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LIGNITE: SOURCE OF UNCONVENTIONAL OIL AND GAS

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Abstract - *The world has been confronted with an energy crisis due to depletion of finite conventional resources and to sustain the ever increasing energy demand, we have to go for the unconventional resources. The promising solution is conversion of LIGNITE to unconventional oil and gas. The aim of this paper is to tell about the evaluation of lignites and its role in improving the energy scenario by the methods to convert it into oil and gas. An assessment of lignite for conversion to oil and gas has been attempted based on samples of lignites by the rock eval pyrolysis process. The conversion of lignite can be done through processes like gasification and liquefaction. Gasification is the process of producing syngas – a mixture consisting primarily of methane, carbon monoxide, hydrogen, carbon dioxide. While liquefaction is the method to produce liquid fuels from lignites. The*

evaluation, based on organic geochemical studies, indicates that lignite contains a mixture of type II and type III organic matter which can be a source of both oil and gas.

The study indicates moderate potential for conversion of lignite to gas. Lignite can generate significant amount of liquid hydrocarbons by simple heating in inert atmosphere (pyrolysis), it can be used as a good source of liquid fuel. UPA has led to extract oil and gas from coal.

Key Words: (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1.INTRODUCTION *(Size 11 , cambria font)*

Day after day with increasing consumption increases the need of more energy resources. Due to the cataclysmic impact of the conventional fuels on the environment along with the soaring prices of the conventional energy sources for use and of the much needed transport, there's a necessity to find unconventional sources of energy to sustain the ever increasing energy demand.

As a result of continued research we came up with an best unconventional source of energy as the LIGNITE which is the source of oil and gas. LIGNITE can be converted to oil and gas through techniques like gasification and liquefaction. This paper deals with scenario of lignite in INDIA, evaluation of lignite, techniques to convert lignite into oil and gas, challenges , government policies and scope of lignite in improving the INDIAN SCENARIO.

1.1 Sub Heading 1

The evaluation of lignite will lead to knowing whether the lignite is capable to generate oil and gas or not and the techniques like gasification and liquefaction converts it into oil and gas thus it will lead to less dependency on foreign imports of oil and gas which will lead to the improvement of energy scenario of INDIA and in turn making INDIA self sufficient in terms of energy. To facilitate this plan, the Congress-led UPA has worked out an alternate plan to extract oil from coal which will produce 80,000 barrels of oil per day per project by 2020.

1.2 WHY LIGNITE

Lignite begins as an accumulation of partially decayed plant material, or peat. burial by other sediments results in increasing temperature, depending on the local geothermal gradient and tectonic setting, and increasing pressure. this causes compaction of the material and loss of some of the water and volatile matter (primarily methane and carbon dioxide). this process, called coalification, increases the carbon content, and thus the heat content, of the material. deeper burial and the passage of time result in further expulsion of moisture and volatile matter, eventually transforming the material into higher rank coals such as bituminous and anthracite coal.lignite deposits are typically younger than higher rank coals, with the majority of them having formed during the tertiary period.

2. Lignite Blocks in India

Indian lignite deposits occur in the Tertiary sediments in the southern and western parts of peninsular shield

particularly in Tamil Nadu, Puducherry, Kerala, Gujarat, Rajasthan and Jammu & Kashmir. The total known geological reserves of lignite as on 1.4.2011 were about 40.91 billion tonnes. About 80% reserves are located in Tamil Nadu with about 32.89 billion tonnes. Other states where lignite deposits have been located are Rajasthan, Gujarat, Jammu Kashmir, Kerala, West Bengal and the Union Territory of Puducherry. Statewise/districtwise reserves of lignite as on 1.4.2011 are given

Table -1: Production in India

STATE	TOTAL(in million tonns)
Gujarat	2722.05
Jammu & Kashmir	27.55
Kerala	9.65
Rajasthan	4835.29
Tamil Nadu	32892.92
Puducherry	416.61
West Bengal	1.79

Characteristics

1.Lignite is brownish blackin colour.

2.It has carbon content of around 25-35%,

3.It has an ashcontent ranging from 6% to 19%.compared with 6% to 12% for bituminous coal

4.The energy content of lignite ranges from 10 - 20 mj/kg
5. . It has high inherent moisture content sometimes as high as 66%, and susceptibility to spontaneous combustion can cause problems in transportation and storage

Source rock evaluation of lignite:-

The research on lignite for conversion to oil and gas has been tried based on samples from two mines in the districts of Bikaner–Nagaur and Barmer in Rajasthan.

The evaluation, based on organic geochemical studies, indicates that lignite contains a mixture of type II and type III organic matter which can be a source of both oil and gas. The study indicates moderate potential for conversion of lignite to liquid fuel and gas.

In sedimentary basins where oil and gas are found, mainly primary source of hydrocarbons are present in organic-rich rocks. Various geochemical studies carried out in different basins indicates that coal can act as good source for oil and gas If necessary conditions are fulfilled.

For the estimation of the hydrocarbon potential the samples were analysed by Rock Eval pyrolysis. The maximum relative error (standard deviation x 100/mean) was found to be 2.5%.In addition, selected samples were analysed on pyrolysis –GC-MS.

Samples were first thermally extracted at 300°C and then pyrolysed at 600°C. GC was programmed from 35 to 300 at the rate of 2C/min. The pyrolysis products were directly swept into GC and separated components were analysed by MS operating in full scan mode in the 50-50 amu mass range.

The proximate analysis of lignite broadly shows the following properties:-

I. Moisture – 30 to 40 %;

II. Ash- 15 to 30%;

3.Volatile matter- 20 to 25%; IV. Fixed carbon- 15 to 22.5%;

V. Calorific value- 2001 to 3250kcal/kg Maceral composition of lignite shows huminite content in the range 82.1 to 88.8%, inertinite content 2.3 to 3.4% and vitrinite approximately 0.35%.

S1 = the amount of free hydrocarbons (gas and oil) in the sample (in milligrams of hydrocarbon per gram of rock).

S2 = the amount of hydrocarbons generated through thermal cracking of non volatile organic matter. S2 is an indication of the quantity of hydrocarbons that the rock has the potential of producing should burial and maturation continue.

S3 = the amount of CO2 (in milligrams CO2 per gram of rock) produced during pyrolysis of kerogen. S3 is an indication of the amount of oxygen in the kerogen and is used to calculate the oxygen index.

*T*max = the temperature at which the maximum release of hydrocarbons from cracking of kerogen occurs during pyrolysis.

HI = hydrogen index (HI = [100 x S2]/TOC).

OI = OXYGEN INDEX ([100 x S3]/TOC).

TOC content :-

Lignite – 12.5% to 51.5%

The rock Eval Parameter S2, measures the hydrocarbon generation potential of organic matter and for lignite it has higher values (32. 6 to 159.5 kg hydrocarbons/tonne). This shows that lignite has good potential to generate hydrocarbons.

Table 2. Rock Eval analysis results of Giral and Barsingsar lignite and shale

Location	Lithology	TOC (%)	S_1 (kg/t)	S_2 (kg/t)	S_3 (kg/t)	T_{max} (°C)	HI (kg/tonne TOC)	OI (kg/tonne TOC)
Giral 1a	Shale	1.29	0.01	0.55	0.65	424	43	50
Giral 1b	Lignite	51.53	2.3	92.81	21.39	410	180	42
Giral 2a	Shale	0.54	0.06	0.28	0.85	416	30	90
Giral 2b	Lignite	19.13	1.97	93.79	19.64	414	490	103
Barsingsar 1a	Lignite	12.51	0.86	52.61	3.5	421	251	28
Barsingsar 1b	Lignite	48.45	5.16	159.5	11.07	410	329	23
Barsingsar 2a	Shale	3.22	0.45	18.11	2.16	421	545	55
Barsingsar 2b	Lignite	17.42	1.01	66.57	12.07	416	359	59
Barsingsar 2c	Lignite	23.58	1.11	116.22	15.63	414	493	56

Lignite is a mixture of type II and type III organic matter and consists of both oil and gas – prone organic matter. Tmax for the lignite and shale is very low (410-424 C) hence are immature to generate hydrocarbons . Petrographic analysis shows a mean vitrinte reflectance value in the range 0.27-0.34%, indicating low rank. The oxygen index of lignite is high(23-105kg CO2/tone of TOC. Also from plot of HI and OI we can tell about the organic matter types, which are there in lignite.

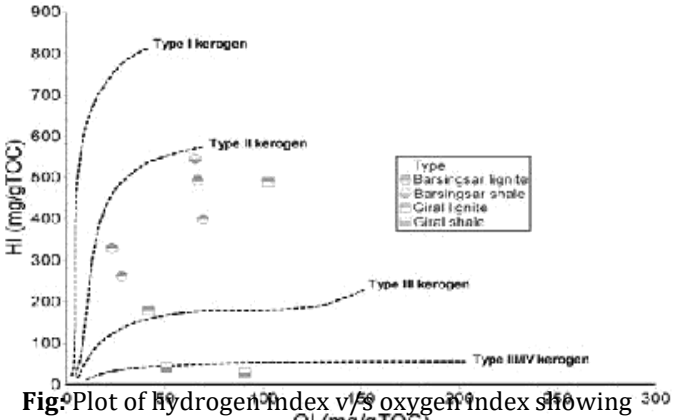

Fig: Plot of hydrogen index v/s oxygen index showing organic matter type.

The average hydrocarbon generation potential of lignite is 94 kg/tonne. Therefore, it is capable of generating approximately 86 kg oil/tonne of lignite.

TECHNIQUES:-

Liquid fuel and gas can be obtained from coal and lignite by various processes which mainly consist of gasification and direct liquefaction.

1)Coal gasification- It is the process of producing syngas –a mixture consisting primarily of carbon monoxide(co),hydrogen(H2),carbon dioxide(co2) and water vapour(H2O)-from coal and water, air and/or oxygen . The main processes under these are

1. Steam-Oxygen Gasification
2. Catalytic Steam Gasification
3. Hydrogasification

1) Steam –Oxygen Gasification Steam-Oxygen Gasification of Lignite reactions $CH_{0.8}O_{0.2} + 0.8\ H_2O = 1.2H_2 + CO$

ΔH = +47.7 Kcal/mol lignite – endothermic - 90% lignite conversion Lignite Combustion ------- $CH_{0.8}O_{0.2} + 1.1\ O_2 = 0.4\ H_2O + CO_2$

2) Catalytic Steam Gasification

REACTIONS

$CH_{0.8}O_{0.2} + 0.7\ H_2O = 0.55CH_4 + CO_2$

The catalyst is potassium carbonate used in large quantities, amounting to

about 20% by weight of the feedstock, which combines with the coal ash, and has to be separated and recovered from the alumina and silica in the ash.

3) Hydrogasification

The main feature of this process is that the hydrogasification is exothermic, which makes the process thermally energy efficient, It is necessary to convert part of the methane back to hydrogen by reforming with steam, The capital investment is lower than for steam-oxygen gasification, There is no requirement for a catalyst.

REACTIONS

$CH_{0.8}O_{0.2} + 1.2\ H_2 = 0.8\ CH_4 + 0.2\ CO$

Impact of use of lignite:

a.) Carbon dioxide emissions over the full lifecycle of the fuel are more than double those for the crude oil equivalents if no carbon capture and storage (CCS) is used during production (the burning of the fuel in vehicle engines releases the same amount of carbon dioxide to the atmosphere as conventional fuels would have done).

b.) Even with efficient (and as yet unproven) CCS technology, carbon dioxide emissions over the full life-cycle of the fuel would still be at least 5% higher than for crude oil based products.

c.) A large increase in coal mining and production may be unacceptable to the public.

d.) IT LEADS TO INVESTMENT OF LARGE PART OF ECONOMY FOR IMPROVEMENT OF TECHNOLOGY.

e.) Coal also contains low levels of uranium, thorium, and other naturally occurring radioactive isotopes whose release into the environment may lead to radioactive contamination.

f.) Coal-fired boilers / power plants when using coal or lignite rich

in limestone produces ash containing calcium oxide(CaO). CaO readily dissolves in water to form slaked lime / Ca(OH)2 and carried by rain water to rivers / irrigation water from the ash dump areas.

g.) Surface mining of coal causes direct and indirect damage to wildlife. The impact on wildlife stems primarily from disturbing, removing and redistributing the land surface. Some impacts are short-term, and confined to the mine site; others have far-reaching, long-term effects.

India scenario and Government policy

Government of India (GOI) has always shown keen interest in the production of liquid fuel from lignite. Initially, the production of lignite was not on a larger scale due to obstacles like high labour input and lack of technology but now government of India is collaborating with foreign institutions to get the latest technology.

To fulfil the gap between demand and supply government of India has also come with several plans to extract oil from lignite. These plans includes both direct and indirect ways to convert lignite into liquid fuel. Mines of lignite in Rajasthan and Gujarat are already being allotted to PSUs by ministry of coal and several blocks of lignite like Panandhro extension, Bharkandanm and Ghala in Gujarat, Nagurda—Joranda in Rajasthan and Vastan (UCG block) in Gujarat are five lignite blocks in they are under allocation process according to the ministry. The ministry of coal has recently allotted two major coal blocks having name Talcher coal-fields, in the district Angul of Odisha to two major companies. It is expected that this project will come out with around 80,000 barrels of oil per day and also it is expected that up to 2018 both projects will be operated.

Neyveli Uttar Pradesh Power Ltd, Odisha Thermal Power Corp, Jammu & Kashmir State Power Dev Corp, Chhattisgarh State Power Gen Co Ltd, Andhra Pradesh Generation Co, Maharashtra State Power Generation Co, Rajasthan Vidyut Utpadan Nigam and Punjab State Power Corp Ltd, these PSUs are also allotted coal blocks.

3. CONCLUSIONS

We have witnessed drastic changes in the socio-economic and political strategies of most countries in

the world over the past couple of decades. There seems to be a clamour for ascendancy and expansion in the energy world. The energy security is alarming world over with India being no exception!. There is a renewed human interest towards developing unconventional sources of energy like Shale, CBM, Gas hydrate and Lignite. Oil production from the project of conversion of lignite into oil and gas helps the country to reduce significant quantities of oil imports from other countries. Since the liquid fuel which we are getting from lignite has almost equivalent property like crude oil and India has abundant resources of Lignite blocks. Government of India also launched various projects to achieve effective conversion of lignite into liquid fuel. Thus lignite is undoubtedly the future of India's increasing energy demand but there is a need for its suitable tapping.

REFERENCES

1. Salpeteur, I., Raju, S. V. and Mehrotra, A., Oil shale exploration in the Assam–Arakan basin. In Paper presented at the 28th Oil Shale Symposium, Colorado School of Mines, Golden, Colorado, 13–15 October 2008
2. Sharma, K. K., K–T magmatism and basin tectonism in western Rajasthan, India. Results from extensional tectonics and not from reunion plume activity, 1999.
3. Bhandari, A., Phanerozoic stratigraphy of western Rajasthan India: a review.
4. In Geology of Rajasthan: Status and Perspective (ed. Kataria, P.), MLS University, Udaipur, 1999, pp. 126– 174.
5. Behar, F., Beaumont, V. and De B. Penteado, H. L., Rock Eval 6 technology: perfomances and developments. Oil Gas Sci. Technol. Rev. IFP, 2001, 56, 111–134.
6. Bordenave, M. L., Applied Petroleum Geochemistry, Editions Technip, Paris, 1993, p. 524.
7. http://petroleum.rajasthan.gov.in/inhouse.htm
8. http://www.currentscience.ac.in/Volumes/104/06/0752.pdf
9. http://www.med.govt.nz/sectors-industries/energy/energy-modelling/technical-papers/liquid-fuels-from-lignite

BIOGRAPHIES (Optional not mandatory)

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