

Gases Emission in Underground Coal Mines and its Controlling Measurements

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ABSTRACT

The amount of methane (CH₄) released during coal mining depends on a number of factors, the most important of which are coal rank, coal seam depth, and method of mining. Underground coal mining releases more methane than surface or open-pit mining because of the higher gas content of deeper seams. Total national emissions from coal mining, regardless of the selected methodology, should be calculated as the sum of emissions from underground mining, surface mining, post-mining activities, and emissions avoided due to recovery. The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines) provide two general approaches to estimating CH₄ emissions from coal mining. The first approach, outlined in the Tier 1 and Tier 2 methodology is based on coal production and an emission factor. The second approach, the Tier 3 method, uses mine-specific measurement data from ventilation and degasification systems to develop national estimates for underground mines. For countries with significant underground mining, the Tier 3 method is much more reliable because it takes into account variability in geologic formations and mining practices. The difference between Tier 1 and Tier 2 emissions factors for coal mining is that Tier 2 requires measurement data from underground mines within the country itself. Generally, for both Tier 1 and Tier 2, the uncertainty in the activity data (coal production) is low compared to the uncertainty in the emission factors. Ventilation data from underground mines are much more accurate, typically being accurate to within 20 percent. Important considerations for completeness include emissions from abandoned mines and from waste piles, although currently no methodologies exist and data are difficult to collect. For reporting of emissions, it is important that countries disaggregate fugitive emissions from coal mining and natural gas systems, and also provide information on the method and emission factors used.

INTRODUCTION

from coal mining and handling Methane (CH₄) is produced during coalification (the process of coal formation). Only a fraction of this remains trapped under pressure in the coal seam and surrounding rock strata. This trapped methane is released during the mining process when the coal seam is fractured. Methane released in this fashion will escape into the mine works, and will eventually escape into the atmosphere. The amount of CH₄ released during coal mining depends on a number of factors, the most important of which are coal rank, coal seam depth, and method of mining. Coal rank represents the differences in the stages of coal formation and depends on the temperature history of the coal seam. As coal rank increases, the amount of CH₄ produced also increases. Because pressure increases with the depth of the coal seam and the adsorption capacity of coal increases with pressure, deeper coal seams generally contain more methane than shallow seams of the same rank.¹ In addition, over time

methane can be released to the atmosphere from near surface coal seams through natural fractures in overburden strata. Coal extraction tends to lead to the release of more methane than was originally trapped within the mined coal seam itself, because the drop in pressure draws in additional gas from surrounding strata. Also, the mining process tends to fracture the surrounding strata including neighbouring seams, particularly where long wall extraction is used.² Underground coal mining releases more methane than surface or open-pit mining because of the higher gas content of deeper seams. Because CH₄ is highly explosive in air concentrations between 5 and 15 percent, mine operators have developed two types of systems for removing methane from the underground mine workings: (i) ventilation systems, and (ii) degasification systems. The purpose of ventilation systems, used extensively in all major coal producing countries, is to reduce CH₄ concentrations to safe levels, usually less than 1 percent. Despite the low CH₄ concentration, the large amount of air flushed through mine ventilation shafts leads to significant annual emissions. At present almost all ventilation air is emitted into the atmosphere. Preliminary studies by USEPA indicate that economic options exist in some situations for the use of vented air.

CONCLUSIONS

All estimates of total national emissions from coal mining, regardless of the selected methodology, should be calculated using the following general equation: Total Emissions = Emissions from Underground Mines + Emissions from Surface Mines + Emissions from Post-Mining Emissions - Emissions Avoided Due to Recovery. The IPCC Guidelines provide two general approaches to estimating CH₄ emissions from coal mining. The first (Tier 2 and Tier 1) uses coal production as the activity data and an emission factor based on methane emissions per unit of coal production. Tier 2 emissions factors require measurement data from underground mines within the country itself, whereas there are default Tier 1 emission factors for regions. The Tier 3 method uses minespecific measurement data from ventilation and degasification systems to develop national estimates for underground mines. Given the large contribution to total emissions from underground mining, and the feasibility of collecting accurate measurement data from these mines, the best way to reduce uncertainty is to focus on the Tier 3 method. Wherever possible, the national emission estimates should be corrected for the amount of CH₄ that is used as fuel, by subtracting this amount from total estimated emissions. There are no methodologies for estimating emissions from abandoned mines or coal waste piles in the IPCC Guidelines, but if a country has data on which to base a measurement, it should do so in a transparent manner. For the purpose of transparency and comparability, it is important to disaggregate fugitive emissions from fossil fuels into coal mining, natural gas, and oil. The quality of all activity and emission factor data should be studied and reviewed in cooperation with the personnel responsible for collecting, compiling, and analyzing the data.

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