Intake-air ventilation flow to reduce firedamp concentration

A section in a coal mine is ventilated with 7,079 m^3/s. The methane concentration measured in the intake airway and at the working face are 0,14 and 0,98% respectively. Assuming no fluctuation in the methane content of the intake air, and neglecting air leakage in the section, calculate the intake-air quantity that is required to maintain the methane concentration at 0,65% at the working face.

Solution

It must be assumed the presence of a strata gas (SG) flow that causes de increase in methane concentration in the working place

Mass Balance for methane

Intake = Output + Accumulation

$Q_{intake\text{-}air}$ (m^3/s) · C_{CH4_intake} (m^3 CH_4/m^3 air) + SG (m^3 CH_4/s) = (Q + SG) (m^3/s) · C_{CH4} (m^3 CH_4/m^3 air)

7,079 · 0,0014 + SG = (7,079 +SG) · 0,0098

SG = 0,06 m^3 CH_4/s

Now that SG is known, the airflow intake to get a CH_4 concentration of 0,65% can be calculated using the same mass balance, as follows:

Q · 0,0014 + 0,06 = (Q +0,06) · 0,0065

$Q_{intake\text{-}air}$ = 11,7 m^3/s