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Present and Future Potentiality of Coal Bed Methane Gas Exploration and Production in Indian Coal Fields

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Coal bed methane is produced commercially in the United States, and it has attracted worldwide attention as a potential source of cost competitive natural gas. Since the beginning of the coal bed methane industry in the mid1970s, operators have modified and applied petroleum industry technology to improve the operation of their fields. However, conventional oil and gas technology does not always work effectively for producing coal bed methane.

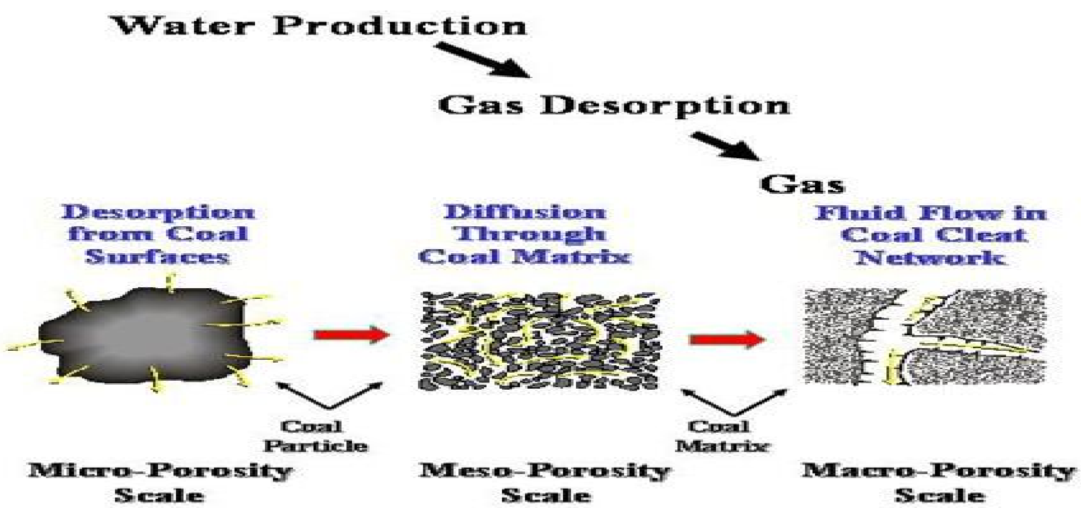
Because coal geology is so different from that of typical gas formations, you must use a different approach that takes into account:

The composition of the rock. Coal is 90 per cent organic, whereas conventional gas formations are nearly 100 per cent inorganic.

The different mechanical properties of coal. Coal is brittle and weak, and it tends to collapse in the wellbore.

Coal's naturally occurring fractures, or cleats. These fractures, called face cleats and butt cleats, are extensive in coals. Most coal Coal's gas storage mechanism. Gas is adsorbed or attached onto the internal surfaces of the coal, whereas gas is confined in the pore spaces of conventional rocks. The large volumes of water present in the coal seams. Water must be pumped continuously from coal seams to reduce reservoir pressure and release the gas. The low pressure of coal reservoirs. Backpressure on the wellhead must be kept low to maximize gas flow. And all produced gas must be compressed for delivery to a sales pipeline. The modest gas flow rates from coal reservoirs. Capital outlays and operating expenses must be minimized to produce an economical project. field requires prudently managing the technical as well as the economic aspects of the project. To develop techniques for economically producing coalbed methane fields, Gas Research Institute (GRI) and Taurus Exploration, Inc. designed The Rock Creek Methane from Multiple Coal Seams Completion Project. This field research site is located in the Black Warrior Basin southwest of Birmingham, Alabama. The overall objective of this project, initiated in 1983,is to develop technology for more cost-effective production of methane from shallow, thin multiple coal seams using single vertical wellbores. Ile project has specifically focused on determining the best combination of drilling, completing, stimulating, and operating techniques to economically produce these wells. The Rock Creek project and the work of other operators in the Black Warrior Basin have produced many practical techniques and guidelines for developing coalbed methane fields. The cooperation and open communication between operators and service companies in the Black Warrior Basin have been necessary to advance both basic knowledge and applied experience in producing methane from coal seams.

1.2 FORMATION OF COAL BED METHANE



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I. FORMATION OF COAL BED METHANE

Mature into bituminous types, water is expelled, porosity decreases, and biogenic methane formation decreases, because temperature rise above the most favourable range for bacteria. At the same time, heat breaks down complex organic compounds to release methane and heavier hydrocarbons (ethane and higher). Inorganic gases may also be generated by the thermal breakdown of coal.

A. *CBM potential in India*

Total coal resources: 248 billion tons

1) Gondwana Basins contribute about 99% of it.
2) Damodar valley coal fields contribute 50% of this resource – primary target for exploration.
3) Estimated CBM resource – 0.8 to 1.5 TCM.(different resources).
4) ONGC preliminary assessment indicates Damodar valley coal fields viz. Jharia, Bokaro, North Karanapur and Raniganj to be most prospective.
5) Most of the Indian coals are the falling short of the threshold maturation level of 0.8 VRO and it is unlikely that sufficient thermogenic methane generation to saturate the coal at reservoir condition will be present.
6) Methane resource through biogenic route known from few foreign basins, with less than threshold maturity, by active hydro-geological play. Such favourable condition, if present in any Indian coal basin, may be prospective
7)

II. COAL FIELDS OF INDIA AND THEIR CATEGORIZATION

Category I	Gondwana coals ranking High volatile bituminous A and above	Jharia, Bokaro, Raniganj and North Karanapur coal fields.
CategoryII	Gondwana coals ranking High volatile bituminous A and below	South Karanapur, Raniganj, PenchKanhanandSohagpur coal fields.
CategoryIII	Low ranking Gondwana coals	Talchir, Ib, Pranhita-Godavari Valleylandwardha valley coal field.
CategoryIV	Tertiary coal/ Lignite	Cambay, Biknaneer-Nagaaur, Barmer, assam-Arakan, Cauvery and Himalayan foot Hills Basins.

Table 1.1 Coal fields categorization in India

Coal bed methane can be found almost anywhere there is coal. Considered a dangerous nuisance in the mining industry, it has potential as an abundant clean energy supply to help replace other diminishing hydrocarbon reserves.

State	Coal field	Resources	Proved reserves
Orissa	Talcher	40869.47	12311.10
West Bengal	Raniganj	25558.85	12877.90
Orissa	Ib-rever	22364.11	5401.83
Jharkhand	Jharia	19430.06	15077.57
Chattisgarh	Mand-raigarh	19106.04	1953.88
Andhra Pradesh	Godavari Valley	17714.46	8791.13
Jharkhand	N. karanapur	15860.91	8077.77
Jharkhand	Rajmahal	14275.91	2077.97
Madhya Pradesh	Singrauil	13478.31	5002.52
Chattisgarh	Korba	10115.21	4980.58
Jharkhand	E.Bokaro	7067.47	4980.58
Jharkhand	S.Karanapur	6036.79	2542.18
Maharashtra	Wardha Valley	5669.63	2944.42

Jharkhand	W.Bokaro	5004.99	3488.10
Chattisgarh	Hasdo-arand	4972.96	1183.36
West Bengal	Birbhum	4683.02	7985.40
Madhya Pradesh	Sohagpur	4602.63	1688.54

Table 1.2state wise coal field in India

Source: GSI (2007) Note: where coal fields overlap state borders, the state with the dominant share of resources is shown.

Sample collection and characterization

Coal samples were collected from various coal fields of India. Samples are collected from various seams of the bore holes at different locations.

BH.N	SEAM	Avg Depth(m)	M%	Ash%	V.M %	FC %
BH 1	1	427	3.76	26	32.5	37.74
		431	3.01	24.94	32.75	39.3
	2	498.3	3.04	26.59	26.3	44.07
		499.7	3.38	22.82	31.62	42.18
		503	3.12	17.03	30.46	49.39
	3	541	3.53	22.65	23.3	50.7
BH 2	1	369	2.95	23	28.96	45.1
		371	2.46	45.99	25.45	26.01
	2	435.5	3.43	25.17	33.61	37.79
		435.5	3.72	15.39	27.68	53.21
		443.5	3.15	10.52	40.26	46.07
	3	456.5	3.82	11.15	31.11	53.92

Table 1.3 Proximate analysis result

Avg.Depth(m)	C	H	N	S	O
427	54.66	4.09	1.76	0.68	9.05
431	57.49	4.12	1.63	0.66	8.15
498.3	57.47	3.79	1.69	0.59	6.83
499.7	59.42	4.22	1.73	0.55	7.88
503	66.17	4.34	1.57	0.57	7.2
541	61.89	3.77	1.59	0.43	12.17
369	44.38	3.94	1.79	0.54	8.72
371	38.44	2.91	1.48	0.49	8.23
435.5	56.36	4.12	1.67	0.51	8.74
438.5	67.68	4.31	1.71	0.55	6.64
443.5	70.24	5.07	1.66	0.63	8.73
456.5	71.01	4.58	1.69	0.6	7.15

Table 1.4 Elemental analysis of the samples

Caprock of each seam is mainly made of coarse to very coarse grained sandstone, greyish all over. The depth under study varies from 369m to 541m.NFrom the results it was observed that the ash content varies from 10.52% to 26.59% except one sample that showed an irregularly high ash content of 45.99%. Proximate analysis of the investigated coal samples reveal that the moisture content (M%) varies from 2.46% to 3.82%, whereas volatile matter ranges from 23.30% to 40.26% and fixed carbon (FC) content varies from 26.01% to 53.21%. From elemental analysis it is seen that the fixed carbon percentages varies from 38% to 71 %. In

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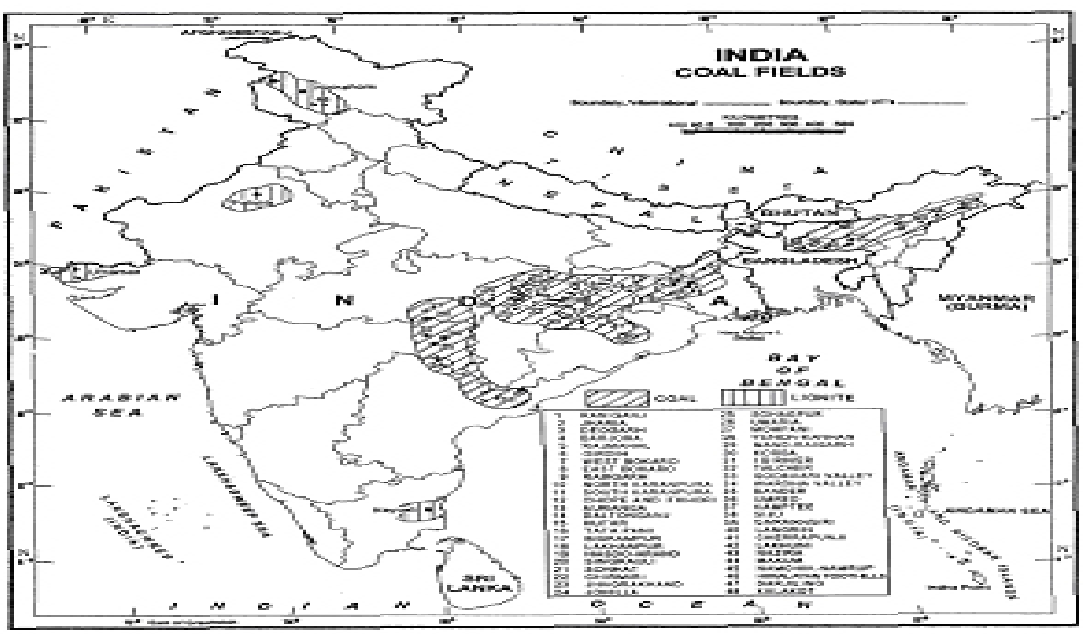
general it is recognized that the fixed carbon of coal increases with increase in coal depth which is directly proportional to the coal maturity and rank. Since it is generally true that methane is not adsorbed onto non-coal material, ash and moisture values can be used to make appropriate corrections on the total measured gas contents. Gas content is seen to increase with depth, and bituminous coals are associated with the highest gas contents, followed by sub bituminous coals. Cross plot of Gas Content versus non- coal content (ash + moisture content).Moisture and ash content within the coal reduces the adsorption capacity of methane. Adsorption capacity of methane decreases with increasing ash and moisture percentage within the coal. As little as 1% moisture may reduce the adsorption capacity by 25%, and 5% moisture results in a loss of adsorption capacity of 65%.

II. BENEFITS WITH COAL BED METHANE

Within Indiana, the overall increase in natural gas consumption, coupled with the use of natural gas for the generation of electricity, have significantly increased the demand for gas. The production of coal bed methane will help provide additional indigenous natural gas house hold and industrial uses and for generating power in the state.CBM recovery also can enhance the safety of underground coal mines by reducing the amount of methane present in the coal. In the past, methane in the in underground coal mines caused explosions resulting in the loss of life and considerable economic damage. Methane control during underground mining is mandated, thus increasing safety and providing the added benefit of producing an energy resource.MM Considering concerns about the impact on Indianan air quality resulting from the burning of coal for electrical power, CBM may prove to be cleaner energy resource derived from the state‘s abundant reserves of coal. During the production of the CBM, ground water is extracted from coal seam aquifers to facilitate the release of methane gas tapped under hydrostatic pressure. Development of new CBM fields typically generate large volumes of water that may represent an opportunity for operators to provide themselves, the landowner, and nearby industry with water that not result in the waste of this resource. The ability of CBM operator to provide CBM produced water for he water produced from CBM wells varies from very high quality (meeting state and federal drinking water standards) to le quality, essentially unusable (with total dissolved solids [TDS] concentration up to 180000 parts per million). Currently, the management of CBM produced water is conducted using various water management practices depending on the quality of the produced water. In areas where the produced water is relatively fresh, the produced water is handled by a wide range of activities including direct discharge, storage in impoundments, livestock watering, irrigation, and dust control. In areas where the water quality is not suitable for direct use, operators use various treatments prior to discharge, and/or injection wells to dispose of the fluids The use of CBM produced water for beneficial use represents a flexible and valuable approach to utilizing an important resource by providing benefits to operators, land owners, and in some cases the general public. The quality of the produced water, the surrounding environmental setting, operator and land owner needs, and pertinent regulations, will often dictate the water’s designated use. In most cases certain aspects of development can benefit either by practical resolution or by satisfying public request or needs. Beneficial usage for CBM produced water has been integrated.



3.3 Coal fields in India

III. CONCLUSION

A. India's energy scenario

1) India is one of the fastest growing economies.
2) The GDP growth is over 8%, likely to increase to over 10% in near future.
3) This GDP growth is required to eradicate poverty and meet country's human development goal.
4) To sustain such growth ¾ fold increase in primary energy requirement envisaged.
5) Integrated energy policy document indicates total energy requirements of the country will increase from a current level of about 500MTOe to 2000MTOe by 2031 – 32.

CBM technology is proceeding with good space to prove itself as a cleaner energy security to India as well as the World. However, production strategy of methane from CBM is very much different from conventional gas reservoir. With increasing depth maturation of coal increases and generation of methane gas also increases. However, in future this field may be considered for methane extraction using advanced technology and in emergency condition.

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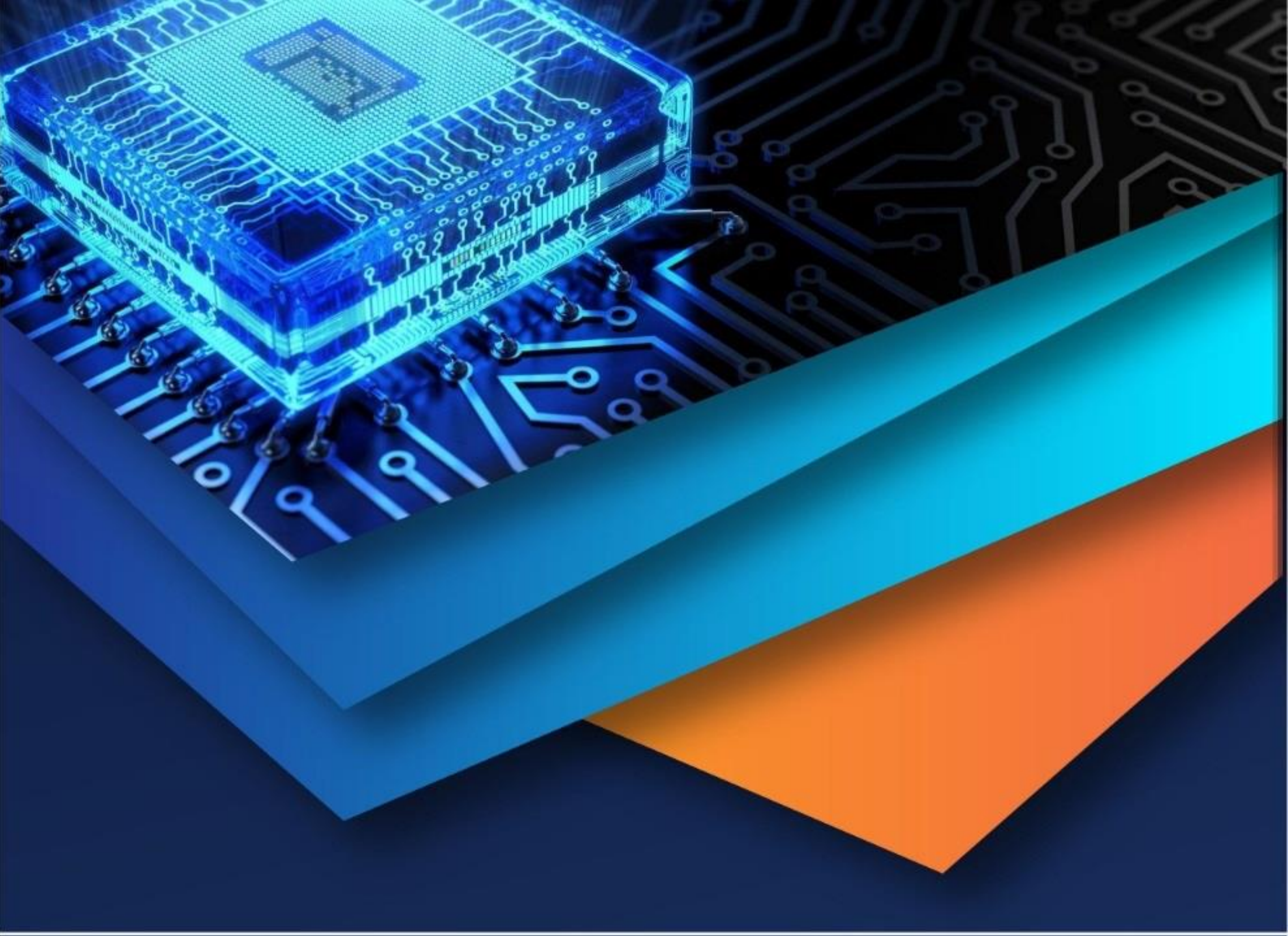

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