The mercury concentration in coal varies in a wide range from less than 1 ppb to 300 ppm (more than 5 orders of magnitude) \cite{1, 2}. Generally, the mercury content in coal is governed by geological position of the coal deposit and syngenetic or subsequent geochemical processes rather than by the coal type \cite{1}. Mercury speciation in coal can be represented by syngenetic mercury bound to organic matrix, by elemental Hg(0), mercury bound to crystal lattice of sulfides and silicas minerals. The thermospeciation analysis based on real-time detection of the mercury release from a sample during its gradual heating is applied to reveal mercury species having different bond energy with coal matrix.

**Experimental setup**

The standard RA-915M mercury analyzer and PYRO-915 attachment (Lumex Instruments) \cite{1}, were used for the thermosampling of solid samples \cite{3, 4}. Using the RAPID software, the special mode of continuous, quasi-linear increase of the PYRO-915 atomizer temperature from ambient to 850°C was applied \cite{1}. Mercury release from coal were studied. The findings are as follows:

- The measurement procedure demonstrates quite good reproducibility of the thermospectra, one of the examples is shown in Fig. 3.
- Total Hg concentration in the anthracite sample is 885 ppb. Mercury is released from anthracite in following temperature intervals:
  - 30–300 °C: 300–550 °C: 550–800 °C
  - 180 ppb: 265 ppb: 440 ppb
  - 20%: 30%: 50%

**Mercury thermospecies in pyrite**

It was found out that significant part of mercury in productive coal horizons is accumulated in sulfides, mainly in pyrite, FeS2 \cite{1, 2, 3}. Therefore, it is interesting to compare the mercury thermospectra of pyrite and pyrite-bearing coals (Fig. 4).

**Optimization of the thermosampling procedure**

For optimization of the measurement procedure, the three kinds of coal: lean, fat, and anthracite with relatively high concentration of Hg (480–500 ppb) were chosen and tested. The effects of the temperature gradient, carrier gas composition (air and nitrogen), weight of a sample, and grain size on the dynamic behavior of mercury release from coal were studied. The findings are as follows:

- Linear sample heating with a heating rate of 0.8 °C/sec was chosen as optimal for thermospecies revealing and resolution.
- Optimal sample weight for thermosampling is 200 ± 30 mg.
- Granulometric composition does not have a distinct effect on reproducibility of the thermospectra; particles of size up to 1 mm can be used for analysis.

**Conclusion**

- Total mercury concentration in the studied coals varies in a range of < 2 ppb to 2 ppm. In productive layers, mercury is accumulated in sulfides and coal matrix.
- The thermosampling data show the presence of various mercury thermospecies in coals enabling determination of the low-, mid-, and high-temperature mercury species in coal, which could be represented by Hg(0), mercury bound to coal organic matrix, and mercury in sulfides.
- Mercury in pyrite exists as adsorbed Hg(0) releasing at the low temperature, and included into crystal lattice of FeS2 escaping with its destruction starting at 350 °C.
- The thermoscanning technique gives additional information about mercury speciation in coal. This is useful for better understanding of the regularities of mercury geochemistry, causes of mercury enrichment in coals, and also for enhancement of the coal pre-treatment technology before combustion to reduce mercury emission to environment.

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