Economical and Environmental aspects of Spontaneous Combustion in Kosovo Open mining Process

PRESENTED BY
BASHKIM LUSHTAKU

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Introduction

- Spontaneous combustion history.
- Coal resources and Economy
- Geology & Kosovo coal basins
- Exploitable fields
- Spontaneous combustion new technology
- Environment & International
- What next?
Spontaneous combustion background
old methodology Vs new one
Sc process stage of development

- <50°C - slowly oxidation
- 50-80°C - incubation stage
- >120°C - evolution of oxides of Carbon
- 180-250°C - thermal disintegration
- 200-250°C - sc convulsive reaction

Chemical reactions:

\[ C + O_2 \rightarrow CO_2 + 394 \text{ kJ/mol} \]
\[ 2C + O_2 \rightarrow 2CO + 170 \text{ kJ/mol} \]
\[ 2H_2 + O_2 \rightarrow H_2O + 241 \text{ kJ/mol} \]
Main parameters related with process

Other relevant factors:

<table>
<thead>
<tr>
<th>Coal factors</th>
<th>Geological factors</th>
<th>Environmental factors</th>
<th>Mining</th>
</tr>
</thead>
</table>
| 1. Coal reactivity.  
2. Calorific value.  
3. Density  
4. Ash content  
5. Total sulfur  
6. Friability  
7. Porosity | 1. Presence of faults  
2. Depth of seams  
3. Floor rolls | 1. Mean temp. & rain fail distribution  
2. Sinkholes  
3. Subsidance  
4. Source of hot Spots. | 1. Methods of working  
(opencast or underground mining)  
2. Coal left at roofs and floors |
### Basic Coal properties - Kosovo coal basin

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humidity [w]</td>
<td>38.00%-48.00%</td>
</tr>
<tr>
<td>Ash</td>
<td>9.48%-21.32%</td>
</tr>
<tr>
<td>S –total</td>
<td>0.68%-1.31%</td>
</tr>
<tr>
<td>S in ash</td>
<td>0.61%-1.51%</td>
</tr>
<tr>
<td>S ignite</td>
<td>0.07%-0.49%</td>
</tr>
<tr>
<td>Cocks</td>
<td>27.47%-36.58%</td>
</tr>
<tr>
<td>C-fix</td>
<td>15.26%-17.63%</td>
</tr>
<tr>
<td>HTL</td>
<td>9663Kj/kg</td>
</tr>
<tr>
<td>LTL</td>
<td>7921Kj/kg</td>
</tr>
<tr>
<td>Carbon</td>
<td>20.00%-29.56%</td>
</tr>
<tr>
<td>SiO2</td>
<td>21.65%-31.76%</td>
</tr>
<tr>
<td>Al2O3</td>
<td>5.95%-12.21%</td>
</tr>
</tbody>
</table>
Sc in Kosovo coal basins

1. In the Kosovo basin, lignite deposits are located between the Mitrovica city in North and Kaqanik in South of Kosovo.

- Length on North-South direction: 85 km.
- East-west extension: 10 km.
- Surface in total: 850 km².

Total exploitable reserves in:
1. Kosovo Coal basin: exploitable reserve 10.00 billion ton
2. Dukagjini basin: 2.70 billion geological reserves
3. Drenica basin: 300 million geological reserves
<table>
<thead>
<tr>
<th>Country</th>
<th>Billion/tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Germany</td>
<td>42.8</td>
</tr>
<tr>
<td>Poland</td>
<td>14.0</td>
</tr>
<tr>
<td>Kosova</td>
<td>10.0</td>
</tr>
<tr>
<td>Hungary</td>
<td>7.80</td>
</tr>
<tr>
<td>Turkey</td>
<td>5.90</td>
</tr>
<tr>
<td>Greece</td>
<td>4.20</td>
</tr>
<tr>
<td>Serbia</td>
<td>3.06</td>
</tr>
<tr>
<td>Romania</td>
<td>3.00</td>
</tr>
<tr>
<td>Bulgaria</td>
<td>2.50</td>
</tr>
</tbody>
</table>
Geology of basin.
Exploitable fields
Coal seem thickness
S.C & New technology (grouting system)
Sc and new technology cont.
<table>
<thead>
<tr>
<th>Process</th>
<th>Old methodology</th>
<th>VS</th>
<th>New methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Detection</td>
<td>Visual</td>
<td></td>
<td>Infrared cam</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hand camera</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Visual</td>
<td></td>
<td>Hand camera</td>
</tr>
<tr>
<td>Prevention</td>
<td>Water spray</td>
<td></td>
<td>Grouting &amp;drilling system</td>
</tr>
<tr>
<td>Control</td>
<td>Visual</td>
<td></td>
<td>Hand camera</td>
</tr>
</tbody>
</table>
Spontaneous combustion mapping

- Coordinates x: 4.720 000
  y: 7.520 000
- Air monitoring (CO, CO₂, CH₄)
- Economical criterion (irrelevant, short term, long term)
- Geological type (coal seam, sliding block)
- Geotechnical type (huge, big, small)
- Burning type (crack related, surface ignition)
- Environmental criterion (next to employee)
Monitoring & management of sc.

Management information system

Daily monitoring
- Temperature analysis
- Safety information evaluating
- Dangerous level classification

Temperature inside
- Database of Thermo images

Monitoring under Urgent situation
- Temperature monitoring

Combusting level evaluating
- Gas monitoring
- Dangerous level and early warning

Source
Spontaneous combustion Strategies

MAP – SITUATION OF CURRENT MINES

- Sibovec South-West
- Sithica east
- Mirash
- Bardh

Map showing the current situation of mines.
Section in Sibovc South-East
Injection (sample due trainings)
Lost of omission

Fig 3.0 Affected area from spontaneous combustion (section I-I)
Lost of omission cont.

<table>
<thead>
<tr>
<th>Profile</th>
<th>Surface(m²)</th>
<th>Distanc (m)</th>
<th>Volume(m³)</th>
<th>Coal Density t/m³</th>
<th>Price €/t</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Separately</td>
<td>Average</td>
<td>Separately</td>
<td>Cumulative</td>
<td></td>
</tr>
<tr>
<td>I-1</td>
<td>11567.87</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II-2</td>
<td>5291.29</td>
<td>8429.58</td>
<td>5.5</td>
<td>46362.7</td>
<td></td>
</tr>
<tr>
<td>III-3</td>
<td>45</td>
<td>2668.14</td>
<td>5.5</td>
<td>14674.8</td>
<td>661037.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.14</td>
</tr>
</tbody>
</table>

\[ Cp = C v \ (m^3) \times \int (t/m^3) \times P \ (€/t) \]

\[ Cp = 661037.5 (m^3) \times 1.14 \ (t/m^3) \times 20 \ (€/t) \]

\[ Cp = 139 \times 10^6 \ € \]

**CP-total estimated price if the action is not taken.**
Spontaneous combustion & Environment

Co2 emission – PP and Sc.

2.7 t CO₂

5.1 t CO₂ Äquivalent x21

1.3 t CO₂

0.18 t CH₄

1 t Kohle mit 750 kg C

1 t Kohle mit 750 kg C
<table>
<thead>
<tr>
<th>Mine</th>
<th>CO (ppm)</th>
<th>CO\textsubscript{2} (ppm)</th>
<th>CH\textsubscript{4} (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bardh.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X:4.724041</td>
<td>125</td>
<td>600</td>
<td>0</td>
</tr>
<tr>
<td>Y:7.506134</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>X:4.723857</td>
<td>130</td>
<td>1000</td>
<td>0</td>
</tr>
<tr>
<td>Y:7.506534</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CO$_2$ emissions mine cont.

Gas emissions due to SC mine Bardh 2007

- Level of CO (ppm)
- Level of CO2 (ppm)
- Level of CH4 (%)
- Linear (Level of CH4 (%))
- 2 per. Mov. Avg. (Level of CO2 (ppm))
- 2 per. Mov. Avg. (Level of CO (ppm))
Other States affected from process

- CHINA
- GERMANY
- UNITED STATES OF AMERICA
- INDIA
- AUSTRALIA
What next?

- To take into account the likelihood of spontaneous combustion when preparing all mining planes and provide adequate planned procedures.

- To identify areas where spontaneous combustion is most serious and arrange appropriate urgent actions.

- Applying the new technology in 2010 for immediate economic and environmental benefits.
What next cont.

All features and procedures are considered to be done under coal mine health & safety regulations and an assessment should be regularly made to confirm the extent to which they are adhered to.

All procedures should be applied in the existing coal fields and potential Kosovo coal fields.

To further encourage the exploitation and use of domestic deposits of lignite in environmentally responsible ways because of the potential enormous economic gains.
Thank you for your attention

Questions & comments!