CBM Gilowice Project – Applied Fracturing Technology and the Obtained Results

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Agenda

1. New seismic interpretation data
2. Fracturing treatments
3. CBM pads development
Structural Interpretation of the Międzyrzecze CBM License Area

 ✓ Previous interpretation of the 510 coal seam structure contour as of 2016:
   • fault system concept limited to multi-well correlation,
   • high level of uncertainty regarding faults geometry.

 ✓ Previous experience in the Upper Silesian basin demonstrated that the fault network of mature mining areas is generally much more complicated than it was predicted based on pre-mining interpretations.

 ✓ New challenge – 3D seismic interpretation is critical for the understanding of structural setting in this tectonically complicated area.

Source: “Międzyrzecz” geological data package, based on PGI case study (Jureczka et al., 2016) .

Source: Processing and interpretation of seismic data - 3D Międzyrzecze (Geofizyka Toruń, 2018) .
Structural Interpretation of the Recently Acquired 3D Seismic Data

✓ The new geological model differs from the previous interpretation.
✓ New insight into coal seams geometry based on structural interpretation.
✓ Existence of many normal and reverse faults, almost perpendicular to previously inferred faults (western part of Międzyrzecze block).
✓ New interpretation of fault polygons for the 350 and 510 coal seams.


Seismic Cross-section Through Gilowice-1 and Gilowice-2H wells
Seismic Cross-section Through Gilowice-3K and Gilowice-4H wells
Gilowice-3K and Gilowice-4H wells

Well Gilowice-3K

- final depth – 1360 m (TVD 1062.8 m)
- vertical displacement – 774 m
- max. inclination ~ 45°

Well Gilowice-4H

- final depth – 2200 m (TVD 752.2 m)
- vertical displacement – 1570 m
- maximum inclination ~ 95°
- length of horizontal section – 1070 m
Hydraulic Fracturing

**Gilowice-2H**
- **5 stages** with Hybrid technology
- Fluid: 20-30# linear gel avg 390 m$^3$/stage + 30# X-link avg 125 m$^3$/stage. Total over 2580 m$^3$
- Sand: 100 mesh avg 6.8 tons/stage + 40/70mesh avg 74 tons/stage (at the last stage 30/50mesh 40.5 tons instead of 40/70mesh). Total over 404 tons
- Flow rate avg 6.7 m$^3$/min
- Plug&Perf with 6 clusters/stage
- **1 stage/day**

**Gilowice-4H**
- **9 stages** with Hybrid technology
- Fluid: 20-25# linear gel avg 240 m$^3$/stage + 25-30# X-link avg 114 m$^3$/stage. Total over 3186 m$^3$
- Sand: 40/70 mesh avg 39 tons/stage + 30/50mesh avg 29 tons /stage. Total over **612 tons**
- Flow rate avg 7.9 m$^3$/min
- Plug&Perf with 4 clusters/stage
- **2 stage/day**
Hydraulic Fracturing Microseismic Mapping

<table>
<thead>
<tr>
<th>STAGE</th>
<th>UP</th>
<th>DOWN</th>
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<tbody>
<tr>
<td>TVD</td>
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<td>-49.63*</td>
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<tr>
<td>II</td>
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<tr>
<td>V</td>
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<td>-27.00</td>
</tr>
</tbody>
</table>

Maximum depth (up/down) of seismic events

Avg depth of seismic events
Hydraulic Fracturing - Results

downhole pressure [bar]
water production [m³/day]
gas flow rate [m³/day]

gas flow rate
downhole pressure
water production

10000 m³/day
5200–5400 m³/day
7000 m³/day
Pads Development: Gilowice-1, Gilowice-3K, Miedzyrzecze-3 and Międzyrzecze-4
Gilowice-1 Pad Development

✓ Installing the Caterpillar Power Station CG170-12 – electrical power 1000 kW.
✓ Preparing gas on the installation and transfer to the Power Station.
✓ Transferring power to Tauron S.A network.
Gilowice-3K Pad Development

✓ Construction of surface infrastructure and pipeline to PSG network
✓ Surface infrastructure:
  • Pre-separation system
  • Heating and measuring system
  • Filtering system prior to compression
  • Installation of gas compressor with acoustic shield
✓ Pipeline:
  • Connection to PSG DN65 (350 m from G-3K)
  • Connection to DN 150 with pipeline passing near G-1 well (approx. 1150 m)
  • Conversion to electricity of excess gas volume using G-1 infrastructure
Międzyrzecze 3 and Międzyrzecze 4 Pads Development

✓ Collecting gas on the Christmas tree.
✓ Transferring to separation system.
✓ Pressure reduction and transferring to the surface infrastructure on Gilowice-3 Pad.
✓ Transferring to PSG gas pipeline network.
Thank you for your attention