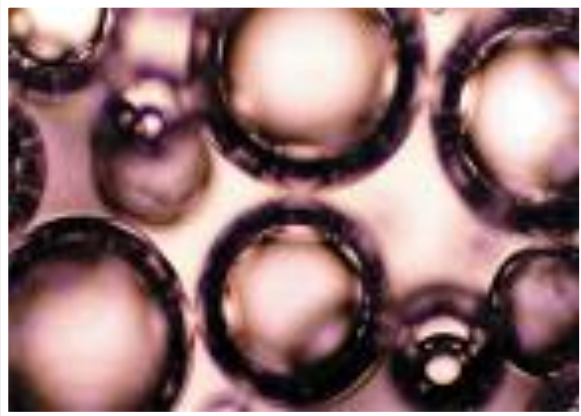


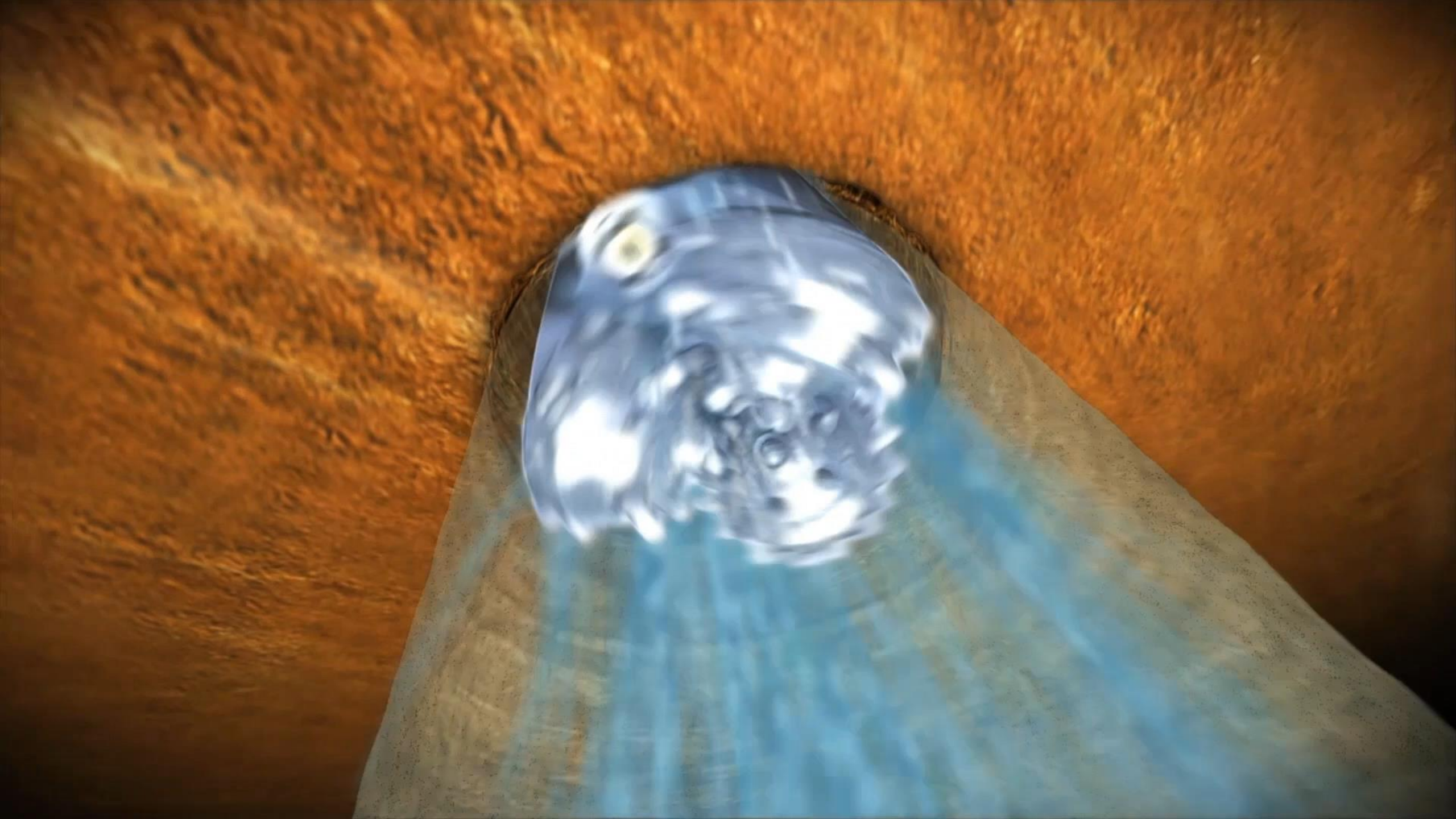


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APHRONICS™

AN ALTERNATIVE TO UBD, MPD, BRIDGING OR OBM





Inside The APHRON FLUID Technologies



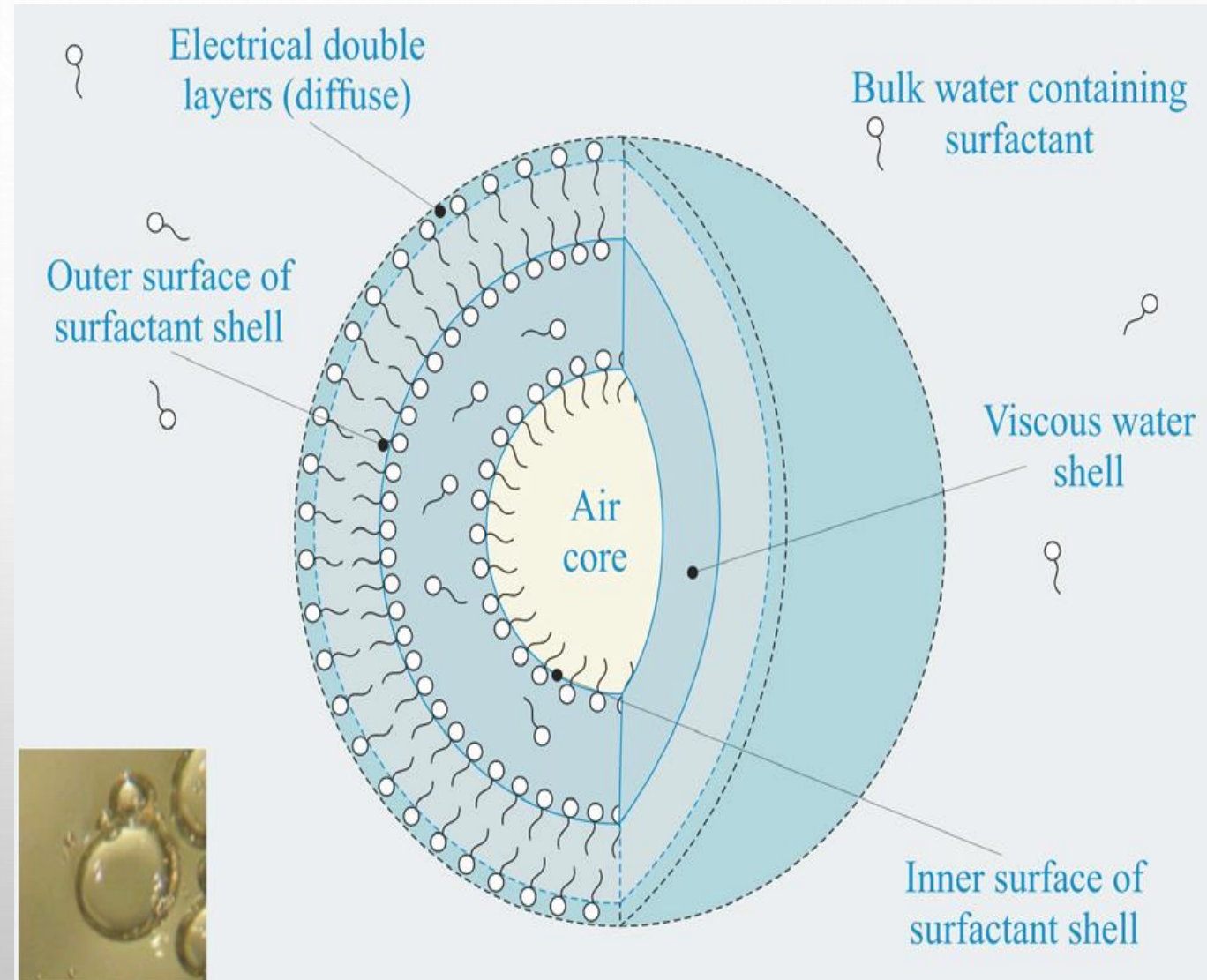


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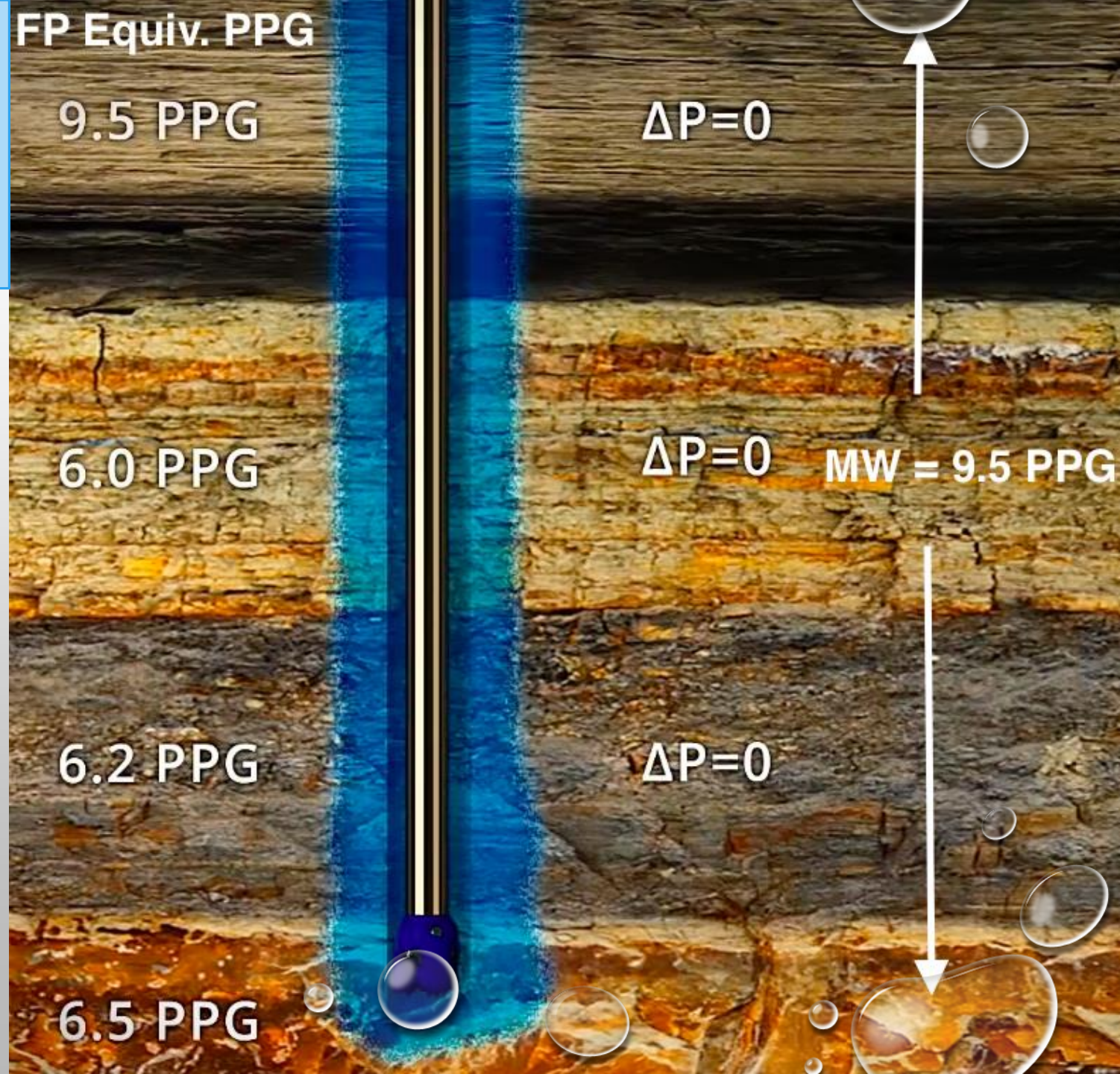
STRUCTURE OF AN APHRON

- Aphrons exist as independent bubbles of air encapsulated by a multi-layer film.
- Aphrons are stabilized with a high yield LSRV polymer. This polymer viscosifies the water “lamella” that surrounds the Aphrons
- Hydrophobic exterior results in low affinity for each other and for mineral surfaces (conventional bubbles are water-wet)



APHRONICS APPLICATION

- DRILLING MULTI-PRESSURE ZONE IN ONE INTERVAL
- DEPLETED FORMATIONS
- RESERVOIR INTERVALS WHERE SHALE IS PRESENCE
- HIGH OVERBALANCE
- FRACTURED CARBONATES
- SENSITIVE SHALES AND HIGHLY DEVIATED WELLS
- UBD AND MPD ALTERNATIVE
- OBM ALTERNATIVE.
- NO DIFFERENTIAL STICKING DUE TO PRESSURE DIFFERENCES.
- ENVIRONMENTALLY FRIENDLY ORGANIC SYSTEM REDUCES DISPOSAL COSTS.
- REDUCED PUMP PRESSURES THAT REDUCE FORMATION DAMAGE.





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APHRONICS ADVANTAGES

- A SOLIDS FREE SYSTEM
- FLEXIBLE WELL DESIGN
- MINIMIZE WHOLE-FLUID INVASION IN DEPLETED FRACTURED FORMATIONS
- BALANCE PRESSURES ENABLING THE USE OF ONE MW TO DRILL MULTI-PRESSURE ZONES
- IMPROVES CEMENT BOND
- IMPROVE BOREHOLE STABILITY IN SENSITIVE SHALES (APHRONS ARE HYDROPHOBIC)
- ELIMINATES DIFFERENTIAL STICKING
- SUPERB RHEOLOGICAL PROPERTIES, HOLE CLEANING IS UNIQUE
- FASTER WELL CLEAN UP AND ENHANCED PRODUCTION
- NO SPECIAL EQUIPMENT NEEDED AS COMPARED TO UNDERBALANCED OR MANAGED PRESSURE SYSTEM

Aphron's System versus Conventional Loss Circulation Material



Centrifuge Overflow

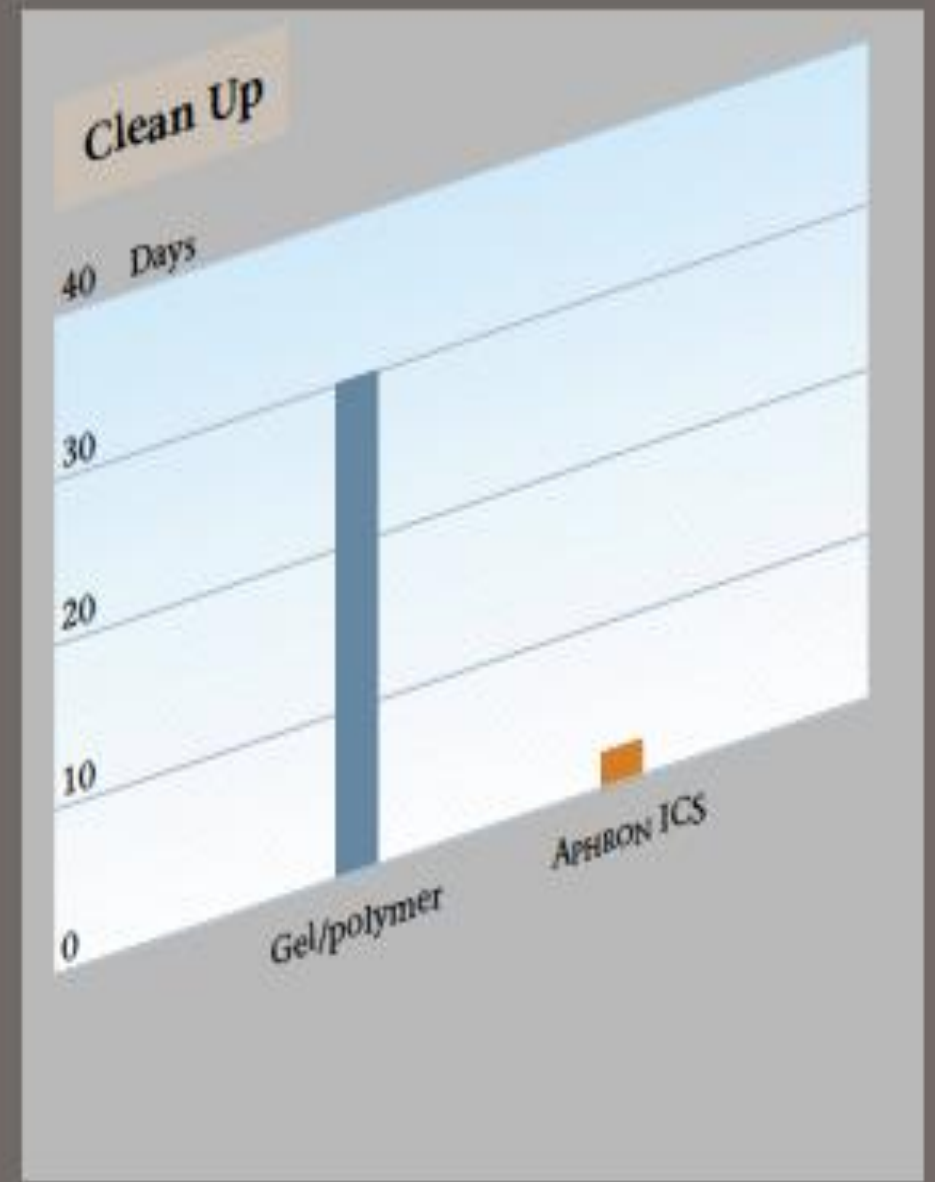
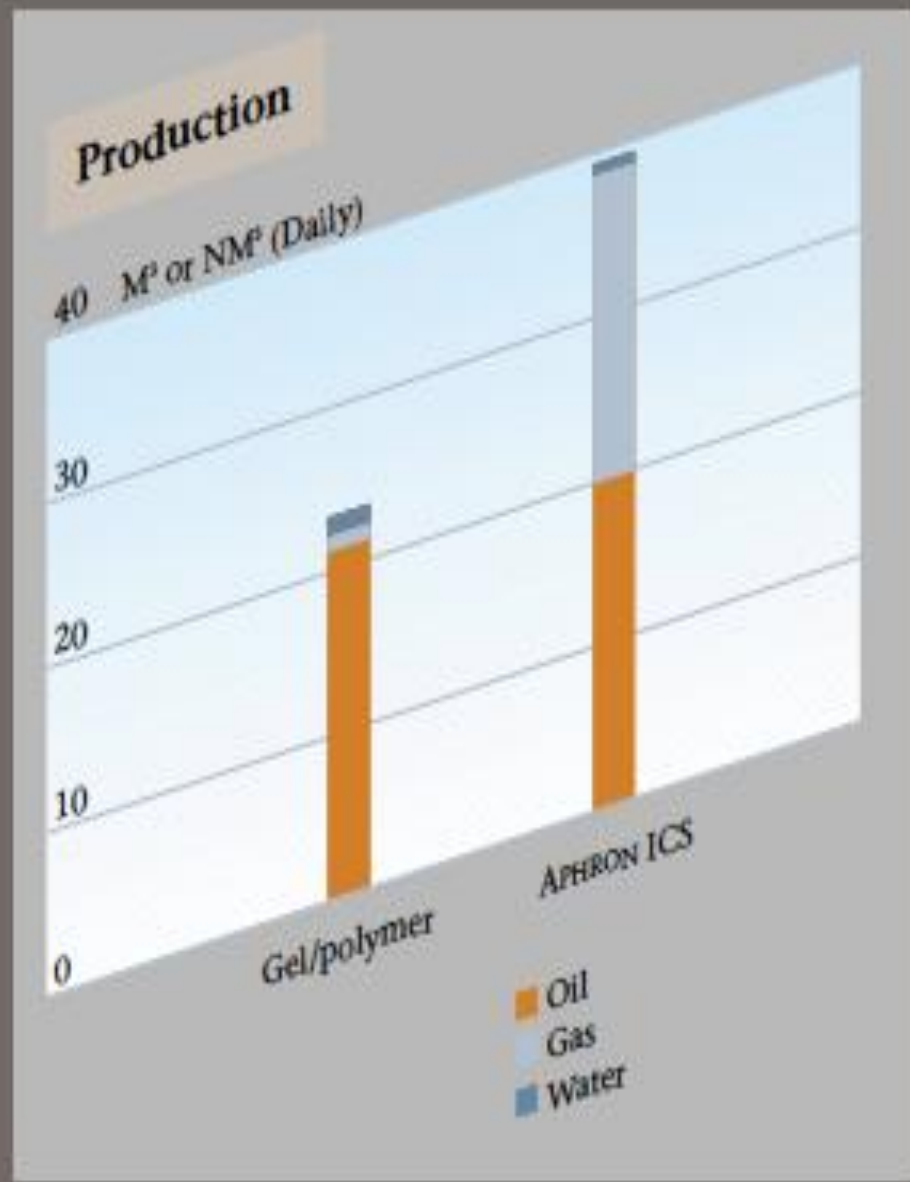
200 Mesh Shaker Screen





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Aphrons Impact on





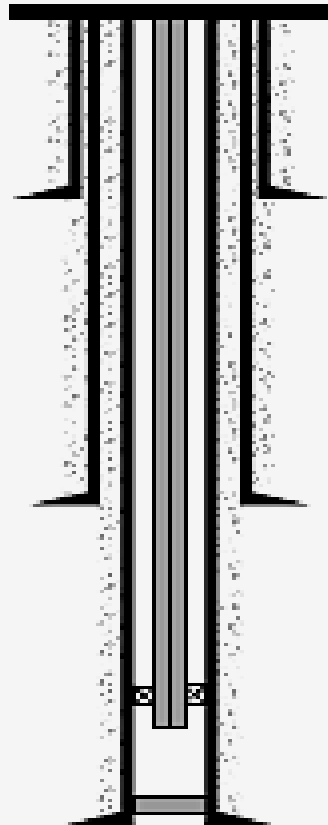
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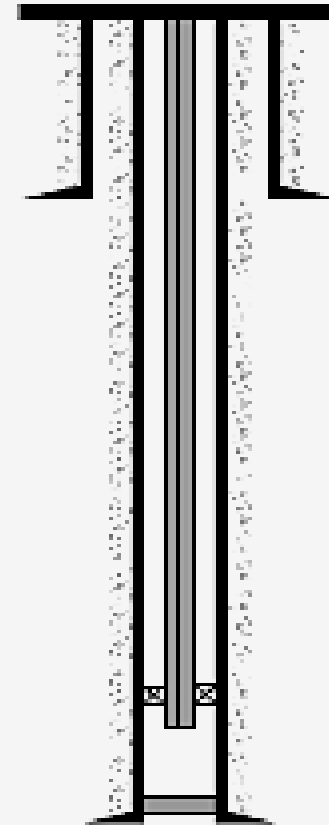
IMPACT ON WELL DESIGN

Aphrons behavior enabled clients in many parts of the world to eliminate at least one casing string

Before Aphron Fluids



After Aphron Fluids





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AphronICS™ - Case Studies





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Where has the system been used?

- **Over 1200 wells worldwide**
- Payzones in **Texas, New Mexico, Oklahoma, California, North and South Dakota and Michigan.**
- Horizontal payzones in **Canada, Kazakhstan, Azerbaijan, etc.**
- Multi-Pressure and depleted payzones in **Venezuela, Colombia, Libya, Algeria, Angola, etc.**
- Loss of Circulation fluid in **Yaman, Iraq, etc.**
- Workover operations in **Mexico, India, etc.**



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AphronICS Fluid Systems

Depleted Sands

Lake Maracaibo, Venezuela

Fractured Granite, Yemen

**DEPLETED , FRACTURED
LIMESTONE, LIBYA**

Vugular Dolomite

Eddy County, New Mexico

*Depleted, Fractured, Vugular Carbonate
Offshore Angola, West Africa*

*Depleted, Fractured, Vugular Carbonate
Onshore Erbil, Kurdistan / Iraq*

*(Nukhul) Depleted Sands Offshore **South Abu Zenima** -
Muzhil-9 / Egypt*



Lake Maracaibo, Area Lagomar, Venezuela

- Mature Formations, Low Pressure
- Pressure Gradient: 0.16 a o.20 psi/ft @ 6,000 feet.
- Equivalent: 2.4 - 3.9 ppg
- Wells drilled with aerated mud: VLA-1271, VLA-1278, VLA-1283, VLA-1285, VLA-1289 & VLA-1291.
- Density equivalent with aerated mud: 4.0 ppg.
- Problems Experienced
 - Unstable borehole due shales, tight hole, differnicial sticking
 - Lost circulation even with aerated mud
 - Lost circulation during cementing
 - Difficulty with logging and using MWD



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WELL VLA- 1321 Results

- *Drilled low pressure zones.*
- *Obtained geological information.*
- *Eliminated need for air equipment.*
- *Obtained cores of producing zones.*

OPERATIONAL ACCOMPLISHMENTS:

- *Drilled well to programmed TD.*
- *Successful electric logs including RFT.*
- *Excellent cementing with full returns.*
- *Drilled without lost circulation.*
- *Successful coring, 390 ft (91% recovery).*
- *Excellent borehole stability.*

ECONOMICAL ACCOMPLISHMENT.

- *Allowed continued development of the Lagomar field*



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Indian Basin Field, Eddy County, New Mexico

H₂S Rich, Highly Fractured and Vugular Dolomite

Project Description:

- ***Kerr McGee drilled 20 wells in the field with 4 different drilling techniques***
- ***Field Characteristics:***
 - ***Highly fractured, low-pressure reservoir***
 - ***Difficulty with loss circulation, reservoir gas control, cementing, well clean-up, and production stimulation***
- **Drilling systems employed and compared:**
 - ***Conventional Water Based Mud (Water mud loaded with LCM)***
 - ***Blind/Dry Drilling (Drill to losses and employ water only afterwards)***
 - ***Air Mist (Drill to losses and use air foam (air, water and surfactant blend)***
 - ***Aphronics (Drill from surface to TD with Aphronics system)***



New Mexico Dolomite Gas Fields Summary

- *Only the AphronICS system showed ability to maintain returns.*
- *Gas entrainment was effective by maintaining hydrostatic pressure in the formation.*
- *Any H₂S introduced in the system is scavenged by cations in the system or converted to soluble Sulfides due to alkaline nature of the buffered pH.*
- *Problem free cementing operations: able to use designed cement slurry without losses.*
- *Although the Aphron System was most expensive of the 4 methods.*
- *Operator reported cost efficiency due to reduced/eliminated losses, reduced water costs, problem free cementing, post well clean-up, little/no stimulation, and faster production times and better rates.*



Yemeni Well Profile

- ***9 5/8 inch shoe depth 2790 meters***
- ***8 1/2 inch hole drilled to 3383m MD, 3128m TVD***
- ***Inclination from 36° to 55°***
- ***Lithology fractured granitic gneiss***
- ***Reservoir pressure 240 - 280 bar, 0.90 sg equivalent***
- ***Open hole completion through fractures***
- ***Normally acid washes used on clean-up phase***
- ***Minimal time to full production with APHRONICS***



Sahel Field, Libya

- *Mature Formations, Low Pressure*
- *Pressure Gradient: Equivalent: 4.5 – 5.0 ppg @ 5,500 feet*
- *Pevouis Wells drilled with low density fluids, UBD*
- **Problems Experienced**
 - *Lost circulation*
 - *Lost circulation during cementing*
 - *Difficulty with logging and using MWD*
 - *High Risk of H₂S*

The Aphron ICS Performance:

- *Successfully drilled to TD without lost circulation.*
- *Eliminated the risk of H₂S, by maintaining overbalance successful electric logs and exceptional cementing with full returns.*
- *At least %60 of the overall drilling cost was saved, in comparison with planned cost and previous wells cost.*
- *Enabled operator to safely further plan the field.*
- *Effective alternative to UBD.*
- *On the third well the operator changed the well design eliminating the intermediate casing.*



Erbil / Kurdistan – TAQA (Atrush B.V.) Well Profile

To minimize formation damage for the reservoir section TAQA decided to drill the 8 ½” section with APHRONICS System. From 1389 m to 1985 m.

- ***Lithology Depleted, Fractured, Vugular Carbonate **H2S Rich*****
- ***Reservoir pressure 4.4 ppg equivalent***
- ***Open hole completion through fractures***
- ***Normally acid washes used on clean-up phase***

The Aphron ICS Performance:

- ***Successfully drilled to TD without lost circulation.***
- ***Eliminated the risk of H2S, by maintaining overbalance successful electric logs and exceptional cementing with full returns.***
- ***Minimal time to full production with APHRONICS***

EGYPT

Petrozenima

Muzhil Field Development

South Abu Zenima –

Muzhil-9





South Abu Zenima Offset wells & key problems

Muzhil-4

Well control situation while tripping 8 ½" hole, increased the mud weight from 9.5ppg to 10.0ppg in steps while run in hole. Electric line tools stopped @ 9,036ft and performed condition trip.

Muzhil-3

8 ½" hole had 60 bph losses @ 450 gpm, Cut M.wt f/9.9 to 9.6 ppg. Very bad hole conditions while drilling 8 ½" hole & sidetrack forced to run 7" liner and perform 6" hole. Dynamic losses up to 60bph while drilling Sudr & Nubia formation in 6" hole losses cured with sized lcm materials.

SAZ-A14

While drilling at depth 12833 ft had complete losses, Decreased pump rat to 250 gpm, Attempted to wash up, Had 25 klbs over pull, Worked on string hard back reaming to 12814 ft, Total losses 500 bbls. Dropped SDD Dart sub, Displaced same with 200 bbls LCM (Loaded with 120 PPB fine marble). Pressure increased from zero to 225 psi and dropped to zero again (Circ. sub opened), Displaced LCM with 250 bbls OBM meanwhile working on string hard back reaming to 12785 ft, Cont' hard ream up from 12785 to 12705 ft, While pumped 10 pph in string.



*(Nukhul) Depleted Sands (770 PSI) Offshore **South**
Abu Zenima - Muzhil-9 / Egypt*

Muzhil – 9 (August 2022)

- 9 5/8" shoe depth 9390 ft
- 8 ½ " hole drilled to 9390 ft MD, 12916 ft MD
- Inclination from 39° to 52° then drop to 45°
- Average losses downhole and surface losses from 2 – 5 bbl./hr (max). → Achieve Target no. 1 from the trial system.
- Now waiting to put the well on production to compare and get results to achieve Target no. 2 (reservoir non-damaging to increase production rate).

