Long Term Cement Integrity for Tight Gas Wells in Hungary

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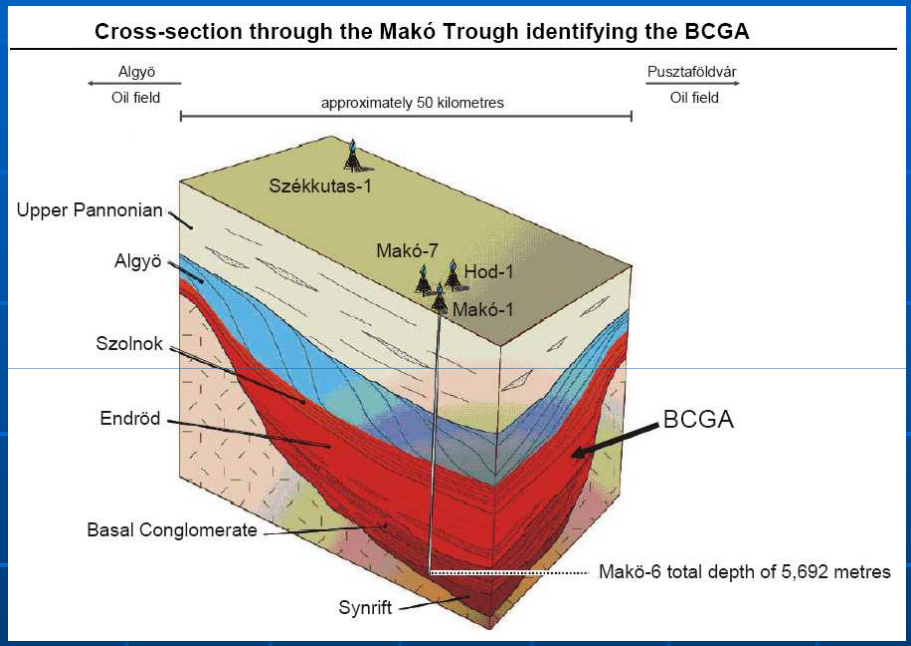
Outline

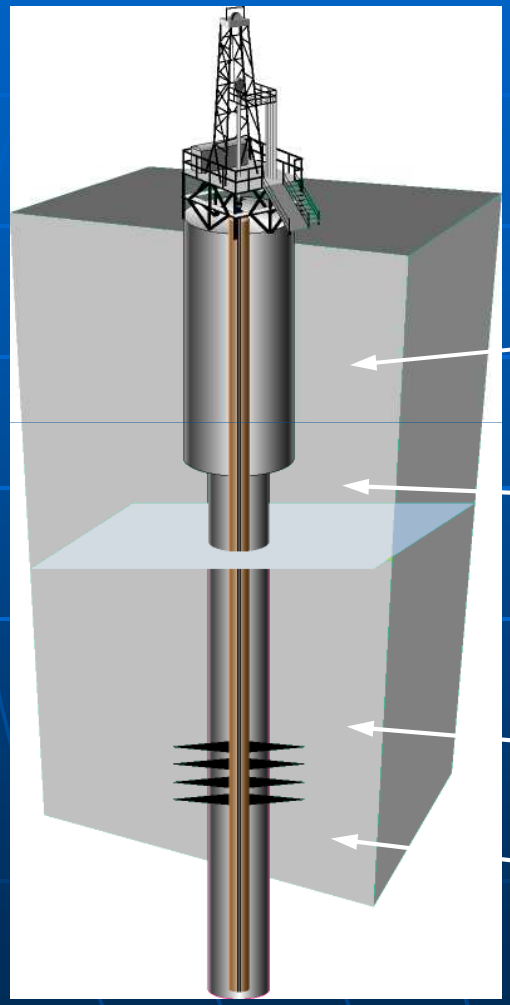
- Introduction to Tight Gas Wells
- Cementing Challenges and Solutions
- Case history
- Summary

Introduction – Tight Gas Challenges

- Tight Gas Environment
  - Reservoir Pressure > 10,000 psi (69 MPa)
  - Static Temp > 170°C
  - Depths from 3500 to 6000m
- Commercial production not possible without hydraulic fracturing (tight gas)
- Unique challenges for cementing
  - Changes in pressure and temperature
  - High temperature and pressure



Tight Gas well is a stressful environment



Temperature changes in upper casings during production

Pressure changes: drilling, production

Hydraulic stimulation

Well completion/perforation

Stress Analysis

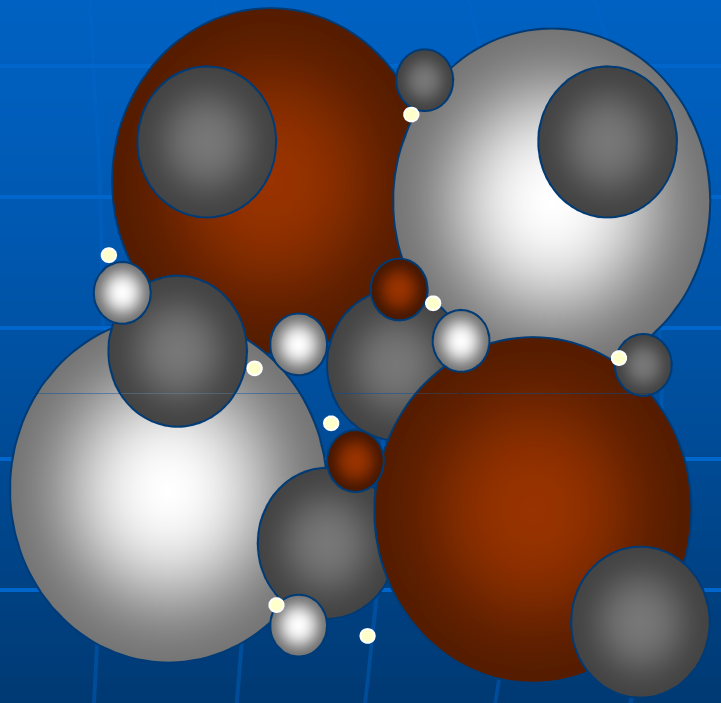
- Need to be able to analyze the stresses in the wellbore
  - Young's modulus
  - Rock, cement and casing
  - Compressive strength
  - Tensile strength
- Young's modulus, CS, Poisson's Ratio and thermal expansion play a complex role in durability

Gas Migration

- Formation
- Mud Removal
- Slurry Properties
  - Density
  - Fluid Loss
  - Free Water
  - Static Gel Strength development
  - Porosity
  - Shrinkage
  - Permeability to gas

High Pressure, High Temperature Environment

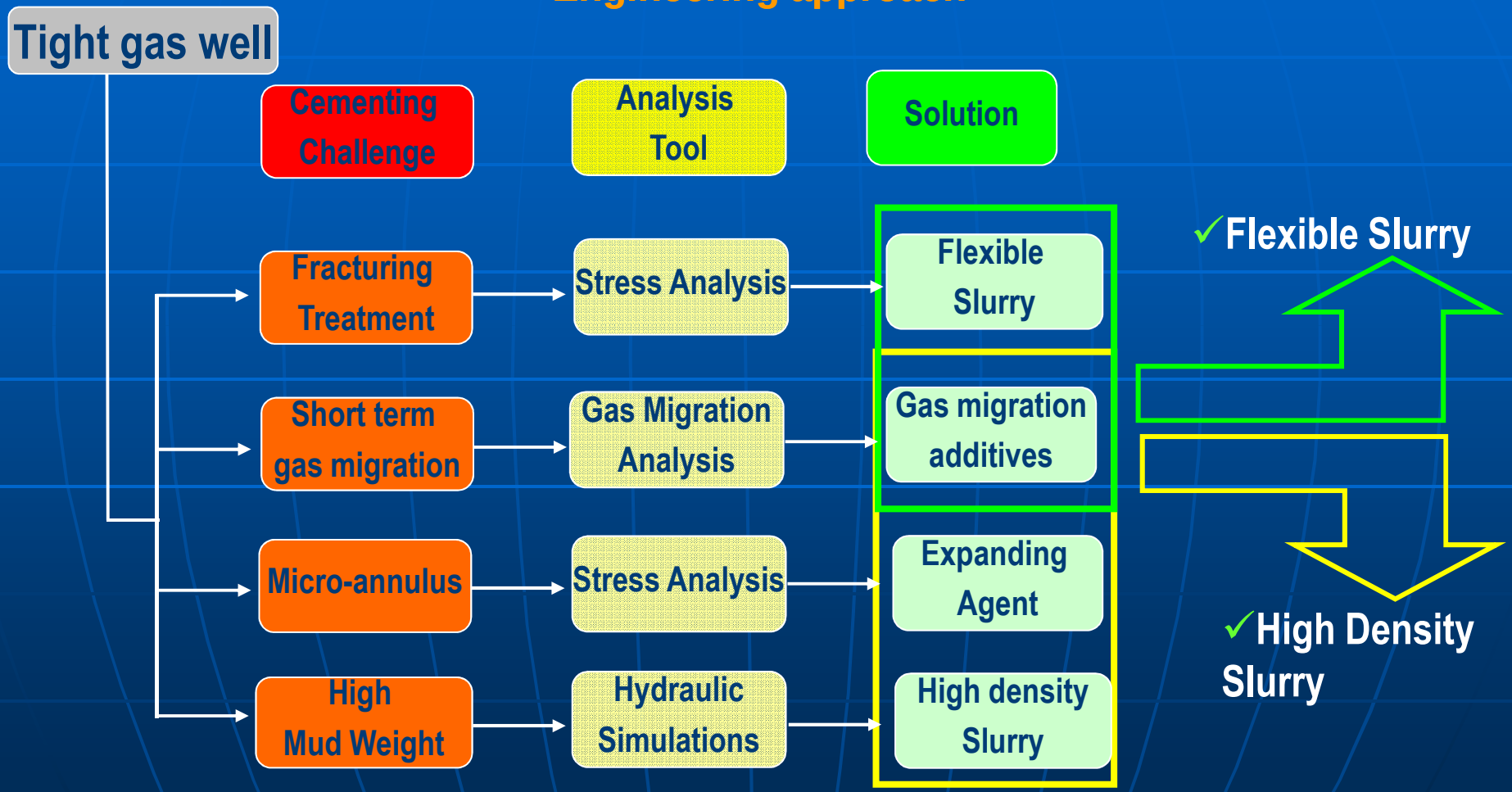
- High density slurry using multi-modal blend design
- High Solid Volume Fraction
- Very low permeability
- Prevent gas migration



- Good mixability
- Quality control at each stage of design and execution

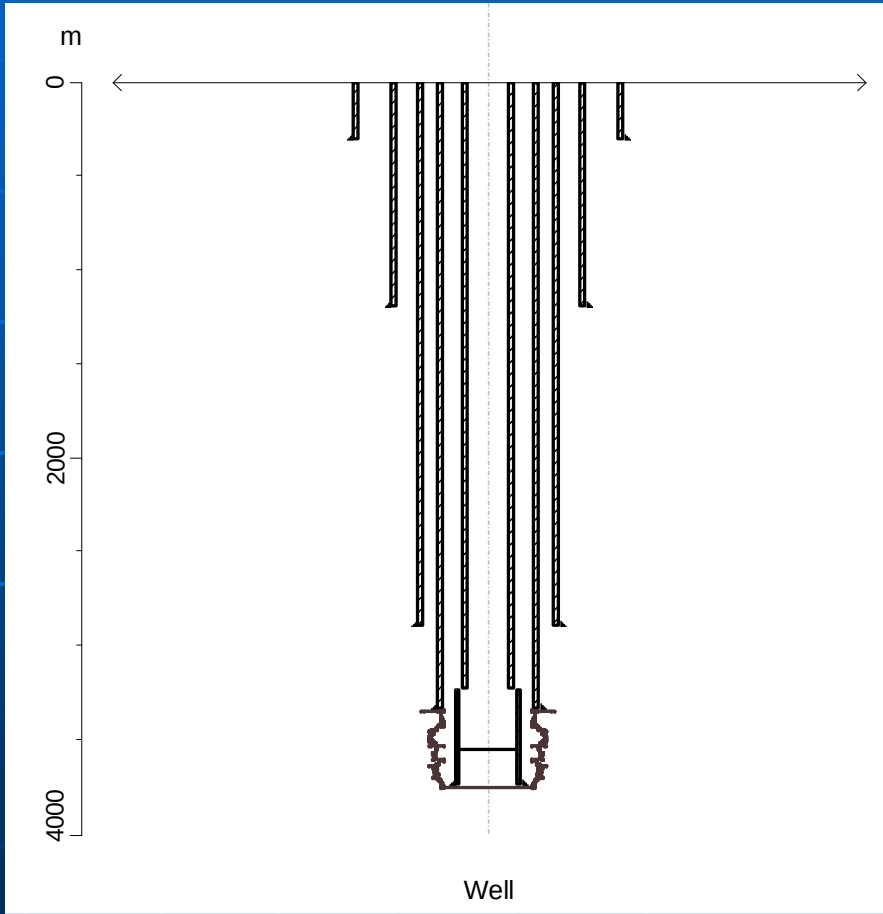
Cementing Challenges and Solutions

Engineering approach

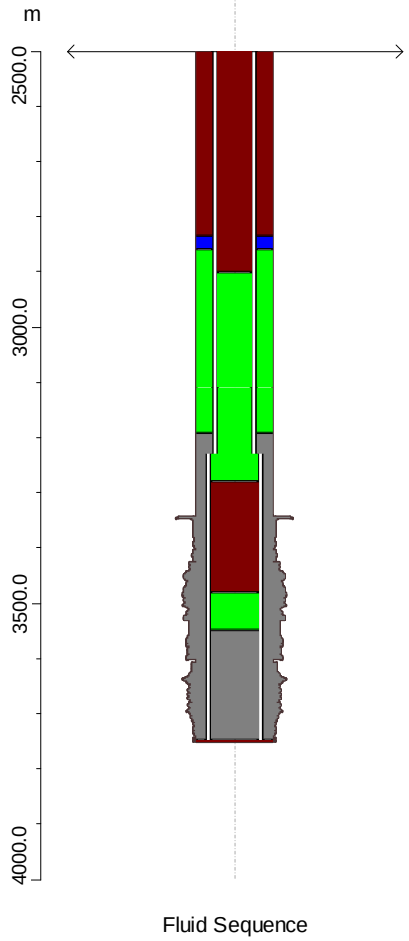


Case history – Tight Gas well in Pannonian Basin

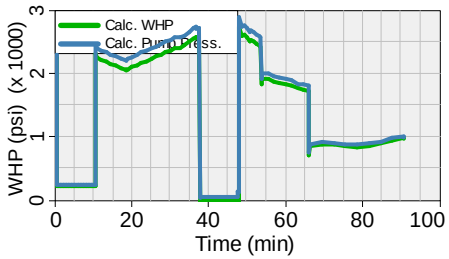
- 500 meter x 4 ½” Liner in 5 7/8” OH
- Gas pressure of formation 10 kpsi (69 Mpa)
- Reservoir temperature 175°C

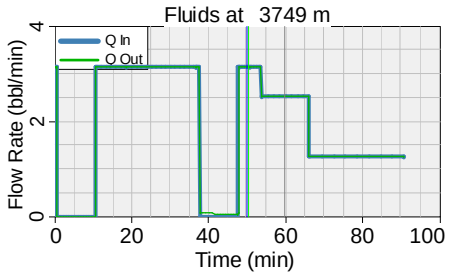


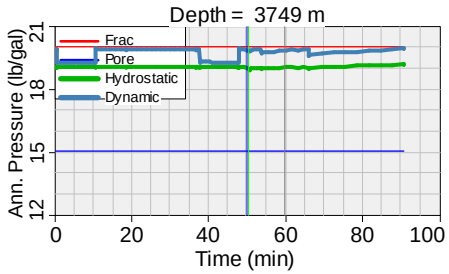
Hydraulic simulations and fluid rheology

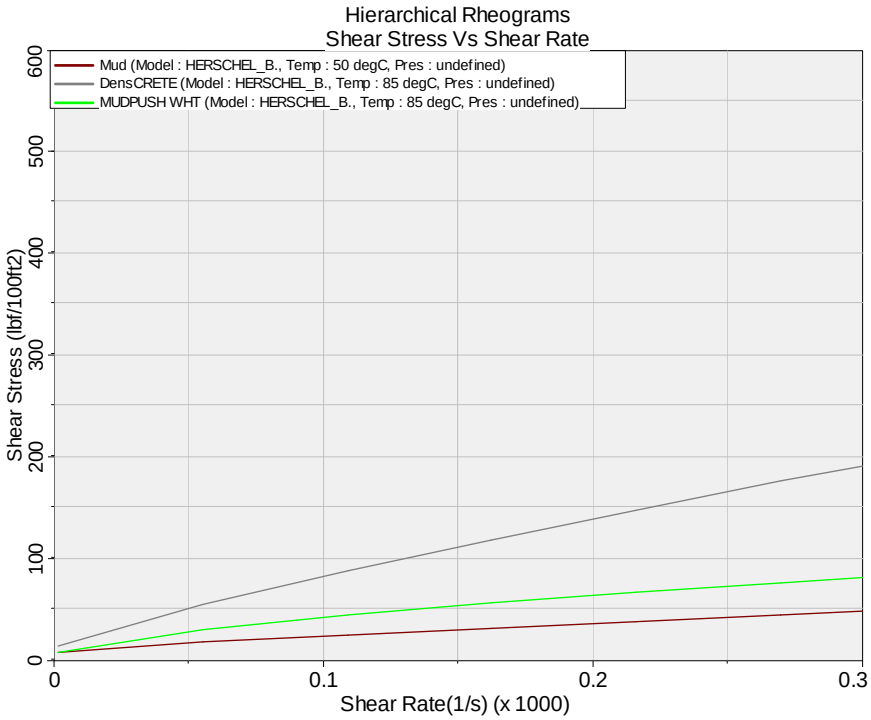


Fluid Sequence



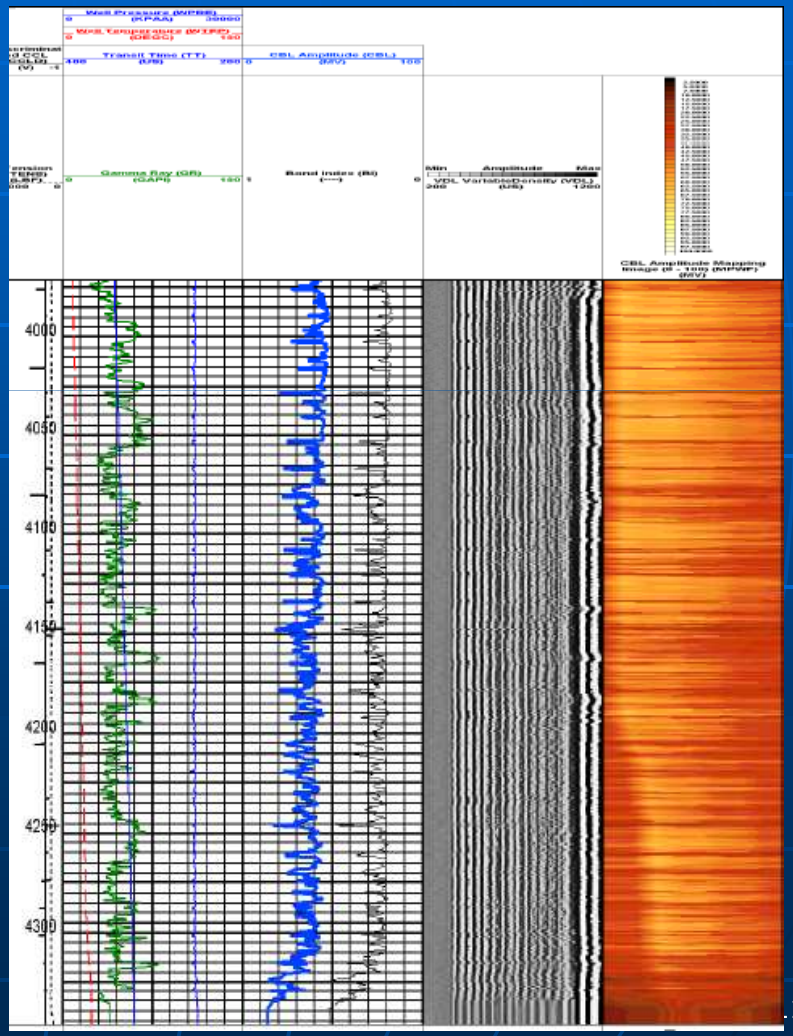






Results of the cementing operation

- Logs run 8 days after the cementing operation
- Exchange to completion fluid 6 days after the job (38 MPa difference)
- Log was affected by micro-annulus
- Expanding agent was used in slurry to close micro-annulus over time
- During hydraulic fracturing treatment on the well (3 months later), cement showed good isolation
- No remedial work was needed



Summary

1. Tight Gas cementing operations in Pannonian Basin are very challenging
2. Complete portfolio of design tools is utilized for complex cementing design
3. Slurry quality control and assurance (QA/QC) is key to success
4. Correct well construction first time: critical