

GREEN HOUSE GAS EMISSIONS FOR COAL MINE



July 2010

MINE END EMISSIONS CALCULATIONS

1.0 Introduction:

Sasan UMPP is developing one of the largest opencast coal mines in India in Private Sector for a rated capacity of 20 MTPA. The allotted captive coal mine namely Moher and Moher – Amlohri extension, located in Singrauli Coalfield is about 25 km. from the power plant. The Captive coal mine is an open cast mine. The net mineable reserves are approximately 470 Million tonnes. The coal is mainly spread in two seams, namely Turra and Purewa. The Purewa is upper mineable seam and overlies Turra seam with a parting in between. The total production from the mine is 470.43 MT and the peak coal production is 20 MTPA.

2.0 Mine-End-Emissions

The following have been considered for Green House Gas (GHG) Emissions during mining operation:

- Methane (CH₄)
- Carbon di Oxide (CO₂) and
- Nitrous Oxide (N₂O) - due to spontaneous combustion

Since the above gases have different potential of global warming, in order to compare different GHG emissions, CO₂ equivalent called the global warming potential (GWP) for the above gases as published by IPCC/EPA is considered.

3.0 Coal Mining Emissions:

The opencast mine will use Electric driven mining equipment like draglines, rope shovels and RBH drills along with diesel driven mining equipment like rear dumpers, loaders, dozers and other support equipment which will run on diesel. In addition to above, power will be required for running the mine infrastructure like coal handling plant along with associated conveyors, mine water pumping, lighting etc.

The mine end emissions are calculated on three broad categories.

- a) Due to use of diesel for various equipments running
- b) Due to methane from the mines
- c) Electricity used for construction and equipment running.

A coal production programme has been developed in line with the coal requirement of power plant. Operation of the Heavy Earth Moving Machinery has been planned according to the mine operations. The Mine Plan has been approved by the Ministry of Coal, Government of India.

4.0 Carbon Dioxide Emissions from Oil usage

Maximum diesel would be consumed upon reaching the full coal production level of 20 MTPA. The estimated diesel consumption is 15095 KL, which will yield maximum CO₂. The total production of coal in life time is 470.43 Million tones. Year wise diesel consumption, CO₂ emission given below:

Years	Diesel Consumption KL	Emission Factor	CO ₂ -e TPA
2010-11	810	2.7	2187
2011-12	3179	2.7	8583
2012-13	8319	2.7	22461
2013-14	13167	2.7	35551
2014-15	15095	2.7	40757
2015-16 to Mine Life	344468	2.7	930063
Total	385038	2.7	1039602
CO ₂ Intensity (g/T of coal mined)=1039602/470.43			2210

5.0 Methane (CH₄) Emissions

Coal is the source of Methane (CH₄). Methane gas is generated during the formation of coal through 'coalification' process of vegetal matter.

Many physical and chemical changes, governed by biological and geological factors, occur during the coalification processes. Coal bed methane during coal formation occurs in two ways:

- (i) By metabolic activities of biological agencies (biological process), and
- (ii) By thermal cracking of hydrogen-rich substances (thermogenic process).

Since methane is generated during coal formation processes, all coals invariably contain methane. However, the gas content of the coal normally increases with (i) rank of the coal, (ii) depth of burial of the coal seams, provided the roof and overburden are impervious to methane and (iii) the thickness of the coal seams.

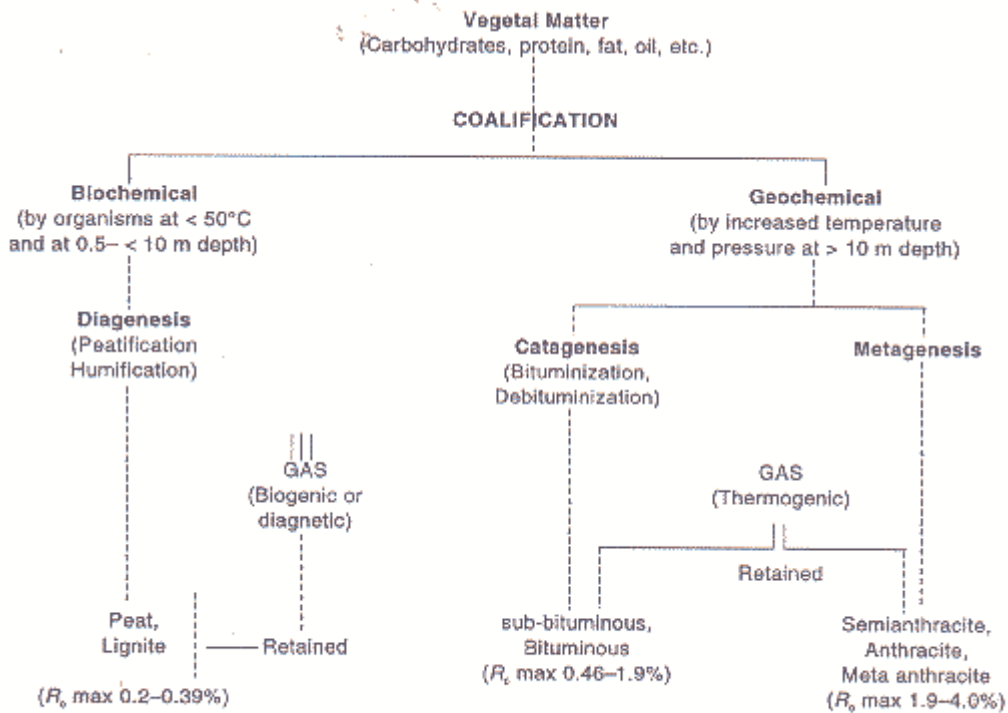


Figure 1. Flow-chart of methane gas generation during coalification.

6.0 Coal bed methane in Singrauli Coalfield

Content of coal bed methane is assessed by several factors, amongst which the rank of the coal is the most important for CH₄ emission. As the Singrauli coal is low rank at lower depth of less than 300 m, methane gas is generated during opencast mining operation. The Central Mine Planning and Design Institute Ltd (CMPDIL), a Government of India undertaking, project report for Moher Sub-Basin, Singrauli Coalfield, has observed the following gas content at different depths based the Eddy's empirical curves:

Mine Depth, m	Gas Content (m ³ /T)
Upto 150	1.5
200	1.75
250	2.0
300	2.5
>300	4.0(avg.)

Based on the above data, CH₄ has been estimated with an emission factor of 1.5 to 2 m³/T with respect to the coal production during mining operation and the same has been converted into CO₂ emission. The assessed figure is presented below for whole life of the mine. It may be noted from the table below that the country specific emission factor for surface mining as

per Government of India-GHG report 2007 released in May 2010 is 1.33 m³CH₄/Ton of coal mined. (1.18 + 0.15, sum of mining and post mining emission factors)

Country specific emission factors for estimating CH₄ emission from coal mining activities

			Emission Factor (m ³ CH ₄ / tons)
Underground Mines	Mining	Deg. I	2.91
		Deg. II	13.08
		Deg. III	23.64
	Post-Mining	Deg. I	0.98
		Deg. II	2.15
		Deg. III	3.12
Surface Mines	Mining		1.18
	Post-Mining		0.15

(Source: India: Greenhouse gas emissions – 2007 available at moef.nic.in)

Year wise Coal Production, CH₄ Emission & CO₂-e Emission

Years	Coal Production MT	Emission Factor (*) m ³ CH ₄ /Ton	CH ₄ m ³	Conversion Factor Gg/10 ⁶ m ³	CH ₄ Generated Gg	CO ₂ -e TPA
2010-11	0	1.5	0	0.67	0	0
2011-12	2.45	1.5	4	0.67	2	51707
2012-13	8.00	1.5	12	0.67	8	168840
2013-14	15.00	1.5	23	0.67	15	316575
2014-15	20.00	1.5	30	0.67	20	422100
2015-16 to mine life	424.98	2.0	850	0.67	569	11958937
Total	470.43	1.95	918	0.67	615	12918159

(*) based on depth of operation

CO₂ intensity (g/t) = 12918159 / 470.43

27460

7.0 Construction Power related emissions

Construction Power, lighting & other electrical equipment are likely to consume 10311.6 MWh of power. This results in CO₂ e emission of 10177 Tonnes at the rate of 0.987 T CO₂ e / MWh as per CEA guidelines. This works out to CO₂ intensity of 21.6 g/ T of coal generated.

8.0 Total Mine end emissions: CO2-e

From above-mentioned CO2-e inventory calculations, average CO2-e emissions per Tonnes of Coal produced works out to 29692 gm/T of coal OR 29.692 kg/T of coal as shown below:

This study has covered all Green House Gases that are emitted directly or indirectly during mining operations. It is represented in g CO2-e / T of coal produced.

SNo	Fuel	Average CO2-e Emissions g / Ton
1	Diesel / Oil usage	2210
2	CH4 mines	27460
3	Electrical energy	21.6
	Total	29691.6

The coal production from the mine varies between 2.45 million tons in the first year to 20 million tons during the peak of production. The annual CO2-e emission ranges from 72744 Tons to 593832 Tons based on the production schedule.