 mmscfd within 96 hours and over 7 mmscfd after five days, with 80 bpd water, and 5 cubic meters per day of condensate. The production has continued in excess of 7 mmscfd on a 19% choke through to the last tests held 45 days after the well was stimulated. The condensate production results indicate a clear response from the previously buried perforations although the actual gas production source remains questionable.

The actual mineral species and weights dissolved as analyzed from the returns are tabulated in Table 1. (Note: The Barite used contained high volumes of Hematite)

Based on the average specific gravity of the dissolved compounds, the mass of solids indicate that theoretically 63' of settled barite and mud could have been removed from the well. That stated, the figure of 63' is erroneous however, as it is impossible for the HDC MARK II to have uniformly contacted sufficient surface area during the stage displacements to address the bulk solids in the 7". Basing the active HDC MARK II on a 25% to 50% activity within the 7", over the period of each displacement, it is estimated with a high degree of confidence that between 19' and 30' of perforations in the lower liner was re-exposed.

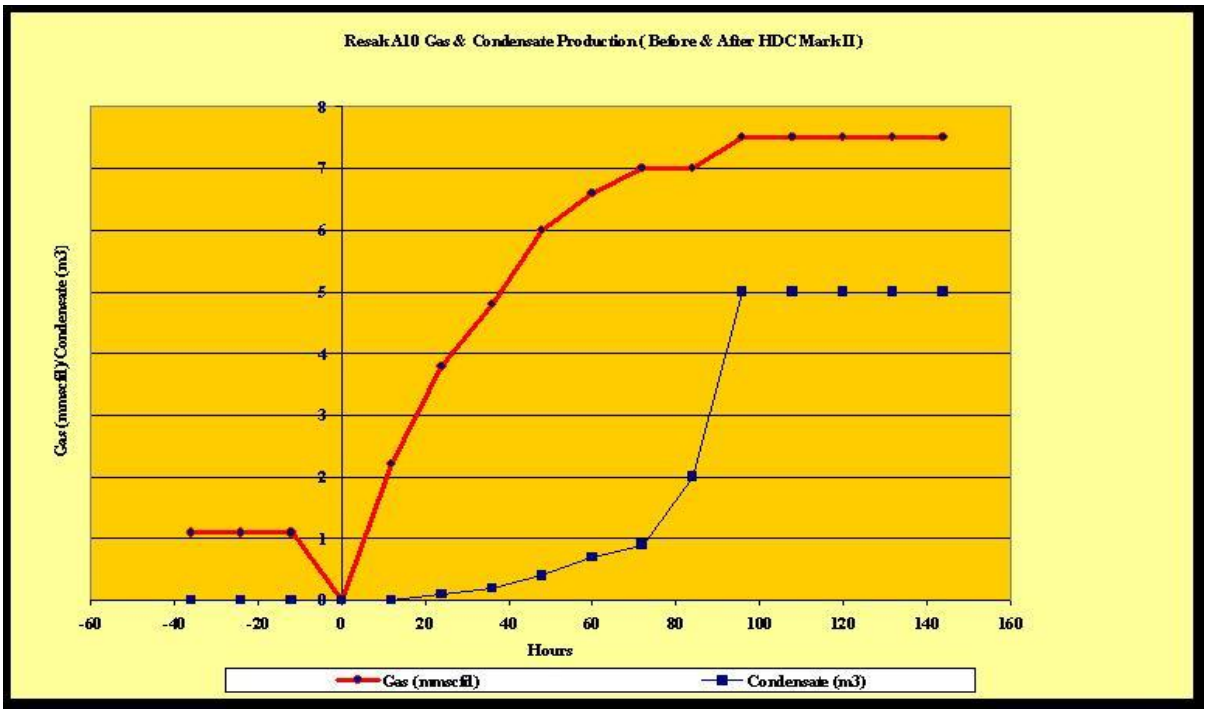
Table 2 reveals the actual analytical breakdown of the liquid volume flow back and dissolving rate of the HDC MARK II in each volume.

Table 2: Separator Volumes, Weights Dissolved/HDC MARK II Capacity

Sample	1	2	3	4	5
Volume bbls	40	40	160	40	40
Cum. Volume bbls	40	80	240	280	320
g/l dissolved minerals	24.24	22.34	32.50	10.83	4.82
Total Litres	6392	6392	25568	6392	6392
Total Grams	154,949.62	142,794.72	830,960.00	69,247.35	30,781.32
Total Kilograms	154.95	142.79	830.96	69.25	30.78

% SD27X In Sample	28.00%	24.65%	31.50%	10.65%	5.00%
Litres SD27X	1,789.76	1,575.63	8,053.92	680.75	319.60
Dissolved g/l	86.58	90.63	103.17	101.72	96.31

Chart 1: Production Gas Rates Before & After HDC MARK II Treatment



Reference: Kasim Selamat - Senior Production Engineer
kasimse@petronas.com.my

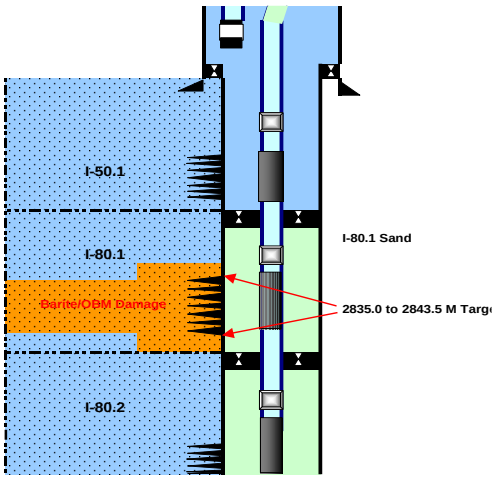
Case History 4.2
HDC MARK II - OBM Barite Dissolving
Petronas Carigali – Resak A3

- **HT Gas Well (325º F)**
- **Deviated**
- **Dual String Completion**
- **OBM Drilling Skin Damage**
- **Conventional Perforated Liner**
- **Multi-stage Bull Head Through Long String Sliding Sleeve**
- **Lifted Using Flow From LS**

Summary: Resak A3 is a dual string gas producer which was severely damaged in the middle target of the long string (I.80 sand) and never produced from this zone. Attempts to bull head acid through the sliding sleeve proved ineffectual. In 2004 PentaFlow cake breaker mixed with PowerPickle® Oil solvent - was bullheaded ahead of HDC MARK II mud barite and solids dissolver system. After 24 hours, the zone was lifted producing 11mmscfd.

Resak A3 is a dual string gas producer drilled by Carigali offshore Terengganu in 1998. The well was completed as a dual string completion to isolate a higher pressure reservoir at the bottom from intermediate production zones above.

The well was badly damaged by the OBM mud used with the middle (I.80 sand) totally impaired and non-responsive to acid treatments.



The zone was isolated from the lower production and bull-headed with 3500 liters each of PentaFlow/PowerPickle® (50/50) and HDC MARK II and allowed to soak overnight. The well was gas lifted from the SSD successfully producing 11 mmscfd and building.

Reference: Kasim Selamat – Senior Production Engineer kasimse@petronas.com.my

Case History 4.3
ESP Cleaning : Maxus/YPF/Repsol Indonesia: Teresia AC6
PentaFlow + Pyrosol ES

- **ESP Scale : Sulfide + Formation + Corrosion**
- **Deviated**
- **Conventional Perforated Liner**
- **Formation Stimulation**

Summary: The ESP in Teresia AC-6 regularly trips from shale/scale build-up and normally requires pump replacement. Cleaning with the **PentaFlow** *and* **Pyrosol ES** *regime needed only 21.5 hours to put the well back on production with no overload on the ESP. The formation was also unexpectedly stimulated when it* ***more than doubled the oil production****, resulting in a* ***payback time of 31 hours****.*

Maxus (YPF Repsol) Indonesia has chronic problems with the build-up of short term shale/scale deposits in their down hole electrical submersible pumps (ESP) in a number of fields. The pumps typically can reach overload in less than 30 days or can last 300 days (or more) of production life if chemical cleaning is successful. More often than not, it has been necessary to pull the pumps completely and replace them.

The debris on the actual pumps was examined, and concluded that the length of time a pump had been exposed down hole determined the type of treatment required to clean the pumps and remove the blockage debris.

In this approach, two distinct treatment regimes were programmed. The first was for pumps designated as “younger” or having been in place less than 180 days, with the second type designated as “older” which had been in service continuously or otherwise for much longer than 180 days.

The Teresia AC-6 ESP had been in service for 211 days producing between **150 to 175 bopd** when it went into over load and tripped out. Attempts to re-start the ESP were unsuccessful and no mechanical or electrical faults were noted. This well was noted for its high scaling potential and the tightness of the formation. It was suspected from previous pumps removed from this well that scale had built up between the diffuser and the impeller.

A treatment of 150 litres of **PentaFlow** was programmed for spotting across the pump in a single 90-minute soak as a pre-cleaning solution. The second stage entailed placing 155 gallons of **Pyrosol ES**, a high performance sulphide and carbonate scale dissolver, across the pump and allowing it to soak for 8 hours. After 8 hours, the **Pyrosol ES** was displaced to 155 gallons of fresh **Pyrosol ES** and the well shut in for 12 hours. **PentaFlow** and **Pyrosol ES** are non-corrosive.

After a total treatment period 21.5 hours, the pump was engaged and operating at full potential without tripping. After seven hours of start up, the well began producing 175 BOPD with no over load on the ESP, cleaning up to **396 bopd** after 36 hours of

continuous production and then levelling to **300 bopd**. The payback time was 31 hours but more importantly, the pump did not require replacement.

BEFORE : Typical ESP impeller and diffuser – pulled due to scaling.

AFTER : The same components as above after cleaning with PentaFlow and Pyrosol ES .

References: Robbie Soekama – Maxus Production Technology
rsoekama@notes.maxus.com
Eddie Suparti Yusuf – Maxus Production Engineering
eyusuf@notes.maxus.com

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July 2002

Case History 4.4
ESP Cleaning : Maxus/YPF/Repsol Indonesia: Zelda AC-1
PentaFlow + Pyrosol ES

- **ESP Scale : Sulfide + Formation + Corrosion**
- **Deviated**
- **Conventional Perforated Liner**
- **Formation Stimulation**

*Summary: The ESP in Zelda AC-1 went into overload losing production of between 279 to 387 bopd. The well as treated with **PentaFlow** and **Pyrosol ES** with the chemicals left in the well bore after verifying the restoration of the ESP function. The tubing was pulled and replaced, leaving the **PentaFlow** and **Pyrosol ES** spotted across the perforations during this period. On re-running the tubing, with the original ESP, production was found to have increased to **1046 BOPD – a 300% increase**.*

CNOOC Indonesia (formerly Maxus YPF Repsol) has chronic problems with the build-up of short term shale/scale deposits in their down hole electrical submersible pumps (ESP) in a number of fields. The pumps typically can reach overload in less than 30 days or can last 300 days (or more) of production life if chemical cleaning is successful. More often than not, it has been necessary to pull the pumps completely and replace them.

The debris from the actual pumps was examined, and concluded that the length of time a pump had been exposed down hole determined the type of treatment required to clean the pumps and remove the blockage debris.

In this approach, two distinct treatment regimes were programmed. The first was for pumps designated as “younger” or having been in place less than 180 days, with the second type designated as “older” which had been in service continuously or otherwise for much longer than 180 days.

The Zelda AC-1 well had been in service producing **279 BOPD** when it went into over load and tripped out. Its peak production had been in excess of **1000 BOPD in 1999** but has declined steadily since. The ESP on this well failed and attempts to re-start the ESP were unsuccessful and no mechanical or electrical faults were noted.

A treatment of 150 litres of ***PentaFlow*** was programmed for spotting across the pump in a single 90-minute soak as a pre-cleaning solution. The second stage entailed placing 155 gallons of ***Pyrosol ES***, a high performance sulphide and carbonate scale dissolver, across the pump and allowing it to soak for 8 hours. After 8 hours, the Pyrosol ES was displaced to 155 gallons of fresh Pyrosol ES and the well shut in for 12 hours. ***PentaFlow + Pyrosol ES*** are non-corrosive.

After a total treatment period 21.5 hours, the pump was engaged and operating at full potential without tripping. The pump was disengaged and the **Pyrosol ES** and

PentaFlow pumped back down through the pump and allowed to soak across the perforations. During this soak period, the ESP was pulled and the tubing replaced. After the intervention the well began producing **1046 BOPD** with no over load on the ESP, maintaining this production without decrease for over one month before this report was prepared and is still producing at that rate.

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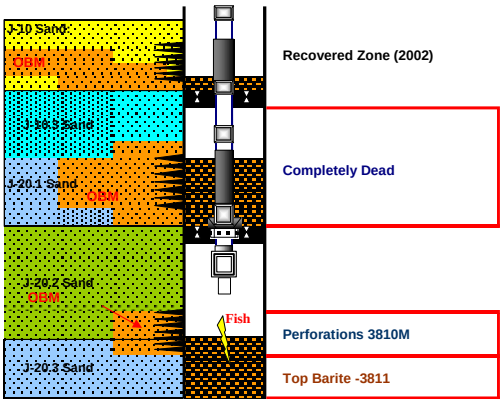
Case History 4.5
HDC MARK II - OBM Barite Dissolving
Petronas Carigali – Resak A10-L

- **HT Gas Well (325º F)**
- **Deviated**
- **OBM – Settled Barite + Acid Damage**
- **Conventional Perforated Liner**
- **Multi-stage Bull Head Through Short String**
- **CTU N_2 Gas Lift**

Summary: Resak A10L was designed to produce 50 mmcfd, but only produced 20 - 25 mmcfd and falling. After pumping 13.0 ppg OBM to kill the well, during a zonal communication problem in 2001 – the well was impaired badly by settled OBM and solids in the formation. Coil tubing washing was attempted with a resulting loss of the jetting head and production was resumed after a poor acid job result. In November 2004 ***PowerPickle*** *oil solvent was bull-headed as a pre-flush to* ***HDC MARK II****. The well was allowed to build up pressure naturally until it came on stream and flowed 45 mmscfd.*

Resak A10 is a dual string gas producer drilled by Carigali offshore Terengganu in 1999. The well was completed as a dual string completion to isolate a higher pressure reservoir at the bottom from intermediate production zones above. Due to communication between



the completions and lack of heavy brine, the well was killed and suspended in 13.0 ppg OBM. On re-entry, it was found that most of the perforations in the short string and long string zones were partially buried under settled barite and OBM. In the upper zone, **HDC MARK II** had been used to restore the well to productivity in 2002, so the same methodology was programmed for the deeper long string which was partially buried under OBM solids. The zone was originally designed to produce 50 mmscfd. At the time of acidizing, the zone was producing between 20 and 22 mmscfd and falling. As CTU was not available – it was decided to bull head the Power Pickle and HDC MARK II although there was no gas lift available. The decision was made expecting the well to take time to clean itself up.

Using 4,000 liters (50/50) **PentaFlow** and **PowerPickle** as a preflush, the lower zone was stage displaced to 9,000 liters of **HDC MARK II**. The well was allowed stand static as the pressure built up over time until it cleaned up and was placed on stream producing 45 mmscfd.

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Case History 4.6
ESP Cleaning – Maxus/YPF/Repsol Indonesia: Farida A11
PentaFlow

- **ESP Scale : Sulphide + Formation + Corrosion**
- **Deviated**
- **Conventional Perforated Liner**

Summary : Maxus (YPF/Repsol) Indonesia has chronic problems with the buildup of short term shale/scale deposits in their down hole electrical (ESP) pumps in a number of fields. The pumps typically can reach overload in under 30 days, or can last as long as three hundred days or more of production life if chemical cleaning is successful. More often than not, it has been necessary to pull the pumps completely and replace them.

The debris from the actual pumps was examined and determined that the length of time a pump had been exposed down hole determined the type of treatment required to clean the pumps and remove the blockage debris.

In this approach two distinct treatment regimes were programmed. The first was for pumps designated as relatively "young" – or having been in place less than 180 days, with the second type designated as "older" which had been in service continuously or otherwise for much longer than 180 days.

The Farida A11 ESP had been in service less than 30 days producing **300** to **350 bopd** when it went into over load and tripped out. Attempts to re-start the ESP were unsuccessful and no mechanical or electrical faults were noted.

A treatment of 800 litres of **PentaFlow** was programmed to be spotted across the pump in two 45 minute soak stages. The first 400 litres was spotted above, through and just below the pump for 45 minutes, with the second stage used to flush the second through the pump and itself allowed to soak for 45 minutes. At the end of the full 90 minutes, the pump was engaged and the well brought onto production immediately. The pump has been producing **310 bopd** since the outset without any overload or tripping since the treatment over the twenty day observation period.

This was a highly successful operation demonstrating that the **PentaFlow** worked very efficiently and quickly in these younger pump blockages. ***The payback time for the operation for the PentaFlow was 20 hours production time.***

References For **PentaFlow** Pump Cleaning:

Robbie Soekama – MAXUS Production Technology
rsoekama@notes.maxus.com

Eddie Suparti Yusuf – MAXUS Production Engineering
eyusuf@notes.maxus.com

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Case History 4.7
OH-Perforation Cleaning –: Carbonate Reservoir Stimulation
CNOOC: Indonesia
PentaFlow

- **Carbonate Reservoir Stimulation**
- **Acid Damaged**
- **Weighted OBM Damage**

Summary :

Summary: The Yani AC-1 well was unsuccessfully stimulated using HCL to cleanout the perforations after completion. Although no chemical explanation could determine what the incompatibility was exactly, the take was that the de-emulsifier and solvent package with the crude was incompatible downhole and the acid by products were in fact causing possible side carbonate liquefaction. ***PentaFlow*** *was used as a last attempt to get the well to flow. Not only did it get the well to flow, but brought the well on stream at 20% more than the anticipated production of 3000 bpd.*

A treatment of 3150 litres of ***PentaFlow*** was programmed for bull heading into the well bore through the perfs and outward. The chemical was pumped and allowed to soak across the perfs – inside and out for 90 minutes, then displaced approximately 36" outward using fresh PentaFlow and water. After allowing to soak for 8 hours, the well was allowed to flow back and clean up on its own which was successful after 24 hours.

Parti Yusuf – Maxus Production Engineering eyusuf@notes.maxus.com

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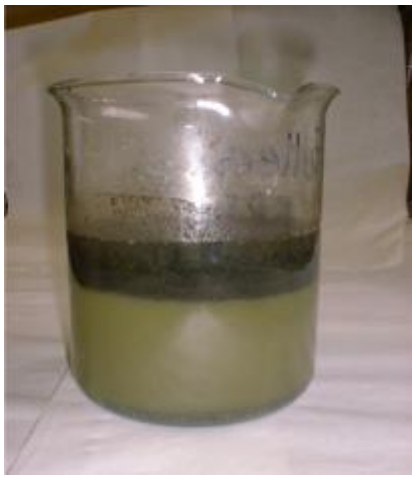
Case History 4.8

ESP Cleaning – Private Contractor For Pertamina
Retrieved Pump – De-scaling Operation On Surface

- **ESP Scale : Sulphide + Formation + Corrosion**
- **Pump on Surface**

Summary : *Summary: The rate of ESP failure in the fields off Indonesia are extremely high due to scale build up and formation solids plating out on the impellers. Although cleaning these downhole had been field proven with some Operators – others were still pulling ESP's and having them treated at surface.* ***PentaFlow*** *was used to soak the ESP's in a bath at ambient temperature to see if this could be done cost effectively. The pumps were soaked in an open tank of* ***PentaFlow*** *and allowed to soak overnight. The pumps were removed and proved to be in pristine condition .*

Photo of fluid removed from soak – note the oil separation from the dissolved scale and corrosion products below:



Typical Before & After Condition of ESPs Being Treated With *PentaFlow*

Case History 4.9

Injector Well Restoration Using HDC MARK II – Monobore - Thailand

- **New Drilled Water Injector**
- **Conventional Perforated Liner**
- **Plugged With OBM – no injection**

Summary :

The well was drilled and completed as a conventional monobore using weighted oil based mud. After cementing the casing, the well was perforated but failed to inject. Reverse flow back and CTU sampling indicated whole oil based mud was in the perforations. Acid failed to make an impact.

The well information was examined and a treatment consisting of **HDC MARK II** was programmed. The programme called for a two stage soak inside the casing and outside into the perforations and matrix to eliminate the barite which appeared to be plugging the well bore.

Due to the urgency of the situation, the Operator decided to proceed with a trial job even though only 50% of the required chemical was available at the particular window for the operation.

CTU was used to place the **HDC MARK II** into the well. The well was bull headed with a solvent pre-flush to remove any gross oil, the followed with the first stage **HDC MARK II** soak.

The **HDC MARK II** was allowed to soak in place for 8 hours, then was displaced into the formation with new **HDC MARK II** lying across the perforations and in the matrix, and the well shut in for 24 hours.

After 24 hours the well was gas lifted using CTU to assist a quick cleanup, then the well placed on injection. ***The well went operational with an injection rate of 8500 bfpd under 1500 psi.***

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Africa & Australia

Production & Well-Bore Intervention Case Histories

- Barite Dissolving: Production Recovery
- ESP Recovery
- Water Injection Recovery

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Case History 5.1

HDC MARK II – ADDAX: OBM Damage – Oil Producer

- **New Drill – Oil Producer**
- **Moderate temperature (140ºF)**
- **Acid Damaged – OBM Damaged – Dead Well**
- **CTU & Gas Lifted**
- **Slotted Liner – OH Completion**

Summary: This well reservoir section consisted of 2,467' of horizontal section drilled and completed in a slotted liner/open hole configuration. With no production seen due to OBM mud solids blockage in an extremely acid sensitive formation, an intervention and well recovery operation was designed using ***PentaFlow/PowerPickle*** *and* ***HDC MARK II****. The recovery programme was implemented bringing the well from 0 BFPD production to 2700 BPD in an operation covering 48 hours.*

OSSU-11H was drilled and completed in the first quarter of 2002, using a 10.7 ppg barite weighted Synthetic Oil Based drilling fluid (SOBM) with a 551 psi overbalance on the formation. An open hole completion was set in place with 9-5/8" casing to 7,630 ft MD (4564 ft TVD) and a 7" slotted liner run in the 8-1/2" open hole to TD @ 10,272 ft MD (2,642 ft of OH).

Due to the overbalance and bridging agents used with the SOBM (barite, calcium carbonate), formation damage was suspected across the near well bore area, hence the inability of the well to flow.

Two subsequent unsuccessful attempts were made to unload the well.

1. Natural gas from an adjacent well was injected down the tubing casing annulus in an attempt to unload the well via the gas lift mandrels. The inability of the gas injection pressure to displace the annular fluid to the targeted lowest GLM, coupled with the fact that flow could not be maintained and adjacent wells had to be put back on production, to mitigate production losses, forced an abandonment of this attempt.

2. Nitrogen was injected down the completion string via CTU @ 200 to 250 scf/min in an attempt to initiate flow. An initial recovery of 60 BLPH (1,440 BLPD) at 60 psi and 80% BS&W was achieved. This rate gradually declined to 30 BLPH (720 BLPD) at 85% BS&W. (450 bbls of formation fluid) and was shut in with 30 psi WHP as natural flow was not possible. Over a 30-day period the tubing pressure gradually increased to 1,100 psi. When opened to production the well flowed crude oil for 20 minutes before gassing out and the FTHP dropped to 520 psig. The well was shut in for build-up and achieved 1,000 psig in 24 hours. When re-opened it gassed out with the FTHP dropping to 500 psig and shut in.

No further attempt was made to flow the well prior to this stimulation job. The shut in tubing pressure prior to this stimulation job was 190 psi.

With oil in the hole a diesel spacer was pumped ahead of the treatment and a CTU utilized to spot the treatment across the slotted liner. While RIH the CT hung up at 8,340 ft **(the maximum depth previously attained by coil was 7,500 ft)**. Slow progress was made on attempts to wash down and the operation was suspended for the night as only daylight operations were performed. On resumption a maximum depth of **8,418 ft** was achieved. It was decided to displace the oil in the hole with diesel and spot a **Power Pickle/PentaFlow** pill (44.5 bbls) across the liner interval. The coil was pulled out of the hole, 150 psi applied at the wellhead and the treatment left to soak overnight.

Upon resumption of the operation noticed that the WHP increased to 190 psi. 22 bbls of the **Power Pickle/PentaFlow** was squeezed into the formation and the coil was run in hole to a maximum of **9,501 f**t. This suggested that the combination of **PowerPickle** and **PentaFlow** had in fact dissolved or dispersed the blockage which had caused the coil to hang up at 8,340 ft. Next 95 bbls of **HDC MARK II** was spotted across the liner interval. The coil was pulled to 7,000 ft and 44 bbls squeezed into the formation. The coil was then pulled to surface, 70 psi WHP applied and the treatment allowed to soak for **42 hrs**. Nitrogen was used to lift the well and the well flowed at **2,700 bpd** at **650 psi** with the well stabilizing to approximately 2500 bpd when completing the report.

January 2005

Case History 5.2
HDC MARK II – Shell Nigeria: Ogini18st

- **New Drill – Oil Producer**
- **Moderate temperature (160ºF)**
- **OBM Damaged – Dead Well**
- **CTU & Bull-Head Above HUD**
- **Excluder Screen – OH Completion**

Ogini # 18ST was drilled in August 1999 using Synthetic mud with barite used as weighing material. The well could not be produced immediately after completions for a period of about 152 days due to community restiveness. Thereafter, it was rocked for two weeks before the completions fluid could be displaced for the well to come in. The well was kicked off on gas lift in March 2000.

The well was subject to frequent surging and from time to time would stop flowing. Diagnosis suggested that the well was not properly cleaned up and the formation was likely to be severely impaired. A clean up attempt was made in January 2001. The clean up was not completed due to encountered HUD at 8477ft.

Production however saw a slight improvement to 1080 bpd with the change in choke size from 36"/64" to open hole done in August 2003. This was not sustainable however and the well continued to drop off. The gas lift valves were changed out in October 2003. A fish was left in the well (HUD) during earlier stimulation operations with a jet blaster tool. As such the subsequent stimulation operation using **PentaFlow** and **HDC MARK II** was bull-headed past this fish. ***At the time of operations, the well was completely dead with no production what so ever***.

Coil tubing was used to run to the top of the fish from where the chemicals were bull-headed. A 50/50 mix of **PentaFlow** and **PowerPickle** was pre-flushed into the well and allowed to soak for 90 minutes. This was subsequently bull-headed into the formation by **HDC MARK II** and the lot allowed to soak for 36 hours.

Nitrogen was used to lift from the HUD. The well came on very quickly, established a stable production rate from its own pressure, at circa 3000 bpd – from 0 bpd.

It is conjectured that due to the fish in the well, it is unlikely that the **HDC MARK II** fluid accessed the total area and that further improvement to the production could be made if the fish could be retrieved and **HDC MARK II** placed uniformly in the well.

Case History 5.3

HDC MARK II – Fish Recovery In HTHP Geothermal Well

- **Geothermal Well**
- **Vertical**
- **Fish Lodged in Settled WBM Barite**
- **Mud Weight 15.5 ppg**

This well is a geothermal well which had a fish lying above and through a milled bridge plug. The fish was identified to be buried in settled water base mud solids, which was 95% barite. I t was necessary to remove the barite which could not be washed away or jetted due to the fish configuration so the Operator decided to try ***HDC MARK II*** *barite dissolver to expose the fish.*

HDC MARK II was air freighted to the location and spotted into the well on top of the fish, which was located circa 2,900'. The fluid was spotted three times with soaks until an over shot was run to tag and grapple the fish if possible.

When reaching the depth of the fish – it was found that the fish had dropped completely when the barite had dissolved. The fish fell to the bottom of the well – in the rat hole where it was no longer problematic.

The Operator was very pleased with the result that saved them a vast amount of time and money on an extended milling and fishing programme.