Assessing the energetic residual potential of the abandoned underground Monceau-Fontaine coalmine using 3D modeling

Methane is a potent greenhouse gas when emitted into the atmosphere. However, it is also an energy resource that can be captured and utilized. During coal mining, particularly in the Charleroi basin, between 48 and 115 m^3 of methane were produced per ton of mined out coal. This methane was either drained and utilized or vented to the surface for safety reasons. Regardless gob re-compaction, methane still occurs underground and can be valued as Abandoned Mine Methane (AMM). One major issue to a profitable valorization of AMM is to estimate how much gas can be recovered in the residual void volume of gobs long time after the abandonment of the mines.

In this work, abandoned gobs representative of post-mining conditions have been characterized to model the recoverable methane in the Monceau-Fontaine coal mine. Sets of geological and mining data were implemented in a 3D modelling tool, considering the gobs in terms of their residual porosity.

The construction of the overall model relies on two main steps: (1) the construction of a 3D geological model of the initial coalbody in order to determine the initial bulk volume of mined out coal; (2) the development of a methodology for assessing the residual void in gobs. The methane gas accumulation in abandoned mines can then be expressed.

Our approach considers abandoned gobs as sets of nested annular parallelepipeds of residual vertical stress and residual porosity. The flow of methane gas within this underground reservoir systems is driven by pressure gradient between the virgin reservoir/transition zone and the gob. The conceptual reservoir is divided into three main compartments: the virgin reservoir, the transition zone and the gob. Long time after mine closure and abandonment, partial pressure of methane in the gob balances the pressure of methane in the virgin reservoir/transition zone. Gobs are assumed dry and saturated with methane. Given the pressure of methane in the reservoir, we consider that the behaviour of methane is described by the ideal gas law.

Two particular coal seams have been investigated. They were mined-out between 1899-1961 and 1877-1968. The model has rendered –respectively –estimates of 210MNm^3 (millions of normal cubic meters) and 140 MNm^3 of recoverable methane accumulated within the residual void in gobs for the seams. Those results show that there are noticeable resources of AMM in the area.

Key words: AMM, abandoned gobs, modelling, Monceau-Fontaine, porosity.