MULTI-STAGE DOWNHOLE WELL STIMULATION

MPC: STIMULATION GENERATED DOWNHOLE

How MPC uses an in-situ exothermic reaction to generate hydrogen, heat, gases and reactive vapors directly at the selected downhole interval.

INSIDE THIS BRIEF

Technical concept supported by published field-application evidence.

WHAT MPC IS

A MULTI-STAGE PHYSICO-CHEMICAL DOWNHOLE STIMULATION METHOD

MPC is a patented, well-specific, multi-stage physico-chemical well-stimulation method based on a controlled in-situ exothermic reaction at a selected downhole interval. The process generates a sequence of gas, thermal and reactive effects intended to improve reservoir-to-well connectivity and address compatible near-wellbore restrictions.

Rather than relying on a single treatment fluid or stimulation mechanism, MPC uses sequentially placed treatment components that react exothermically at the target depth.

SEQUENTIAL DOWNHOLE PROCESS

Treatment components are placed in a defined sequence so that the stimulation process develops progressively across the selected interval.

IN-SITU EXOTHERMIC REACTION

Treatment components are placed sequentially at the selected interval, where they initiate a controlled exothermic — heat-releasing — reaction directly downhole.

HYDROGEN — THE INITIAL GAS PHASE

During the initial reaction stage, hydrogen is generated directly at the selected interval. Because of its high mobility, it is intended to enter connected near-wellbore pathways and establish access for the subsequent stages of the reaction sequence.

FOLLOW-ON HOT GASES AND REACTIVE VAPORS

As the reaction progresses, additional hot gases and reactive vapors are generated. These follow the initial hydrogen phase and contribute additional transport, thermal and chemical effects within the contacted formation volume.

Published technical descriptions report carbon dioxide, carbon monoxide and nitrogen-containing gaseous products together with reactive acid vapors as part of the subsequent reaction stages.

MULTI-MECHANISM STIMULATION

The complete MPC process combines in-situ hydrogen generation, gas and vapor transport, thermal action and reactive stimulation within one well-specific downhole sequence. Hydrogen initiates the process; the stimulation effect comes from the complete reaction environment.

PATENTED TECHNOLOGY

The MPC technology is described in **U.S. Patent No. 10,947,827 B2, “Method for Exerting a Combined Effect on the Near-Wellbore Region of a Production Formation.”**

A field application of the technology is documented in **OTC-34832-MS, Offshore Technology Conference Asia 2024**.

ONE DOWNHOLE REACTION. MULTIPLE STIMULATION MECHANISMS.

HYDROGEN GENERATION → GAS/VAPOR TRANSPORT → THERMAL ACTION → REACTIVE STIMULATION

THE HYDROCARBONS MAY STILL BE THERE. THE FLOW PATH MAY NOT BE.

A well can underperform even when recoverable hydrocarbons remain in the reservoir. The problem may be located around the wellbore, inside the perforations or within the connected formation volume.

POSSIBLE RESTRICTIONS INCLUDE

TIGHT FORMATION PATHWAYS	Low permeability and limited connectivity restrict movement toward the well.
POOR TREATMENT PENETRATION	Conventional stimulation fluids may remain concentrated around the perforations instead of reaching the deeper restriction.
WAX AND ASPHALTENE	Heavy organic material can narrow or block pores, fractures and perforation channels.
ACID-SOLUBLE DAMAGE	Mineral deposits or formation damage can create another restriction to production.
MULTIPLE OVERLAPPING BARRIERS	Many mature wells contain more than one production-limiting mechanism. Removing only one restriction may therefore produce a limited or short-lived response.

THE CENTRAL QUESTION

HOW DO YOU CREATE ACCESS BEFORE TRYING TO TREAT THE RESTRICTION?

This is where the MPC downhole reaction sequence becomes relevant.

THE ACTIVE REACTION IS CREATED AT THE TARGET INTERVAL.

MPC does not transport a large volume of hydrogen from the surface. Treatment components are placed at the selected downhole interval, where a controlled multi-stage reaction begins. Hydrogen is generated during the initial stage of that reaction.

HOW THE PROCESS BEGINS

01	**Position the treatment at the target interval**	Treatment components are placed opposite the selected perforations or formation zone.
02	**Initiate the controlled downhole reaction**	The system begins reacting under controlled conditions at the treatment depth.
03	**Generate the initial hydrogen phase**	The initial reaction stage releases highly mobile hydrogen at or near the restricted formation interval.
04	**Establish access into connected pathways**	The hydrogen begins entering pores, micro-scale channels and connected near-wellbore pathways.
05	**Develop the follow-on gas, thermal and reactive stages**	As the reaction sequence progresses, additional hot gases, reactive vapors and thermal effects are generated and can act within the formation volume contacted during the initial stage.

THE IMPORTANT DIFFERENCE

THE REACTION BEGINS WHERE THE STIMULATION IS NEEDED.

The process does not rely only on pushing another liquid treatment from the surface into an already restricted formation. The initial hydrogen phase is generated directly opposite the selected interval, followed by additional hot gases, reactive vapors and thermal effects.

ACCESS MUST COME BEFORE THE FOLLOW-ON EFFECTS CAN ACT.

Later thermal and reactive effects can only act where the treatment sequence can physically reach. MPC therefore generates a highly mobile hydrogen phase early in the reaction to help establish access into connected near-wellbore pathways.

THE ROLE OF HYDROGEN WITHIN THE MPC SEQUENCE

EARLY MOBILITY	Hydrogen appears before the major thermal and follow-on chemical stages.
FORMATION ACCESS	Its high mobility helps it enter small connected pathways within the near-wellbore formation.
TRANSPORT CONDITIONS	As hydrogen moves through the accessible formation volume, it prepares the path for subsequent gases and reactive vapors.
INTERACTION WITH HEAVY HYDROCARBONS	Under the downhole reaction environment, hydrogen may also support reactions involving wax, asphaltene and other heavy organic material.

IN SIMPLE TERMS

HYDROGEN INITIATES ACCESS. THE COMPLETE MPC SEQUENCE PROVIDES THE STIMULATION EFFECT.

Hydrogen is an enabling first stage — not the complete stimulation mechanism.

MPC CREATES A SEQUENCE OF LINKED DOWNHOLE EFFECTS.

Hydrogen generation is the initiating stage of a broader gas, thermal and reactive sequence. Each stage creates conditions for the stage that follows.

01

HYDROGEN GENERATION

Hydrogen is produced directly at the selected downhole interval.

Purpose: create the first mobile phase inside the restricted area.

02

FORMATION ACCESS

Hydrogen moves into connected pores and micro-scale pathways around the wellbore.

Purpose: improve access to a larger formation volume.

03

GAS TRANSPORT

Additional hot gases and reactive vapors generated by the reaction sequence move through the volume contacted during the initial hydrogen stage.

Purpose: carry subsequent effects beyond the immediate perforation area.

04

THERMAL ACTION

The reaction generates heat directly downhole.

Purpose: warm the contacted region and help mobilize heavy organic deposits.

05

ORGANIC MOBILIZATION / CONVERSION

Hydrogen and heat create an environment intended to act on wax, asphaltene and other heavy hydrocarbon restrictions.

Purpose: reduce organic blockage and restore hydrocarbon movement.

06

REACTIVE STIMULATION

Later reaction products provide an additional chemical effect against compatible mineral or formation damage.

Purpose: complement the hydrogen, transport and thermal stages.

HYDROGEN GENERATION → FORMATION ACCESS → GAS/VAPOR TRANSPORT → THERMAL ACTION → ORGANIC MOBILIZATION → REACTIVE STIMULATION

The commercial value comes from the complete sequence.

DO NOT FORCE THE ENTIRE EFFECT FROM THE SURFACE. CREATE IT AT THE TARGET DEPTH.

Conventional well treatments often depend on pumping a fluid from the surface and forcing it into the formation. That approach can face several limitations:

- restricted injectivity;
- poor fluid penetration;
- fluid loss;
- reaction close to the wellbore;
- limited contact with the deeper restriction; and
- rapid consumption of the active treatment.

MPC uses a different operating logic: the principal reaction environment is generated at the selected downhole interval.

THE EFFECT BEGINS INSIDE THE WELL

AT THE SELECTED DEPTH

The reaction begins opposite the interval requiring treatment.

AFTER PLACEMENT

The system is positioned before the principal reaction cascade develops.

WITH A MOBILE FIRST STAGE

Hydrogen appears at the beginning of the process.

WITH MULTIPLE FOLLOW-ON PHASES

Following initial hydrogen generation, additional hot gases, reactive vapors and thermal effects develop as part of the controlled reaction sequence.

WITHOUT DEPENDING ON ONE MECHANISM ALONE

The system is designed to address several potentially overlapping restrictions.

THE COMMERCIAL DIFFERENCE

THE TECHNOLOGY DOES NOT ONLY DELIVER CHEMISTRY. IT CREATES A REACTION ENVIRONMENT DOWNHOLE.

MPC IS MOST RELEVANT WHEN REVERSIBLE FORMATION OR NEAR-WELLBORE RESTRICTIONS ARE PART OF THE PROBLEM.

TIGHT OR POORLY CONNECTED PATHWAYS	**Relevant MPC mechanism:** initial gas-phase access followed by gas/vapor transport and thermal/reactive effects.
LIMITED TREATMENT PENETRATION	**Relevant MPC mechanism:** downhole generation of a mobile gas phase before subsequent stimulation stages.
WAX AND ASPHALTENE RESTRICTIONS	**Relevant MPC mechanism:** combined hydrogen, thermal and reactive environment intended to mobilize or alter heavy organic material.
MULTIPLE FORMS OF NEAR-WELLBORE DAMAGE	**Relevant MPC mechanism:** multi-stage gas, thermal and reactive effects rather than reliance on a single treatment mechanism.
SHORT-LIVED RESPONSE FROM EARLIER INTERVENTIONS	**Relevant MPC mechanism:** help the complete reaction sequence reach a formation volume that may not have been effectively contacted previously.

IMPORTANT SCREENING PRINCIPLE

Not every underperforming well is an MPC candidate. The technology is most commercially relevant when the operator can identify:

- credible remaining hydrocarbon potential;
- a potentially reversible production restriction;
- evidence that formation access may be limited;
- possible organic or mineral damage;
- acceptable mechanical well condition; and
- a measurable production baseline.

A SUCCESSFUL MPC APPLICATION STARTS WITH THE RIGHT WELL.

The treatment must be designed around the individual well.

01 IDENTIFY THE LOST PRODUCTION

Determine when production declined and which fluid phases were affected.

02 SEPARATE THE POSSIBLE CAUSES

Distinguish formation restriction from mechanical failure, artificial-lift limitations, pressure depletion and other competing mechanisms.

03 CONFIRM MPC TECHNICAL FIT

Evaluate whether restricted connectivity, organic deposition, compatible formation damage or other potentially reversible restrictions could be contributing to lost production.

04 TEST FLUID COMPATIBILITY

Confirm that the proposed reaction environment is compatible with representative well and reservoir fluids.

05 DESIGN THE DOWNHOLE PLACEMENT

Define the target interval, treatment volume, conveyance method and reaction program.

06 INITIATE THE MPC REACTION AT THE TARGET

Position and initiate the treatment so that the controlled reaction develops directly opposite the selected interval.

07 ALLOW THE CASCADE TO DEVELOP

Initial hydrogen generation is followed by gas/vapor transport, thermal action and reactive stimulation.

08 MEASURE THE PRODUCTION RESPONSE

Compare post-treatment performance against a clearly documented baseline.

DIAGNOSE → SCREEN → TEST → PLACE → GENERATE → MEASURE

The chemistry does not replace diagnosis. A successful application begins with the correct well hypothesis. For this reason, MPC engagement begins with candidate screening rather than an immediate treatment recommendation.

THE CONCEPT HAS MOVED BEYOND THE LABORATORY.

A published OTC Asia 2024 paper co-authored by Kuwait Oil Company personnel documented a two-well onshore Kuwait field application of the multi-stage downhole stimulation technology. The documented mechanism included in-situ hydrogen generation followed by thermal and reactive effects.

THE REPORTED APPLICATION INCLUDED

- candidate evaluation;
- well-specific treatment design;
- downhole placement;
- controlled in-situ reaction;
- initial hydrogen generation;
- follow-on gas, thermal and reactive effects; and
- six months of production monitoring.

Both wells reportedly produced at higher average oil rates after the treatment period.

WHAT THIS INDICATES

The field application provides a credible reason to evaluate the technology for technically suitable wells. It demonstrates that:

- the complete multi-stage reaction sequence can be generated and deployed under field conditions;
- hydrogen can be generated in situ as the initial gas phase within that sequence;
- the complete reaction system can be deployed under field conditions;
- the wells can be returned to production after treatment; and
- the resulting production response can be monitored over time.

WHAT IT DOES NOT MEAN

The field application does not establish that every mature, tight or organically damaged well will respond in the same way. Actual performance depends on:

- reservoir conditions;
- formation connectivity;
- type and location of damage;
- mechanical well condition;
- fluid properties;
- treatment placement;
- operating conditions; and
- quality of the pretreatment baseline.

Supporting technical references: OTC-34832-MS, Offshore Technology Conference Asia 2024; U.S. Patent No. 10,947,827 B2. Results were case-specific and should not be interpreted as a universal performance guarantee.

COULD MPC ADDRESS THE RESTRICTION IN YOUR WELL?

The next step is not an immediate treatment proposal. It is a preliminary technical screen to determine whether the production decline, remaining potential and suspected restriction are consistent with the mechanisms MPC is designed to address.

INITIAL SCREENING INFORMATION

- 01 Well, field and formation
- 02 Completion and perforated interval
- 03 Production history
- 04 Current oil, gas and water rates
- 05 Last meaningful stabilized production rate
- 06 Reservoir pressure and temperature, if available
- 07 Oil properties and known wax or asphaltene issues
- 08 Previous acid, solvent, thermal or stimulation treatments
- 09 Artificial-lift and mechanical status
- 10 Operator's current diagnosis of the lost production

REQUEST AN MPC CANDIDATE FIT REVIEW

We will evaluate whether the available well evidence supports moving to a more detailed candidate assessment.

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Technical screening only. No treatment recommendation or performance commitment is made before well-specific evaluation.