

Evaluation of the organic pollutants yields emitted by coal waste during the self-heating: simulation by dry and hydrous pyrolysis

DARIUSZ WIĘCŁAW¹, KRZYSZTOF JUREK¹, EWA SZRAM², ELŻBIETA BILKIEWICZ¹, ADAM KOWALSKI¹, MONIKA J. FABIAŃSKA², JUSTYNA CIESIELCZUK² AND MAGDALENA MISZ-KENNAN²

¹AGH University of Science and Technology

²University of Silesia in Katowice

Presenting Author: wieclaw@agh.edu.pl

Improperly deposited coal wastes in dumps may undergo self-heating and self-burning. During the thermal decomposition of the organic material in oxygen-depleted conditions, besides CO₂ and CO, organic compounds (bitumen, oil-like tars, gaseous and water-soluble) are also generated. Hydrous (HP) and anhydrous pyrolysis (dry distillation, DD) experiments in closed 1-L reactors were conducted isothermally for 72 hrs., at 250, 360 and 400 °C, using rock and distilled water (HP), or dry rock sample (DD) to simulate self-heating processes using 4 samples from Upper Silesia (Poland): from the Janina Mine (J1, J2) (R_t ca. 0.5%) and the Marcel Mine (M1, M2) (R_t ca. 0.9%). The Rock-Eval analysis revealed the presence of the gas-prone kerogen in all samples and 1.8, 27.3, 2.3 and 24.1 wt. % TOC, respectively.

The amount of generated immiscible oil, bitumen, water-soluble and gaseous hydrocarbons (C₁-C₈) was determined, and the yield of each compound was converted to mg/g TOCo (of the original sample).

The total yield of generated hydrocarbons relates to the temperature and type of the process and varies from 7.2 mg HC/g TOCo for J2 at 250°C (DD) to 57.8 mg HC/g TOCo for J2 at 360°C (HP). Usually, more HCs are generated in HP than in DD conditions, regardless of the TOC content and maturity of the OM; an exception is only in 250°C. The yields of produced gaseous HCs increase with the temperature of the experiment, while yields of immiscible oil and bitumen are highest in HP experiments conducted at 360°C. Generation of the last mentioned media in DD experiments is several times lower and unrelated to TOC content in the waste. The water-soluble organic compounds (generated in HP) usually do not exceed 1 mg/g TOCo.

The presented results helped to understand and evaluate the emission of organic pollutants during the decomposition of the deposited coal wastes induced by self-heating. At 250°C, over 90% of generated organic pollutants mass occurs as bitumen and oil-like products; this share decrease with increasing temperature, much faster in anhydrous conditions for TOC-rich rocks.

The financial support of the National Science Centre, grant No 2017/27/B/ST10/00680, is gratefully acknowledged.