hallenges with the Production of Heavier Crudes

TRANSFORMING THE INDUSTRY

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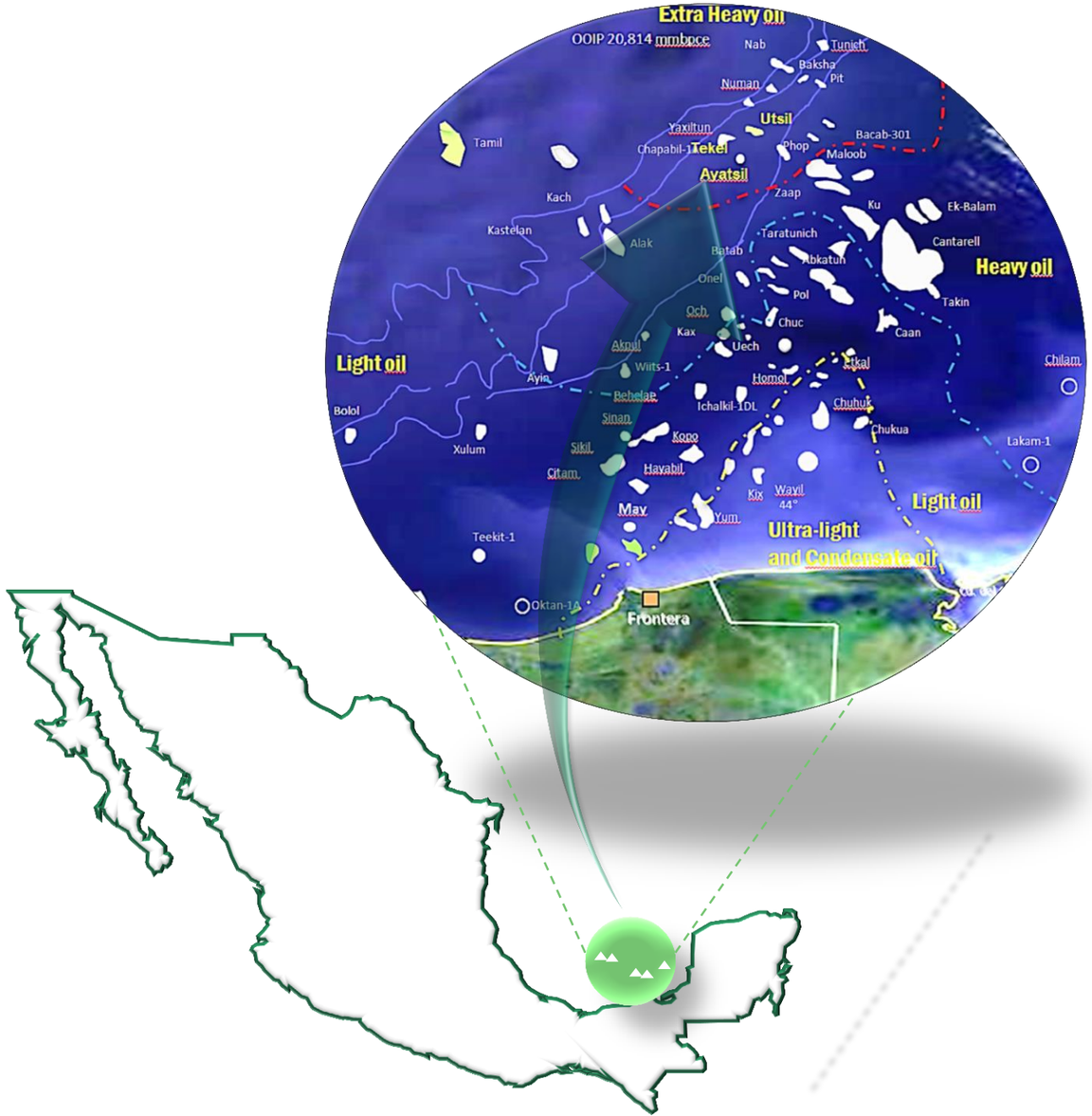
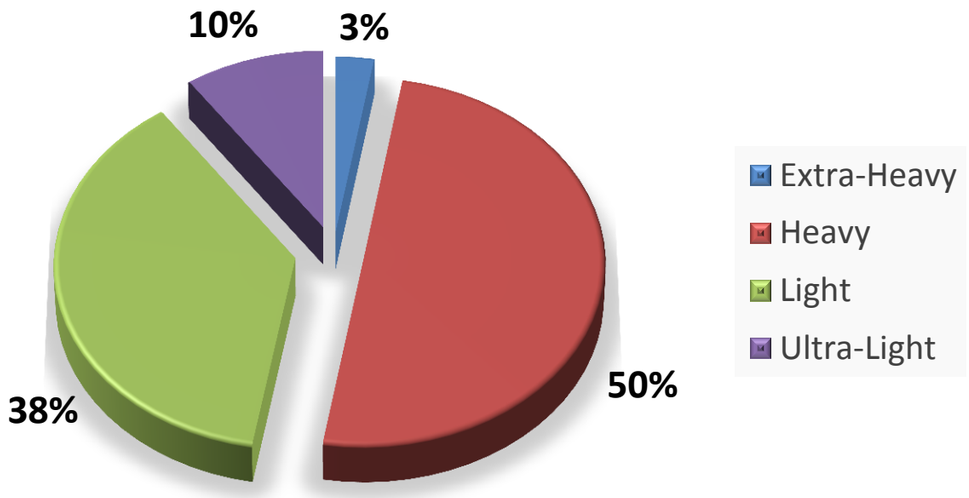
Introduction

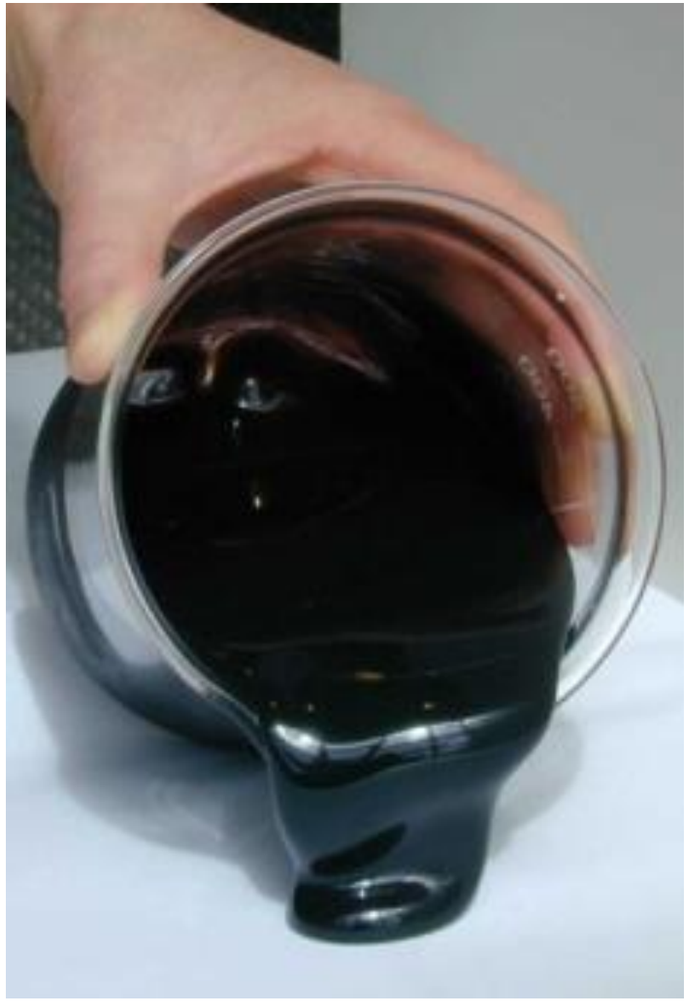


According to Oil in Place, the distribution by type of oil in Mexico is composed as follows:



Extra-heavy oil (<10 °API)	Heavy oil (11 a 22 °API)
Light oil (22 a 38 °API)	Ultra-light and Condensate oil (>39 °API)

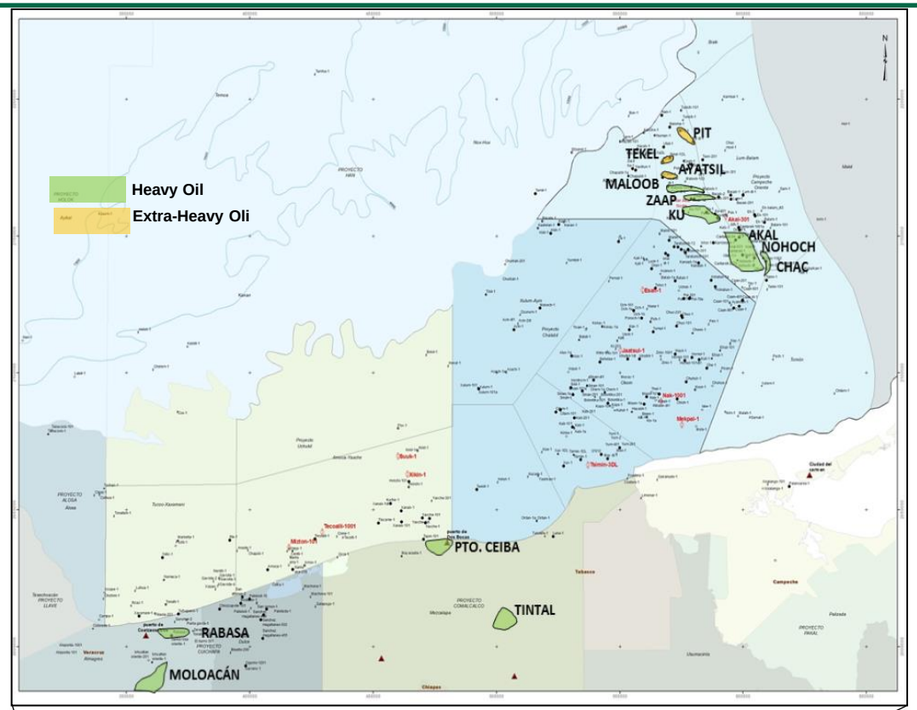
Field General Properties



Field Properties	Extra-Heavy
°API*	≤ 11
Viscosity (cP) @ r.c.	~60
GOR (m^3/m^3)	~20
H_2S %, Gas Mol	**≥20**
CO_2 %, Gas Mol	**≥16**
Temperature (°C)	110 -122
Permeability (Darcy)	6-14
Porosity (%)	~9
Saturation pressure (kg/cm^2)*	~50

0.10 % of H_2S = 

Exploitation Experience



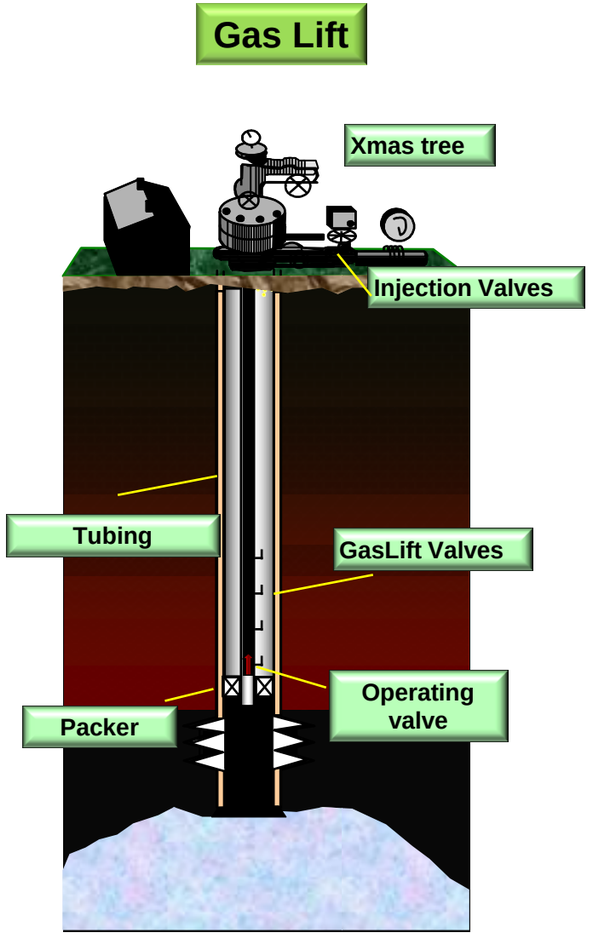
The Major Experience of Oil Exploitation in Mexico is concentrated in Heavy Oil from fields like:

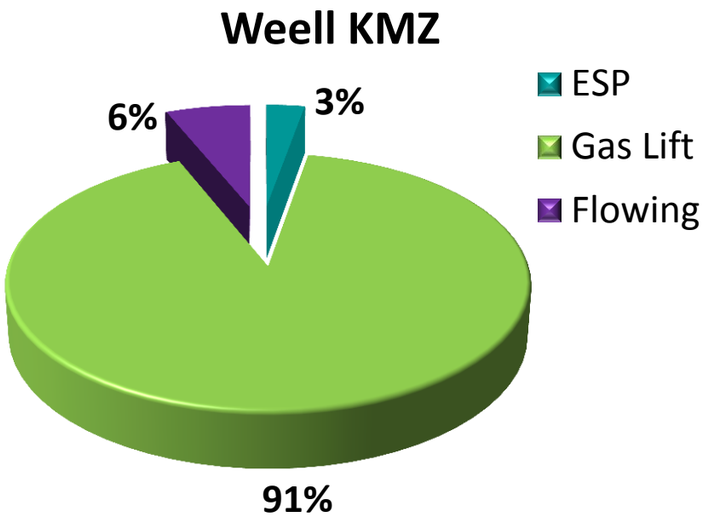
- ✓ Akal
- ✓ Nohoch
- ✓ Chac
- ✓ Ku
- ✓ Maloob
- ✓ Zaap
- ✓ Pueto Ceiba
- ✓ Tintal
- ✓ Moloacan
- ✓ Rabasa

In contrast, the production of Extra-Heavy Oil is carried out only in:

- ✓ Ayatsil
- ✓ Tekel
- ✓ Pit
- ✓ Ogarrio
- ✓ Cacalilao

Artificial Lift Experience (Gas Lift)





Heavy oil fields are produced depending on the pressure of the reservoir, through natural flow or by continuous gas lift:

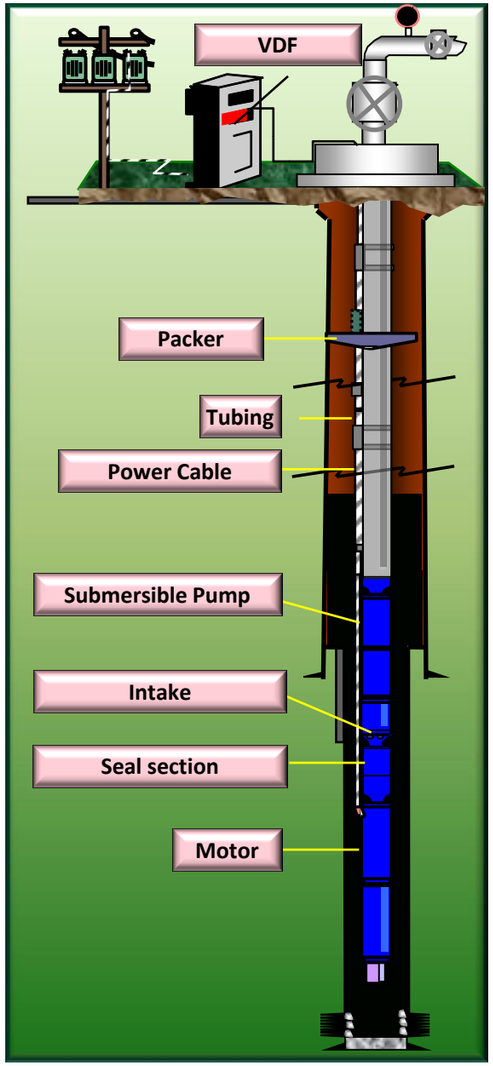
Advantages:

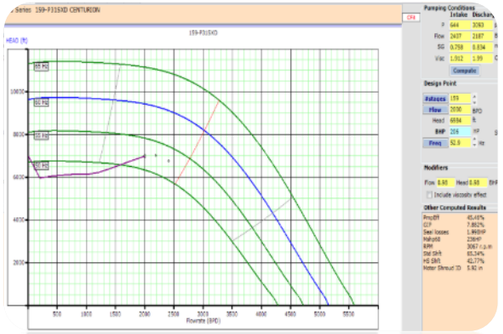
- ✓ Method acts by lightening the column
- ✓ Do not has moving parts
- ✓ Do not has restriction in the flow
- ✓ Easy to operate

Disadvantages:

- ✓ Gas is required for the operation
- ✓ Emulsión generation
- ✓ Heat exchange in the injection point.

Artificial Lift Experience (ESP)





The Extra-Heavy Oil Fields are produced with pumping systems (ESP), which sometimes require:

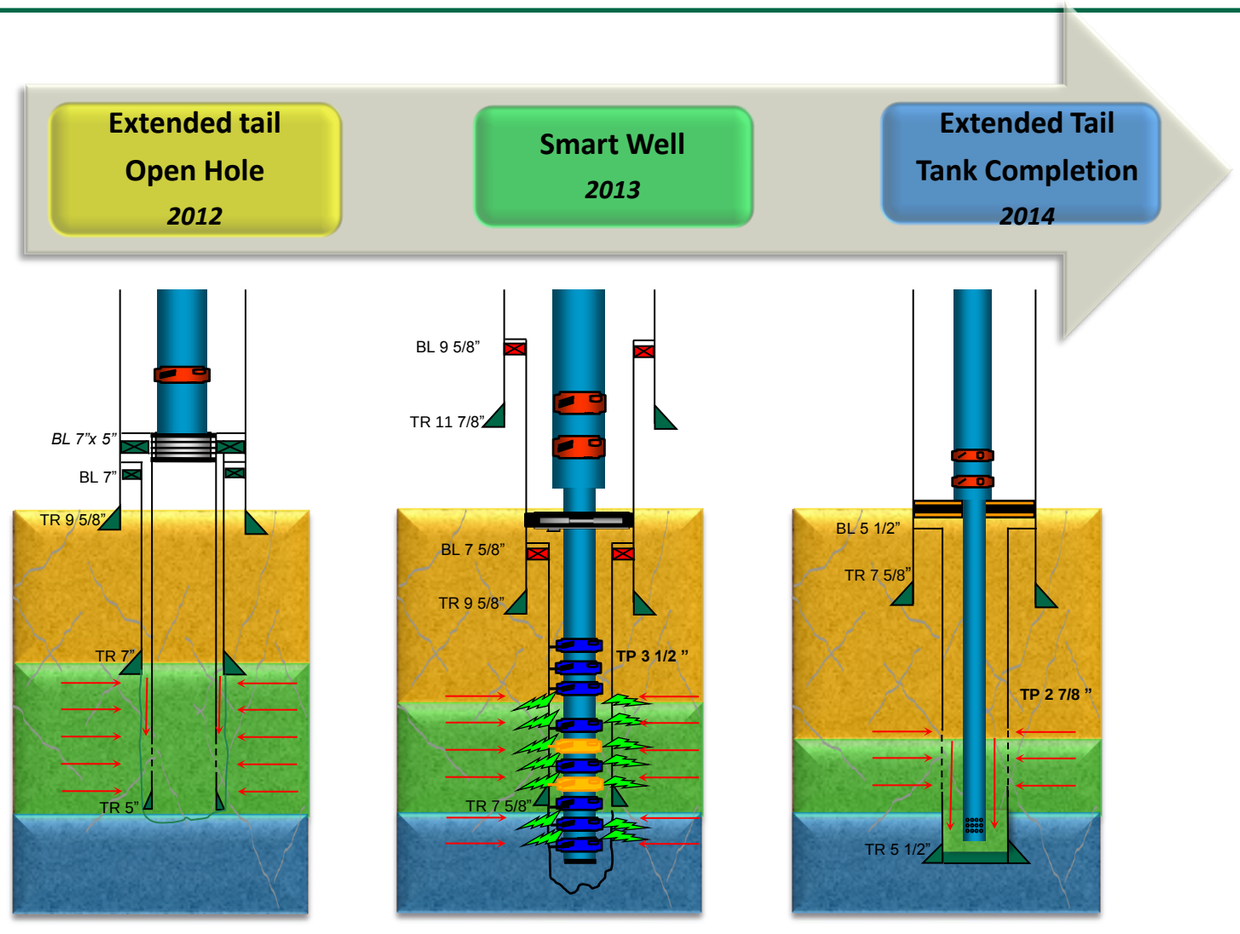
Subsurface:

- ✓ High motor range temperature
- ✓ High stages number in the pump
- ✓ High Horse Power
- ✓ Chemical capillary injection

Surface:

- ✓ Heating
- ✓ Dilution
- ✓ Special Metallurgy

Completion Experience



- Low gas / water coning.
- Extend the well life (3-4 months).

- ContactsMonitoring in real time.
- Applied with hig permeability (>3 D)

- Control of gas by gravity drain into the annular space.
- Delays gas inlet to the well.

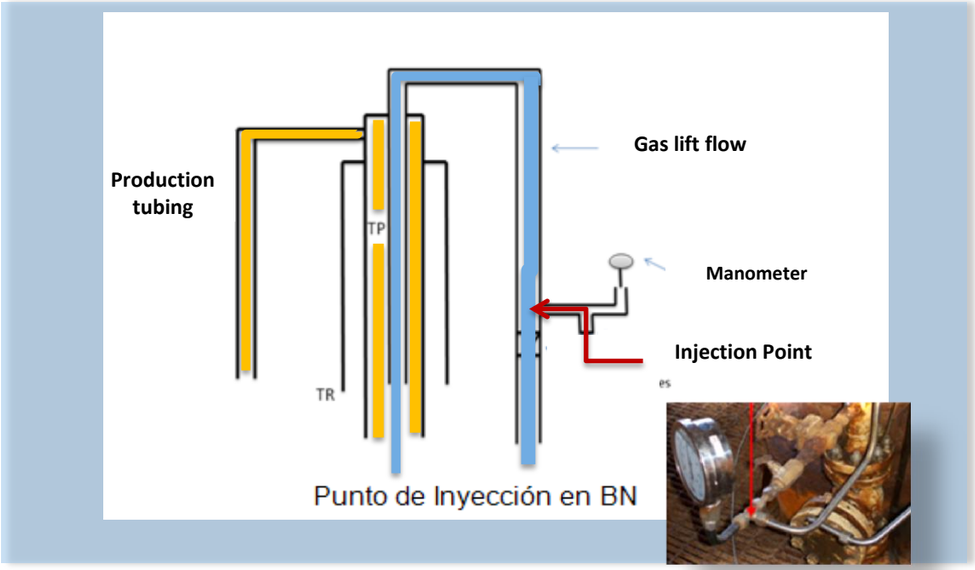
The Completion applied for Heavy Oil considering the maximum Reservoir Exposure Could be very useful in Extra Heavy Oil :

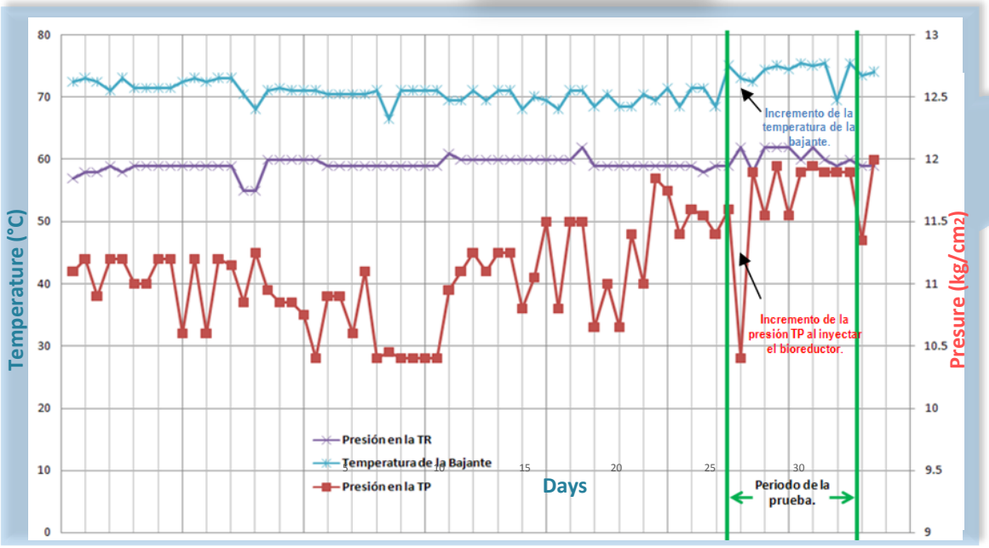
- ✓ Horizontal Wells
- ✓ High Deviated Wells
- ✓ Extended tails

Extended tails have shown great utility having the following advantages :

- ✓ Do Not need cement in the last Liner
- ✓ Allow real-time monitoring and advancing contacts
- ✓ Highly economical, time and materials
- ✓ Easy Workover
- ✓ Control the unwanted invasion fluids in porous media.

Flow Chemichal Improvers Experience





Flow Chemichal Improvers systems have been tested in both artificial lift systems.

The results are :

- ✓ Improved production when added to the gas lift injection.
- ✓ Energy savings and increased production when used with ESP.
- ✓ Increased wellhead temperature and pressure.
- ✓ Decrease Oil Viscosity in the order of 20-40% (laboratory).

Pump Experience

The Heavy Oil has been pumped with multiphase, screw-type and centrifugal pumps.

The Lessons Learned are :

- ✓ Especial seals design
- ✓ Vibration
- ✓ Process estability
- ✓ Complex and Slow Start


Pump casing with liner


Pump rotors

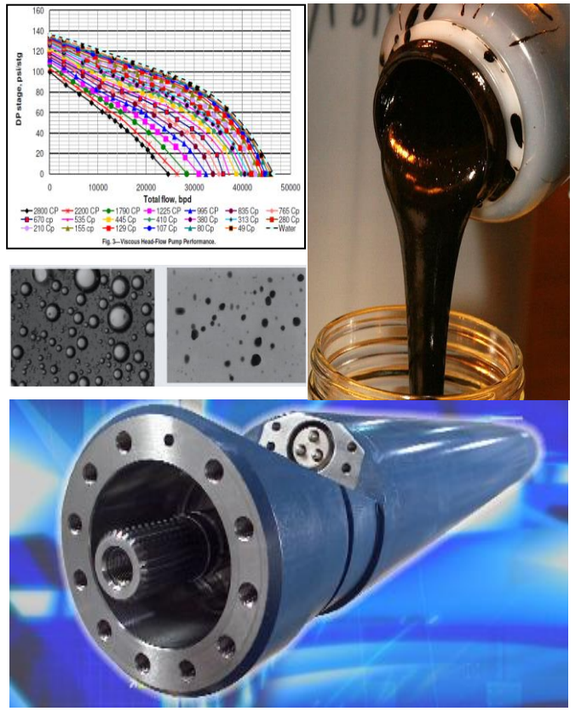
Well Technical Challenges

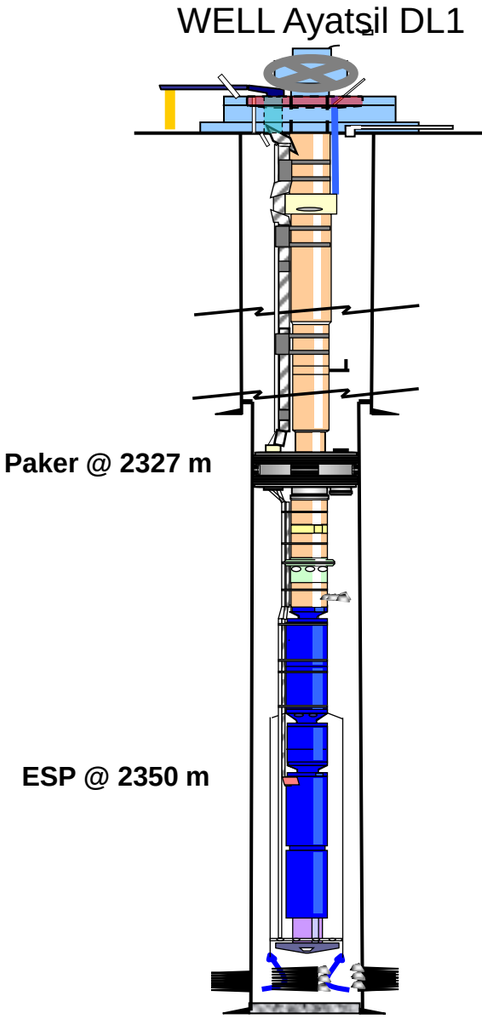
Technological Challenges

- Produce extra-heavy oil, with density is ≤ 11 °API and viscosity ≥ 42 cp @ rc
- Depth of well
- High content of H2S and CO2.
- Increase the run life of the ESP in extra-heavy oil
- Flow assurance (Corrosion, scales , emulsions, asphaltenes, etc.)

Technologies Used

- Portable ESP System
- ESP System
- High Temperature Motors (204 °C)
- Medium voltage VDF
- Special Metallurgy of the ESP Systems for corrosion environment.





Facilities Technical Challenges

Technological Challenges

- High viscosity oil
- High H_2S and CO_2 concentrations
- Asphaltenic crude oil
- Flow assurance

Technologies Used

- Dilution with lighter crude oils
- Chemical applications:
  - Flow improvers
  - Viscosity reducers
  - Corrosion inhibitors
  - Asphaltene dispersants
- Multiphase Pump

Conclusions

- The Greatest Experience of handling oil production in Mexico is for Heavy Oil ≥ 13.
- Artificial Lift Systems for Heavy Oil production has successfully managed whit Gas lift and Electrocentrifugal Pump.
- Completions with maximum reservoir exposure applicable to Heavy Oil Could be extrapolated to the Extra-Heavy Oil by the Extended tails.
- The use of flow improvers has been successfully tested with significant improvements in temperature, pressure and viscosity decrease.
- Experience with Heavy Oil Surface Pumping demands special attention in the design of the seals system, in the process stability, and avoid prolonged shutdowns and start-ups.

THANK YOU

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