

MAJUS
Synergy



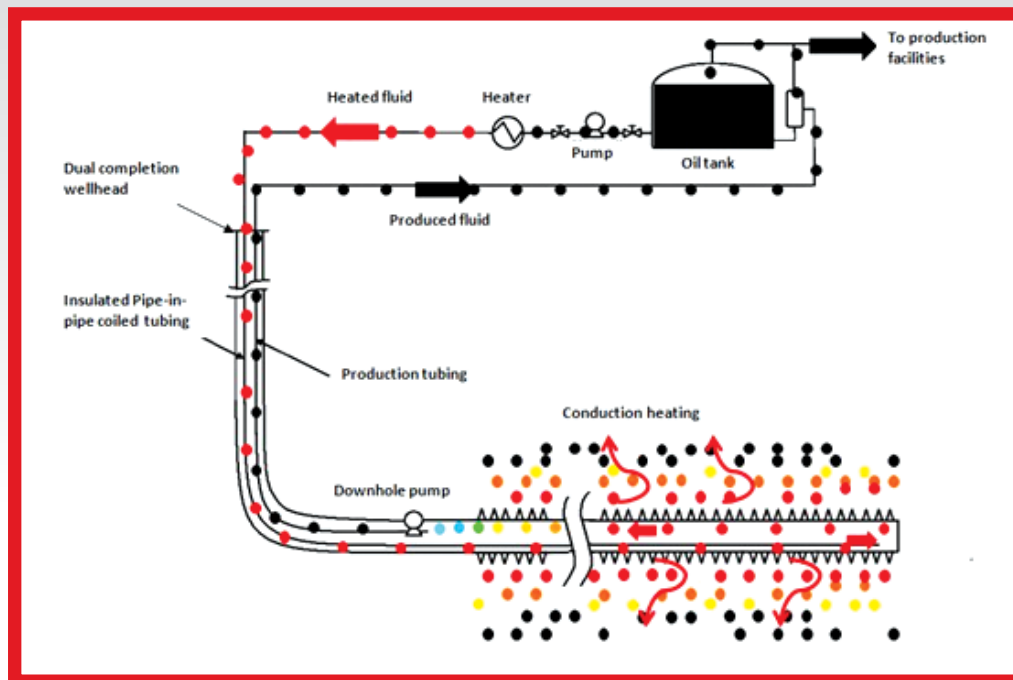
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TOR TECHNOLOGY



TOR technology heats an oil reservoir by conduction using a circulation of hot fluid in the wells which reduces the viscosity of heavy oil in the reservoir around the well. Heating by conduction necessitates a significant temperature gradient between the hot source and the cold one. Therefore, this technology requires very high performance insulation material that avoids thermal loss between the surface heat source and the production zone.

Part of the oil produced is directed to a buffer tank from where it is pumped to a heater and then into an insulated TOR coiled tubing run till the toe of the horizontal well. Oil is mixed with the produced fluids on the horizontal section of the system. During their flow in the horizontal section, the heated fluids heat the formation by conduction thereby reducing oil viscosity in the vicinity of the well and increasing flow rate.



N.B: The vertical section of the project is completed with a conventional production tubing and pump. The TOR tubing is a pipe-in-pipe with insulating material in the spaces between the pipes.

- 🔥 Small footprint of TOR units
- 🔥 No contamination of oil field
- 🔥 No water requirement
- 🔥 No extra water separation requirement
- 🔥 Most efficient way of using the energy available on the field
- 🔥 Easily combined with other EOR technologies
- 🔥 Ideal for peripheral oil wells

APPLICABLE FIELDS

TOR technology can be adapted to:

- 🔥 Small fields, peripheral wells and high pressure reservoirs (where steam drive is not economical).
- 🔥 Stimulation, pre-heating and early production in steam flood, solvent flood, SAGD, VAPEX and in situ combustion.

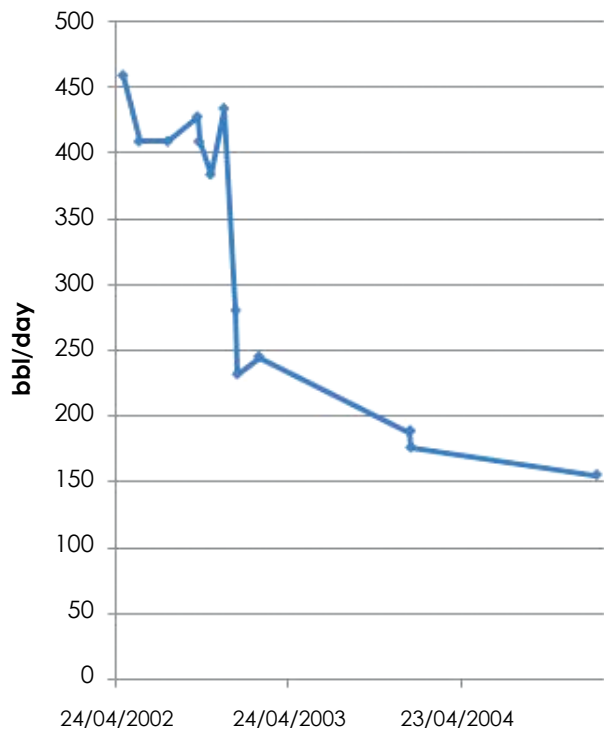
TOR technology can be applied to:

- 🔥 Existing driving mechanism : primary production and natural or forced water flood
- 🔥 8 to 20° API
- 🔥 300 to 1000m deep reservoirs
- 🔥 500 to 2500m long horizontal sections

- 🔥 Reservoir: 800m
- 🔥 Horizontal section: 1000m
- 🔥 Reservoir pressure: 30 bars
- 🔥 Average permeability : 2 Darcy
- 🔥 Oil gravity : 15°API
- 🔥 Reservoir temperature : 50°C
- 🔥 WOR : < 5%
- 🔥 Inner tubing coiled tubing OD : 1.315 in
- 🔥 Outer tubing coiled tubing OD : 2.375 in
- 🔥 Oil temperature at heater exit : 230°C
- 🔥 Oil temperature at injection at toe of horizontal well: 220°C
- 🔥 Majus-Synergy coiled tubing overall heat transfer coefficient : 1.1 W/(m².K)

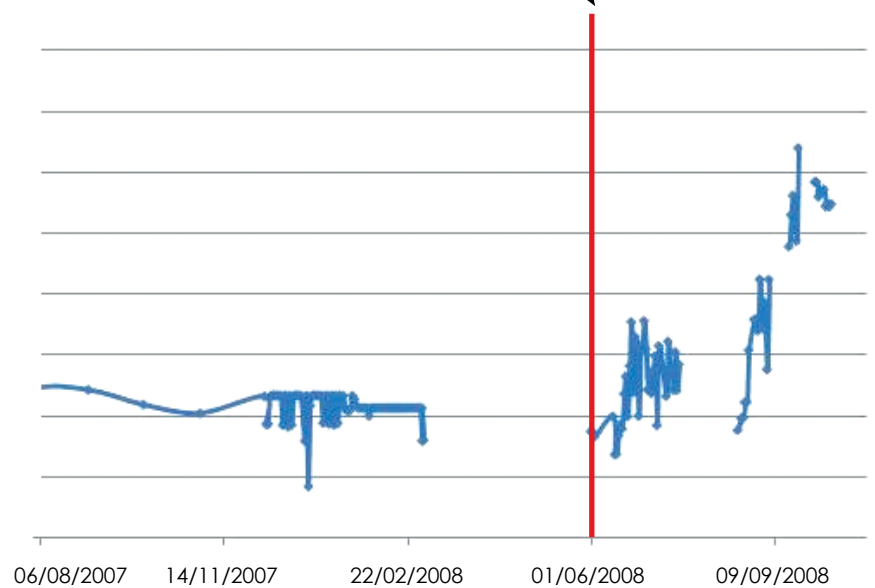
TECHNOLOGY	REGION	LENGTH	TUBING DIMENSION	TEMPERATURE	U-VALUE W/(m ² .K)	INSTALLED
TOR	S America	1800 m	1/2" x 1"1/2	150 °C	1,0	2005
TOR	Middle East	1800 m	1"1/2 x 2"3/8	230 °C	1,1	2008
I-TUBING	W Africa	1800 m	2"3/8 x 4"1/2	40 °C	0,6	2008
TOR	N America	2500 m	1"1/4 x 2"3/8	180 °C	0,9	2012
I-TUBING	Middle East	2 x 900 m	3"1/2 x 5"1/2	310 °C	0,7	2012
I-TUBING	Middle East	24 x 900 m	3"1/2 x 5"1/2	310 °C	0,7	2012
I-TUBING	Middle East	100 x 900 m	3"1/2 x 5"1/2	310 °C	0,7	2012
I-TUBING	Middle East	3 x 900 m	3"1/2 x 5"1/2	310 °C	0,7	2012
TOR	N America	1800 m	1"1/4 x 2"3/8	230 °C	1,1	2013
I-TUBING	Middle East	100 x 900 m	3"1/2 x 5"1/2	310 °C	0,7	2013

Net oil flow rate since 1st oil



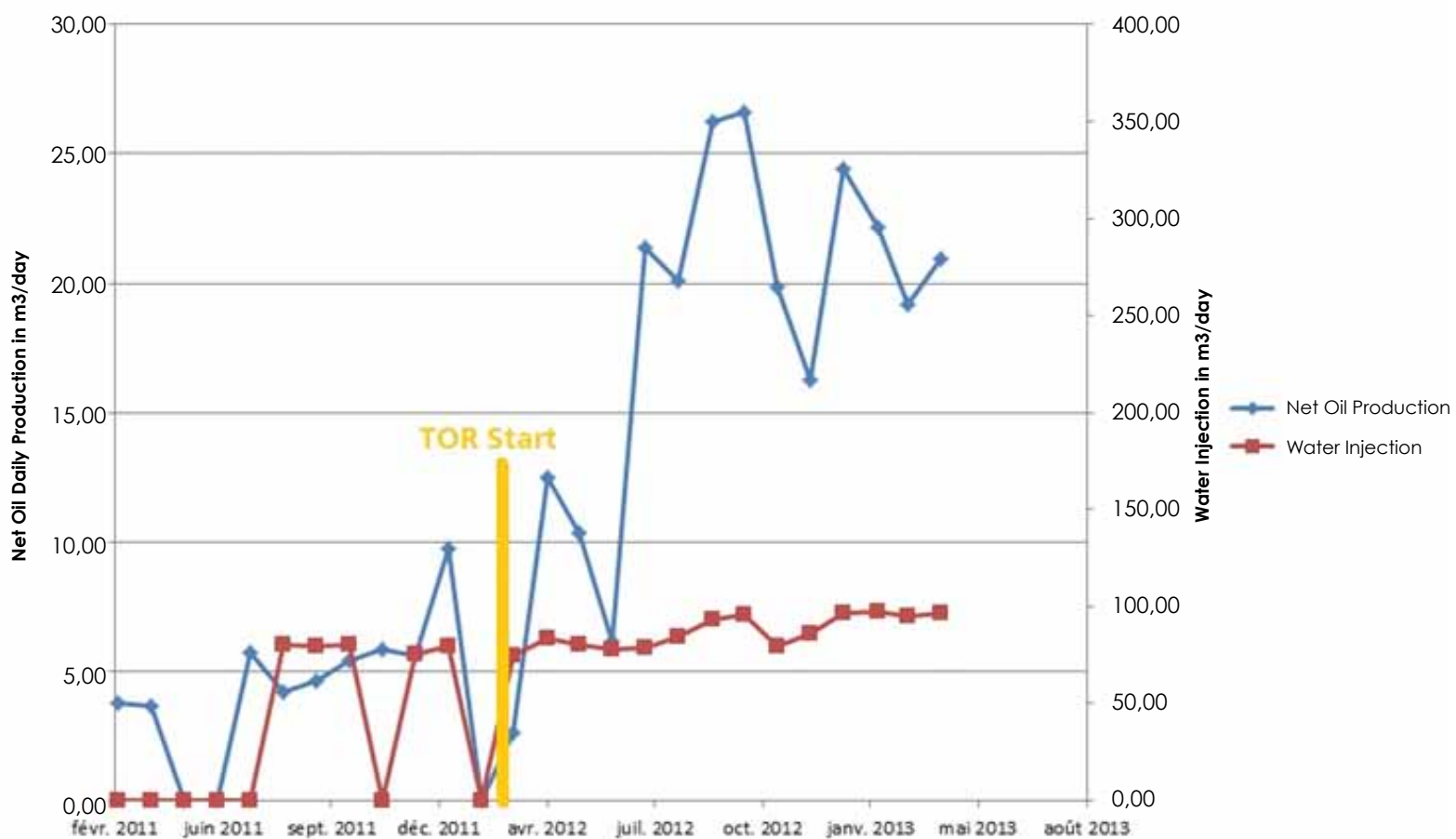
TOR pilot start-up on 12/06/08

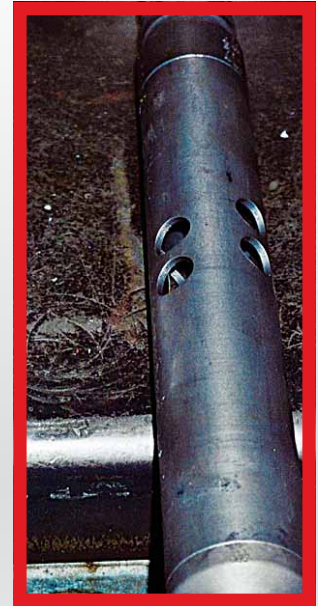
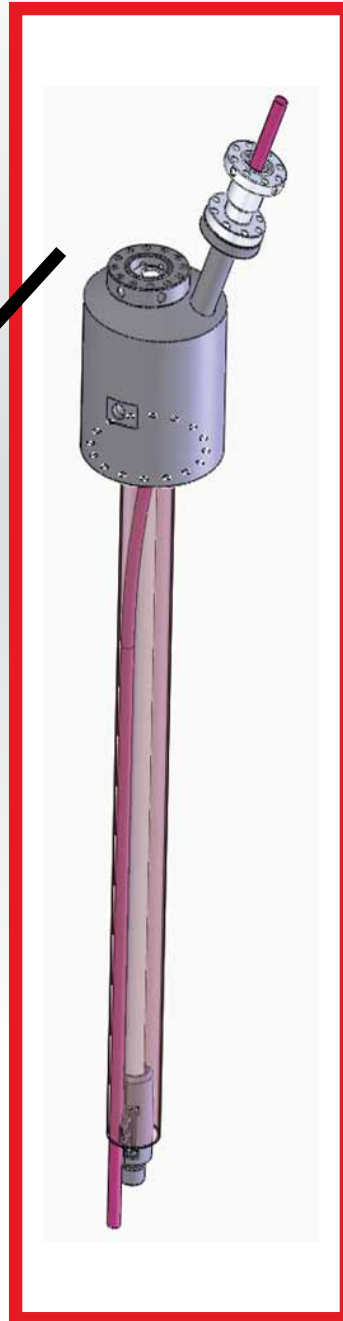
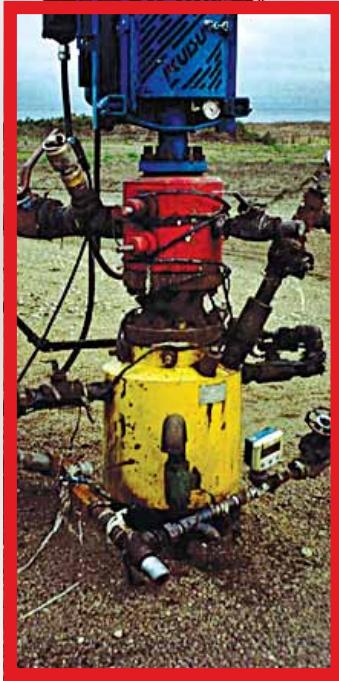
Net oil flow rate was increased ca. threefold



(* Details in IPTC 13695 report (IPT Conference, Qatar, December 2009).

Net oil flow rate in m3/day







WORKOVER



- 🔥 The existing well head is replaced by the new well head with its side entry port for subsequent installation of coiled tubing.
- 🔥 The production tubing is inserted together with the artificial lift devices.
- 🔥 The insulated pipe-in-pipe coiled tubing is inserted within a few hours.





Buffer tank



Heating skid and control cabinets

Surface equipment is designed to limited connection operations to the power source: oil, gas or electricity as part of a “plug-and-play” solution offered by Majus-Synergy.



Coiled tubing spooler



Dedicated insulation fabrication line

Majus-Synergy, together with ITP, developed a continuous fabrication line capable of timely efficient delivery and offering a high quality control process.



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